Generative playfulness dimensions of play artefacts for children with special needs

THESIS

Submitted in partial fulfilment of the requirements
of the degree of

DOCTOR OF PHILOSOPHY

By
Aakash Johry
(Roll No 124130001)

Under the supervision of
Prof. Ravi Poovaiah

Industrial Design Centre
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
October, 2017

Approval Sheet

This Thesis entitled **Generative playfulness dimensions of play artefacts for children with special needs** by **Aakash Johry** is approved for the degree of **Doctor of Philosophy**.

Examiners

____

____

____

Supervisor(s)

____

Chairman

____

Date:

Place:

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity, and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources, which have thus not been properly cited or from whom proper permission has not been taken when needed.

____

(Signature)

____

(Name of the student)

____

(Roll No.)

Date: _____________

Abstract

The instrumental nature of play and its role in development has been the focus of research for a long time, especially in the case of children with special needs. Existing literature presents contradictory opinion on how play of preschool children with Intellectual Disability (ID) differs from their typical peers, based on comparison of their play skills and complexity. Moreover, the experiential and affective aspects of play-activity, as distinct from play skills for children with ID, still remain under-studied. There is also a gap in existing knowledge on designing for play of these children, with lack of theoretical frameworks and guidelines for design practitioners. The present thesis uses design research to bridge some of these gaps in the domain of play, special needs and design practice. The main objective of the present thesis is to study the relationship between design characteristics of play artefacts/activities and observed playfulness of preschool children with mild to moderate ID. Playfulness has been used as a handle to account for the experiential and affective components of play activity and an assessment framework has been developed over the course of the thesis, based on Sanderson's (2010) construct.

The thesis follows a sequential, exploratory mixed-methods design, considering the lack of existing literature on studying play experience in a special school setting in India. Following a set of pilot studies, the exploratory phase constitutes of an interventional study where play interactions of children with a variety of age-appropriate toys are analyzed in a free play context using a qualitative analytical framework derived from Classical grounded theory (Glaser, 1998). Among other rich insights, a set of five generalizable design characteristics have been identified which seem to have a significant positive effect on playfulness, termed as generative playfulness dimensions. These dimensions are defined as design guiding principles which could be used to predictably enhance the playfulness in play interactions across different contexts. They comprise of: narrative, player's movement, showcase

outcome, interactivity and player's agency. Selected dimensions are further validated by operationalizing them individually and in combination, in the toy design across the unexplored application context of challenge-based play context in the validation phase using an experimental, quantitative research framework. A significant contribution of the thesis is to establish these principles using a rigorous methodology based on empirical data, unreported earlier. Apart from these dimensions, several useful properties of the dimensions have emerged which address novel and non- intuitive aspects of play preferences, like level of preferred repetition in narrative, or threshold for persisting in challenge-based play, etc. With the perspective of a design activist, a number of useful actionable insights have also been reported for design practitioners and facilitators. A playfulness assessment framework has been developed which could be used to compare individual play episodes and observe the effect of interventions. Lastly, an initial proposal is made for a model useful for design practitioners to control the features in toy design using the dimensions and aid in the idea generation process for developing playful solutions, which would need further validation.

Organization of the thesis

Chapter 1 describes the different aspects of existing research in play of children with special needs to identify the research gap being addressed in the present study. Some relevant literature is reviewed to explain the need and significance of studying play behaviour of children with ID. This is followed by a discussion on the role of design in this domain and the possible opportunities to contribute through design research in enhancing the play possibilities. This chapter also presents a background of the research problem in Indian context and associated socio-cultural factors to frame the problem. The scope of the present study is described with a set of primary research questions which would be answered over the course of this thesis.

Chapter 2 presents an over-arching literature review of studies addressing a number of relevant discourses, including – play theories, definition and assessment of playfulness, variation in play as a function of special needs, role of environmental factors in affecting play experiences and existing knowledge on designing for typical and special children's play. Significant research gaps are identified leading to primary research questions to be addressed in this thesis. A multi-dimensional and context-dependent theoretical model of playfulness is identified, which forms the basis of the playfulness assessment framework used in the present thesis.

Chapter 3 summarizes the overall research methodology as well as individual research methods and techniques for data collection and analysis in different phases, conducted within the philosophical perspective of pragmatism. A sequential, exploratory mixed-methods research design has been adopted involving three phases. The focus of this chapter is to elaborate the rationale for selecting this research design and framework, and the associated assumptions and limitations. Possible errors and researcher bias is discussed along with provisions to resolve it.

Chapter 4 reports the two pilot studies conducted in the 1st phase of the thesis with the primary objective of developing an understanding of how play manifests and what are the ecological constraints in a special school setting in India. The identified insights play a significant role in informing the research design methodological framework of the overall thesis and selection of research methods for the main studies. While the first pilot study studies the emergence and degree of competitive play in moderate MR children using a quantitative research framework, the second pilot study explores the existing state of play and the associated factors in a special school setting using a qualitative research framework by following ethnographic techniques.

Chapter 5 reports an exploratory, interventional study to understand the relationship between design characteristics of play artefacts and the observed playfulness of children with ID, in the context of a special school. Acknowledging the lack of exposure to different variety of play possibilities due to limited infrastructure at the school, children's are given opportunity to have play interactions with a wide variety of familiar, age-appropriate toys based on the toy classification by Kudrowitz and Wallace (2010). Details of the research design including selection of participants, toys and context is discussed, followed by description of data collection and procedure based on a qualitative analytical framework derived from Glaserian grounded theory. Results from this study are presented both as core categories emerging from the grounded theory based analysis, as well as the resulting generative playfulness dimensions that can be used as design guiding principles to enhance playfulness across other contexts. These dimensions along with useful actionable insights on play behaviour are discussed in light of existing literature, leading to formulation of significant theoretical contributions. Possible validity threats to the findings and their generalizability in other contexts and material are discussed at the end.

Chapter 6 reports a controlled design-intervention based study with the aim of validating the effectiveness of selected generative playfulness dimensions, by implementing them individually and in combination, into redesign concepts of a toy belonging to a different play type (shape sorting toy previously seen to be a non-engaging challenge-based toy). Using a repeated-measures experimental design, playfulness is compared between five different stimuli conditions, based on possible combinations of the three generative playfulness dimensions of narrative, interactivity and player's agency. The chapter describes the research design, data collection and analysis procedure. The effects of integrating the dimensions are reported primarily based on quantitative, statistical analysis (parametric and non-parametric), supplemented by qualitative insights. Besides the validation of selected dimensions, a number of non-intuitive insights also emerge in the process of operationalization, reported as the properties of these dimensions. Validity threats and generalizability of findings from this study is discussed at the end.

Chapter 7 summarizes the research findings and the process that was followed over the course of the thesis, explaining how the primary research questions were answered through the set of studies. Research contributions to the theory, practice and methodology are mentioned next, followed by a section on triangulation of the findings using the two main studies and literature and analysis at the level of overall thesis. A section highlighting the significance of this research and certain salient features of our work follows this. Next section is specifically meant for design practitioners and facilitators, giving actionable recommendations based on the overall findings. Lastly, an evaluation of the study limitations and scope for future research directions is discussed. The chapter ends with concluding remarks on the overall thesis.

Table of Contents

List of figures

List of tables

1. Introduction

Play is an essential component of a healthy childhood, often manifesting even in difficult ecological settings. From early philosophers to contemporary scholars, the significance of play has been acknowledged in diverse fields like psychology, biology and neuroscience as a universally present behaviour type linked to the development of children (Frost, 1998). Play has been seen both as a medium and a condition for learning, associated with different developmental perspectives including social, cognitive and emotional development (Fromberg & Bergen, 2015). While majority of studies on play have used the 'instrumental approach' to understand the role of play in socialization, learning and development, more recent play studies use the interpretive approach which locates the meaning and purpose of play in itself and its inherent creativity, thus focusing on the non-instrumental nature of play (Meire, 2007). The importance of 'play for its own sake' in children's life has been emphasized by UN in the article 31 of the UN convention[1] stating, "Children have the right to relax and play, and to join in a wide range of cultural, artistic and other recreational activities". The general comment 17 by UN has been later released in 2013 reiterating the need for better implementation of article 31. While the universality of play has led to its recognition in the developmental discourse, it has also made it difficult to develop a comprehensive operational definition of play which could explain the variety in which play can manifest among different people and contexts. The general discourse in defining play has been towards identifying a set of dispositional characteristics which could distinguish it from other behaviours. Some of the recurring dispositional characteristics related to play include intrinsic motivation, focus on means versus ends, active engagement, absence of external rules, going beyond functional properties of object, pretense/ non-literality, positive affect, etc. (Jenvey & Jenvey, 2002; K. H. Rubin, Fein, & Vandenberg, 1983).

[1] For summary of children's rights in UN convention, refer http://www.unicef.org/crc/files/Rights_overview.pdf

In the present context, a number of socio-cultural changes in developing nations like India are influencing the way play is practiced among children. The flourishing urban development has reduced the open spaces for outdoor play and playground spaces are also limited compared to the population density. With sporadic employment opportunities, India has moved from living in joint families to small, nuclear families. All these factors reduce the opportunities of play for children especially in urban areas. In this context, school can be one of the few spaces where children could get opportunities of unstructured and structured play. This situation is even more applicable for children with special needs who have very limited access to recreational spaces outside of school, due to their limitations. With recent worldwide trends showing increased academic influence in early elementary education and reduction of recreational time (Bassok, Latham, & Rorem, 2016), the play of children with special needs at schools becomes even more threatened due to a heavy developmental agenda. The present study attempts to understand how play manifests for preschool children with Intellectual Disability (ID) in Indian special schools, and how play opportunities could be enhanced by studying children's preferences in play. Being the second largest population in the world, India also accommodates an enormous amount of population associated with disability. Based on the recent Census in 2011, there are 2.68 Cr (26.8 million) persons with disability which accounts for 2.21% of the total population of India (Government-of-India(GOI), 2016a). Moreover, there is a pattern of increasing proportion of population with disability as the assessing and surveying methods improve. Within this population, about 12% are young children aging between 0 to 9 years, leading to about 32.5 lakhs (3.25 million) young children with disability. It is surprising to see the dearth of research studies on play in Indian context with children having special needs considering that there are huge opportunities for research interventions that could improve the quality of life for these children.

Acknowledging the variability within the special needs population, there are limited studies which look at preschool children's play for different etiologies. Studying play separately for children with special needs becomes even more relevant considering that there is no clear consensus on if and how their play differs from that of typical children. While a number of research studies have reported that children with developmental disabilities have deficits in exhibited play skills and complexity (e.g. Case-Smith & Kuhaneck, 2008; McWilliam & Bailey, 1995; Sigafoos, Roberts-Pennell & Graves, 1999), there are other researchers who state more of similarity (Hestenes & Carroll, 2000) and even higher sophistication in play of preschool children with ID (D. M. Malone, 2006b, 2009) in comparison to their typical peers. These studies are discussed later in more detail in the chapter 2 on literature review. However, it can be safely inferred that studies on play behaviour of typical children cannot be directly translated for insights in the play behaviour of children with special needs. Along with a lack of guiding research literature, the present work has also been motivated by the personal experiences of the researcher at a different special school facility in Kanpur city, India where there seemed to be a lack of engaging and enjoyable play activities in general (Johry & Patil, 2011). This assumption was further reconfirmed over the course of the thesis as lack of unstructured play was seen and children were found to be generally disinterested in the activities at special school (Johry & Poovaiah, 2015). With the perspective of a design practitioner, this situation presented an opportunity to understand if children with special needs are capable of experiencing the same levels of engagement and enjoyment in their school activities and play. If yes, how it can be embedded in their play artefacts and activities.

1.1 Design research and practice in children's play

Within the limited research literature on play behaviour of children with special needs, there seems to be lot more focus on sociological and therapeutic interventions coming from more established fields like sociology, psychology, occupational therapy, etc. (e.g. Barton, Chen, Pribble, Pomes, & Kim, 2013; Butler & Walton, 2013; Lin & Bratton, 2015; Singer, Nederend, Penninx, Tajik, & Boom, 2014). From application's perspective, there has been a noticeable increase in use of technological interventions in the form of assistive technology (e.g. Ferrari, Robins, & Dautenhahn, 2010; Patrizia, Claudio, Leonardo, & Alessandro, 2009; Prazak, Kronreif, Hochgatterer, & Fürst, 2004; Pykhtina et al., 2012), or adaptive toys (e.g. Hsieh, 2008; Kiliç, 2007). However, these are generally case-specific, pragmatic solutions e.g. adaptive toys are created by modifying typical toys and emphasizing primarily on ergonomic aspects meant for serving an individual. These studies do not attempt to generate a theoretical understanding of the relationship between the characteristics of play artefacts and the playfulness of the children.

On the other hand, there are only few toy companies that design toys and play equipment with consideration to different special needs and they largely use a development based criteria for toy market. e.g. AblePlay® (www.ableplay.org) is a website which reviews toys for children with special needs using a toy rating system which categorizes each toy into five main developmental skills which could be addressed including sensory, cognitive, communicative, physical and social/emotional. While the rating can be used for toy selection, the website also gives other useful product information like play ideas. Similarly, Toy”R”Us® (www.toyrus.com) is a well-known international organization that publishes a toy selection guide for differently abled children, again focusing on a set of ten developmental skills which could be targeted through toys. At the time of reporting this work, there were still no Indian toy companies who specifically look at toys for special needs. Thus, within the scarcity of guiding resources and the heavy developmental discourse, the engagement and enjoyment aspects of toys and other play artefacts seem to be given lesser significance in the industry.

There is a clear need for design researchers to develop theoretical knowledge and tools for toy design with focus on the engagement and enjoyment aspect. It is important to understand that the standard tools or frameworks for aiding the design process are generally not applicable in this context because play as an activity differs significantly from most other activities, often having no fixed structure and sequence, and focusing more on the process than the actual outcome of the activity. The focus of a play designer or activity planner is on making the activity/artefact more engaging and fun, rather than ensuring a higher efficiency, as in the case of other activities. Thus, some of the well-established design methodologies like systematic design (Pahl, Beitz, Feldhusen, & Grote, 2007), axiomatic design (Suh, 2001), etc. cannot be directly applied in the context of play activities as they often focus on fixed mental models of usage and breaking down the artefacts/activities into functional requirements. Among the few studies that specifically look into designing for play, Kudrowitz & Wallace, (2010) developed a visualization tool for designing toys called as ‘play pyramid’ which prompts designers to derive ideas from different play types to enhance playfulness. Kiliç (2007) in her thesis discussed about design characteristics for toys for special children however her observations were based on a very small amount of empirical data and output was some suggestions for existing toys. There is a lack of application-oriented theory which can address the engagement and enjoyment factors in play and design research could bridge this gap by theoretical development based on empirical data guided by design interventions. There is a need for creating frameworks which are useful for design practitioners and activity planners for developing artefacts and activities for children with special needs. Moreover, such a study would also account for the socio-cultural context of play at special schools in India which is different from Western nations.

1.2 Socio-cultural context for special needs in India

India presents unique challenges for policy making and practicing with a huge variability in the country’s population. While there is a booming middle class showing a constant increase in their spending capacity, a large part of Indian population especially that resides in rural areas, still struggles to meet their ends. A report by UNESCO Instıtute for Statistics (2005) pointed the effect on literacy noting that India has the highest absolute number of out-of-school children, which includes it among the 35 countries most unlikely to meet education for all goals by 2015. Within these overall challenges in the field of education, education for children with special needs becomes a part of the larger problem in facilitating schooling. Historically, education of children with disabilities has been seen through a charitable service approach in India. Most school going children with disabilities are admitted at special schools in India which receive grants-in-aid from the Ministry of Social Justice and Empowerment or other International agencies. Singal (2006) explains that traditionally government has used a dual focus on special and integrated facilities, however in past decade the attention of policy makers has shifted more towards equal opportunities by enabling inclusion and participation of children with special needs (Parasuram, 2006), as also reflected in the recent ‘the rights of persons with disabilities act’ (Government-of-India(GOI), 2016b). There have been several efforts from the government in practice also, including a number of educational initiatives like Project Integrated Education Development (PIED), Integrated Education for Disabled Children (IEDC), etc. Despite of these initiatives, there are still a number of obstacles in effective inclusion of these children including lack of infrastructural support and lack of training among mainstream school teachers (Bhatnagar & Das, 2014). A recent study by Elton-Chalcraft, Cammack, and Harrison (2016) in Bangalore, an Indian metropolitan study showed that children, parents and teachers of both special and mainstream schools preferred the separate schooling model over inclusive schooling for children with special needs. Over the course of our research, we also found that special schools were much more common and accessible. Thus, situated in this socio-cultural context, our research has been conducted in a special school setting in the metro city of Mumbai, India. It is an important aspect which differentiates the present work from most of the play based literature in inclusive environmental context as seen in the West. While the curriculum is relatively relaxed at special schools in comparison to the highly competitive education system for typical children (Prochner, 2002), the focus on formal instruction and development outcomes is similarly evident for children with special needs. The research site of the present work had a similar model where children progressed through grades based on their learning performance, and the larger mission of the school was make the children self-dependent and employable, for which it also housed an active vocational school. This however presents a situation where the adult agenda of developmental focus may contradict the preschool child's interests which would be play-focused.

Apart from the school eco-system, there are several other socio-cultural factors which may lead to differences in the behaviour of children with special needs in India, when compared with Western culture. India is one of the countries with collectivist cultural background, implying that interdependence and attending to the needs of others is more valued than independence and expression of one's own wants, seen in individualist cultures of Western Europe. Rudy and Grusec (2006) studied the role of this cultural influence on parenting and found that collectivist mothers (including the Indian sample) endorsed authoritarian parenting more than did individualist mothers. A similar sense of control and authority has been seen in school staff during the studies done as a part of our research work, where exploration and unstructured play has been found limited even in special schools (Johry & Poovaiah, 2015). John (2012) addressed another related factor to parenting in terms of maternal stress in urban Indian mothers of children with ID. The study stated that three-fourth of these mothers experienced clinically significant maternal stress, much higher ratio than what is seen for families of children with ID in other countries. High level of family stress in home environment could translate into behavioural problems in children and affect their self-esteem. Such family stress is often aggravated by limited financial resources and lack of support systems and services in India (Gupta & Singhal, 2005), which may even lead to poor prognosis of children who are at risk. These factors are more relevant in the present context when the Indian family system is shifting from a joint family structure to nuclear families, which further increases the responsibilities of parents which could have been shared in the past. Richard (2014) in an ethnographic study in Ladakh India, elaborates on the need of including the families of children with disability for 'inclusive' interventions to be effective. Most of these factors are unique to Indian context, and may have an indirect effect on the manifested behaviour of children during play.

1.3 Focus and scope of research

As discussed in the above sections, the domain of play for children with special needs is an under-researched domain especially from design research's perspective. However, there were still multiple possibilities of exploration at the onset of this study and hence, it was important to formalize the scope of present work which would shape into a doctoral thesis.

Considering the heavy emphasis on learning and development in the play discourse of children with special needs, **the present study focuses on the motivation, experiential and affective aspects of play**. Hence, the present work **also excludes comparison of findings from play behaviour of children with special needs to their typical peers** which often leads to the discourse of play skills comparison. To account for engagement and enjoyment in a play activity, the term ‘playfulness’ has been adapted from Sanderson (2010), as a multi-dimensional and context-dependent construct (discussed in detail in literature review chapter).

Design research could be used to study different aspects of environment including socio-cultural and physical environmental factors. Considering the relative lack of existing work in physical environment and the background expertise and interest of the researcher, **the present study focuses on designed play artefacts (i.e. objects which have been consciously designed to facilitate play) including toys and games** to look at the effect of its design characteristics on observed playfulness of children with special needs. The present study would attempt at controlling the other aspects of physical environment to avoid uncontrolled, independent variables.

Children with special needs cover a wide spectrum of disabilities, with varying capabilities, needs and interests. It would be impractical to attempt developing generalizable theoretical and practical knowledge for subjects with such a large variety. **The present study narrows down the focus on preschool children with mild and moderate intellectual disability, with mental age in the range of 3 to 6 years**. Intellectual disability (F70 and F71 codes as used in ICD-10, World Health Organisation, 1996) is categorized by value of Intelligent Quotient (IQ) between 35 to 69, as identified by standardized intelligence tests. There were several factors for selecting this population for research. Firstly, preliminary studies conducted by the researcher as well as previous experience showed that highest number of children were found in special schools to be associated with mild and moderate ID (though still a small number), which was important in increasing the reliability of the work. Secondly, literature review showed that there are contradicting opinions on play behaviour of children with ID and there has been more emphasis on other disabilities like physical disability, Autism Spectrum Disorders, etc. Lastly, since this population is not associated with any extreme behavioural issue, the findings would have larger applicability and could even be helpful in inclusive design considerations. The present work looks at children in preschool age because early interventions for children with special needs have universally been accepted to be related to significant positive outcomes (Kirk, Gallagher, Coleman, & Anastasiow, 2011). Plomin, DeFries, Craig, & McGuffin (2003) also emphasize the need of optimal early environment for learning as brain develops through interaction with the environment. It is also logical to consider a younger population as their play is relatively simpler.

The present study specifically excludes physical disabilities, severe and profound mental retardation as well as social-emotional disabilities like Autism since their needs are distinctly different and thus require separate focussed studies. It is however expected that the findings from the study would be useful for children with medical conditions judged to be causative of or associated with mental retardation e.g. Down‘s syndrome, Cerebral Palsy with cognitive delay, sensory impairments with cognitive delay, etc. Also, as discussed above, the focus of the present study is on the experiential factors of play and hence, the effect of studied artefacts and activities on learning and development is beyond the scope of the present work.

1.4 Research questions

The present work is approached from the perspective of a design activist with an attempt to develop theoretical knowledge relating the design of artefacts and activities to observed playfulness, which could be useful for practitioners to design toys, games and activities for the children. In this regard, the present study aims to answer the following primary research questions applicable to children with mild to moderate ID having 3 to 6 years of mental age.

1. Do design characteristics of play artefacts/activities affect observed playfulness of children with ID, and how?
2. Do the identified design characteristics predictably enhance the playfulness when implemented as design guiding principles for artefacts/activities belonging to different contexts, and how?

In order to address these primary research questions, it becomes imperative to answer the following subordinate research question:

3. How can the level of engagement and enjoyment be compared between play activities having different contexts using playfulness as an assessment tool, to check the effectiveness of environmental interventions?

2. Review of literature

2.1 Introduction

This chapter presents an in-depth exploration of literature relevant to play, special needs and design. Play theories and definitions of play are explored to develop an understanding based on existing knowledge. The focus is then shifted to research studies that specifically look into play of children with special needs. An attempt is made to establish how play varies as a function of etiology for children with special needs. Following this, the review of literature tries to explicate the role of design artefacts in facilitating play, with emphasis on literature from application oriented research and design domain. The main objective of this chapter is to identify overall gaps which would be addressed through the studies conducted as a part of the present thesis. However, contextual literature references in relation to findings from the studies are discussed alongside in the subsequent chapters. In order to avoid repetition, some of this literature is intentionally removed from this chapter. Following sections present relevant literature that acts as a foundation for the thesis.

2.2 From play to playfulness

Play could be seen as one of the fundamental behaviours exhibited by humans and animals alike, playing a critical role in evolution (Burghardt, 2014). In case of humans, play as a phenomenon has been recorded from the pre-historic times, as could be seen in the carvings and archaeological artefacts. In his seminal work, Huizinga (1949) discussed how play has preceded human society and culture. Over the course of time, changes in socio-cultural and political contexts have seen an evolution in the way play has been perceived from early philosophers to modern scientists. An interesting narrative emerges by looking at the historical development of theories of play showing how play as a concept has been shaped to support the dominant perspectives as a specific point of time. A brief historical review of play theories is presented as follows, with the objective of situating the present study within these multi-faceted and sometimes contradictory conceptualizations of play.

2.2.1 Historical overview of play theories

Play theories have been classified by Mellou (1994) as classical or modern based upon their order of historical occurrence being pre-world war I or during the 20th century respectively. Most of the classical theories of play share a common focus attempting to determine the purpose of play outside the play activity, leading to further categorization into psychological and biological theories. Saracho & Spodek (1995) summarize most of these theories in their review paper, briefly presented as follows. The most predominant theories in the physiological category include the ‘Surplus energy theory’ given by Schiller (1875) which described that play impulse emerged out of the surplus energy, however this energy for play could not be separated from that needed for other activities. Another significant theory in this category is ‘recreation theory’ given by Lazarus (1883) who contrasted the surplus energy theory by stating that play was necessary to regenerate the energy lost in work, thus projecting play as opposite to work. The biological categories, on the other hand, include the ‘preparation for life’ theory (Groos, 1898, 1901) and ‘recapitulation theory’ (Hall, 1905). According to Groos, all play behaviour is helping to practise skills necessary for survival in adult life, thus preparing for life, while Hall’s recapitulation theory proposed that through play, children reproduced the past cultures of their race, instead of preparing for the future.

Unlike explicitly looking for purpose of play outside it, the modern theories concentrated on the form and content of play, identifying purpose from the content (Saracho & Spodek, 1995). One of the significant modern theories that originated in 20th century was given by Mead (1934) who focused on the make-believe play aspect and proposed the major role of play was to socialize children to adapt to their culture, its norms and rules. Bateson's (1955) meta-communicative theory, on the contrast, argued that during dramatic play children learned to differentiate make-believe from real, to communicate the difference to their peers, and to try out and modify various social roles. Psycho-analytic perspective on play was first provided by Erikson (1950) who proposed that play gave children with the opportunity to experience and master reality by creating model situations through experiment and planning. He emphasized on the therapeutic value of play as the mastery achieved helped in relieving anxiety in the child. Christie and Johnsen (1983, p.4) sum up these theories, “There is a duality, a form of tension, in looking at the function of the play process in terms of personal expression versus social adaptation". One of the most widely studied play theories till date was given by Piaget (1962) who tried to see the relationship between play behaviour exhibited and the cognitive development of the child. He described play as involving the cognitive processes of 'accommodation' v/s 'assimilation'. While assimilation involves integrating the information from external stimulus into the existing mental structures, accommodation involves changing the existing mental structures to accommodate the new information presented by external stimulus. During play, the cognitive process of assimilation was found to be dominant. Athey (2007) has been a leading play theorist who extended Piaget‘s idea of existing mental structures or 'schemas', exploring its types and how they lead to development of logical classifications. Vygotsky (1967) also talks about the role of play in the cognitive development through a constructivist perspective. According to him, children experience the 'zone of proximal development' during play and participate at their highest level of competence, leading to progress. Behavioural perspective of play was looked upon by Berlyne (1969) who proposed that play aroused from children‘s drive to maintain an optimum level of arousal. Among the contemporary play theorists, Sutton-Smith (1986, 1997) has been a major influence in shaping the play theory with his critics of earlier theories and focus on a number of discourses like power and identity in play, imaginary play, use of toys, etc. Lindon (2001) has been working on play and early learning and understanding adult roles in play while Else (2009) has wrote on practical approaches for play activities. A number of typologies of play have evolved, including Hughes (1996) who further broke down the earlier categories into fifteen types. Harker (2005) has looked at some of the existing theories and pointed out how most of them have eluded to define play. He suggests, "Playing has no identity (being) itself, except as a secondary characteristic of its conceptual differentiation (becoming) – the identity of difference" (p.16). These theories, while having looked at play from varied standpoints, have been contributing in shaping the construct of play. Interestingly, most of the modern play theories, as reviewed above, have looked at play emphasizing on its role in child‘s development, like cognitive development (Athey, 2007; Piaget, 1962), emotional development (Erikson, 1950), social development (Gregory Bateson, 1955; Mead, 1934), among others. While these theories have been very useful in recognition of play as an essential activity having a critical role in development of children, most of them do not specifically talk about the implicit characteristics of play as an activity which could be used to define and differentiate it from other activities. Hence, these theories cannot be used to guide the present thesis where it becomes imperative to be able to identify the presence and quality of exhibited play behaviour.

Other significant discourses in the domain of play include a number of long-term ethnographic studies on emergence of peer culture through play (Aydt & Corsaro, 2003; Evaldsson & Corsaro, 1998). Studying peer culture as a function of increasing age has helped understanding how play is manifested in toddler's fragile play routines to more stable preadolescent play with emergence of social hierarchies and gender separation (W. A. Corsaro, 2005). Understanding the difference in playing styles as a function of gender (Bhana, 2016; Blatchford, Baines, & Pellegrini, 2003; Karsten, 2003; Trawick-Smith, Wolff, Koschel, & Vallarelli, 2014) has also been an emerging research area with issues like content and type of play, territorialisation of play space, playground factors, etc. Researchers have explored a variety of methods to study children's cultural and material context in play. The use of visual techniques has gained popularity in recent times which includes children maintaining a photo diary which acts as both as a visual output and research tool (Bourke, 2017; Burke, 2005) or the use of children's drawings of their environment (Literat, 2013; K. Malone, 2013). An analysis of varied methodologies and techniques used in children's play research presents an interesting area for future exploration. Empirical work in studying play and the advances in technology has led to the emergence of a number of multi-disciplinary areas like Media-based learning, Digital game based learning (DGBL), etc. Salen and Zimmerman (2004), in their seminal work in *Rules of Play*, define a game as a system in which players engage in a rule defined artificial conflict that results in a quantifiable outcome, thus representing a particular form of play. Van Eck (2006), a well-known proponent of DGBL, elaborates on how games can playfully engage children in learning using the well-established learning tools of situated cognition, anchored instruction, feedback behaviourism, constructivism and many other cognitive psychology and educational theory principles. A decent body of literature is available that deals with the domains like DGBL and video games for learning (Gee, 2003; Prensky, 2003, 2006). With the inclusion of technological advances like virtual reality, artificial intelligence and multi-player online systems, the integration of play and games into real life activities is becoming more and more seamless.

2.2.2 Challenges and confusions in defining play

As discussed in the last section, research on play has mostly focused on its instrumental nature while explicit conceptualizations of play has been elusive, also acknowledged by Sutton-Smith (1997) in his book, *The Ambiguity of Play*. There have been some significant theories in the last two centuries that have attempted to define and shape the construct of play, however being multi-disciplinary in nature, varied disciplines like psychology, anthropology, neurology, pedagogy, among others, have all looked into play from different perspectives and purposes, acting as an obstacle in a universal definition of play. Infact, the characteristics of play that most of the existing definitions suggest are often contradicted empirically as pointed out by Harker (2005). Furthermore, while it is has been found easier to observe and report play in children whether in playground or classroom, researchers have acknowledged problems in deriving an operational definition of play as a uni-dimensional phenomenon with few distinguishing characteristics (Jenvey & Jenvey, 2002; Martin & Caro, 1985). Pellegrini and Smith (1998) corroborated this notion identifying the reason to be play being related to the quality of the action, rather than the action itself, and suggested that play should be defined multi-dimensionally. Thus, the definition of play cannot depend upon one defining characteristic but a combination of such characteristics (Smith & Vollstedt, 1985).

A comprehensive definitional criterion for play comes from Rubin, Fein, and Vandenberg (1983) who identified three paradigms for defining play: play as observable behavior, play as context, and play as disposition. Paradigm of play as observable behaviour defines play in terms of behaviours that follow play often leading to taxonomies like symbolic play, rough-n-tumble play, parallel play, etc. while paradigm of play as context defines play based on the circumstances that elicit and support play which includes a familiar atmosphere i.e. props and people, safe and friendly environment, a minimally intrusive adult, and children who are free from stress, hunger, and fatigue. Paradigm of play as disposition seems to be most relevant for the purpose of defining and distinguishing play as it looks at child‘s approach in terms of motivation and orientation towards the activity. Based upon previous theoretical prepositions and his own analysis, Rubin et al. (1983) proposed the following dispositional characteristics of play: 1) activity being intrinsically motivated, 2) play activity being focused on the means versus the ends, 3) player being actively engaged in the activity, 4) going beyond the functional properties of an object, 5) play behaviours being representational versus instrumental in nature, and 6) play not being constricted by external rules. Bundy (1997) defined play disposition criteria consisting of intrinsic motivation, internal control, freedom to suspend reality and ability to maintain a frame in play. Bundy (2000) further gave a significant conceptual framework for understanding play by placing it on a continuum of activity that can be more or less playful depending on the number of dispositional criteria that have been met, rather than two discrete states of play and non-play. In an empirical study conducted by Jenvey and Jenvey (2002), trained observers viewed videos of eight play episodes of children, and found positive affect, non-literality, communication/intimacy, and physical context, among the major characteristics that defined play behaviour. However, Turnbull and Jenvey (2006) inferred based on their study that non-literality, communication/intimacy, and physical context were related more to pretend play than activity play, thus some of these characteristics may not be applicable to all play types. The progress in the discourse of looking at dispositional characteristics for defining and operationalizing play has led to coining of the term ‘playfulness’, discussed in the next sub-section.

2.2.3 Playfulness: Definition and assessments

The notion of playfulness has been used lately in accordance with the notion of play, however they are semantically different (Lester & Russell, 2010; Youell, 2008). While play refers to the behaviour manifested during the activity, playfulness refers to the unique internal pre-disposition child has to engage in play or his desire to play. The term ‘playfulness’ was first coined by (J. N. Lieberman, 1965) characterising it based on: physical spontaneity, social spontaneity, cognitive spontaneity, manifest of joy and sense of humor. Most of these characteristics seem to be representative of stable personality traits. Over the course of time, the focus has shifted from play abilities of children to play style based dispositions, resulting in dispositional characteristics like intrinsic motivation, non-literality, means v/s ends, active engagement, positive affect, etc. but they also represent playfulness as a stable-personality trait and a uni-dimensional construct (e.g. Bundy, 1997; Rubin et al., 1983; Smith & Vollstedt, 1985). These theoretical developments have also led to progress in objective assessment of playfulness in the form of playfulness assessment scales like Children‘s Playfulness Scale (CPS: Barnett, 1991), Child Behavior Inventory of playfulness (Rogers et al., 1998) and Test of Playfulness (ToP: Bundy, 2000). Each of these assessment focuses on identifying playful personality in a child by including higher-order processes like divergent-thinking, humor, and creativity, as well as culturally driven play skills like telling jokes, sharing toys, etc. These scales have shown strong psychometric properties and have established their validity and reliability among typical children. For special children , recommendations have been made on individual items for improving their usability (Bundy & Clifton, 1998; Okimoto, Bundy, & Hanzlik, 2000). However, treating playfulness as a stable personality trait has led to ignoring the effect of contextual factors including the effect of physical and social environment on play and role of interventions in enhancing playfulness in children. Thus, recent literature has looked on playfulness as a dynamic entity which is context dependent. An example of this treatment is the development of Project Joy Playfulness Scale (PJPS; Sanderson, 2010) which treats playfulness as multi-dimensional and contextual. This scale also tries to segregate the attitude to play from the learned play-skills which are culture-dependent (e.g. telling jokes, sharing toys, saying sorry) as seen in the earlier scales, thus making it more usable across different cultures. All these playfulness assessments have been summarized in table 2.1 for comparison.

Assessment	Basic Structure	Theoretical framework	Duration of application	Strength/ Weakness
Children's Playfulness Scale (1990) - used by teachers	Uni-dimensional, 23 items on 5 point Likert scale	Playfulness seen as stable personality trait comprising of physical, cognitive & social spontaneity, manifest joy, sense of humor.	Based on previous experience	Weakness: Includes higher-order processes like creativity, humor, divergent thinking, needs modifications for usage with children with special needs and was found to lack internal consistency
Child Behaviour Inventory of playfulness (1998) - used by teachers & parents	Uni-dimensional, 21 (playfulness) & 7 (externality) items on 5 point Likert scale	Playfulness seen as stable personality trait, based on Rubin et al. (1983) criterions of play disposition	Based on previous experience	Weakness: Not found prevalent in literature and no studies using CBI to check validity with special children
Test of Playfulness (2000) - used by trained OT	Uni-dimensional, 24 items on three 4 point Likert scale: extent (proportion of time), intensity (degree), skill (ease of performance)	Playfulness seen as stable personality trait comprising of intrinsic motivation, freedom to suspend reality, internal control, framing - also borrows manifest joy and sense of humor from CPS	15 min of free play in natural environment of child's choice	Weakness: Includes higher-order processes like creativity, humor, divergent thinking Strength: Validity & reliability well established with special children (cognitive delays) , however modifications have been asked
Project Joy Playfulness Scale (2010) - used by teachers, interventionists	4 dimensions, 21 items on 4 point Likert scale	Playfulness seen as contextual , dynamic & multi-dimensional , comprising of active engagement, intrinsic motivation, internal control & joyfulness	Past 2 weeks of play in school	Weakness: Validity & reliability not checked for special children Strength: It treats playfulness as contextual, multi-dimensional, learned play skills (culture dependent e.g. telling jokes, sharing toys, saying sorry) segregated from attitude, meant specifically for schools

Table 2.1 A comparison of existing playfulness assessment scales

A recent development in this domain comes from Waldman-Levi and Bundy (2016) who have proposed Parent/Caregiver's Support of Young Children's Playfulness (PSYCP) assessment which looks at co-occupations of children with facilitators. Even though some of the existing playfulness assessment scales are widely used including the domain of special needs, they primarily address the stable component of playfulness. For the purpose of our work, Project Joy Playfulness Scale (Sanderson, 2010) seemed to be most suitable for studying the effect of contextual factors on playfulness. Sanderson has defined playfulness as: "the expression of the child's drive to freely and pleasurably engage with, connect with, and explore the surrounding world" and situated playfulness in the interaction of child and environment, rather than completely being an intrinsic property of a child. Moreover, Sanderson (2010) conceptualizes playfulness as a multi-dimensional construct comprising of active engagement, joyfulness, social dimension and internal control which allows capturing of the experiential aspects of the play interaction. However, PJPS (Sanderson, 2010) could not be directly adopted since it is not designed to measure playfulness of individual play episodes with a specific toy or activity. The scale measures playfulness over a period of time (two weeks) involving play with a group of toys. The present thesis addresses this gap of developing assessment framework to compare playfulness between individual play episodes, useful for interventional studies. While the existing assessments can't be directly used, the theoretical construct of playfulness and its dimensions as proposed by Sanderson (2010) became the basis for assessing playfulness in the present thesis, and are further developed for assessment through a set of empirical studies.

2.3 Play for children with special needs

Analogous to the play theories discussed in an earlier section, research on play and special needs often focuses on instrumental nature of play i.e. play as a tool for development, and thus engagement and affective aspects of play are often secondary, serving more of a facilitative purpose. This is well-reflected in the suggestion made by Brodin and Lindstrand (2000) in their study on children with ID stating that interest in play and toys needs to be kept alive using strong stimuli since children with ID need longer time for learning. Jane Brodin (2005) also identified this pattern in existing literature stating that almost all literature on play and children with disabilities emphasizes on learning or training different skills as an important aspect. A related discourse that emerges in literature from fields like occupational therapy and education is about compensating for lack in play skills and adaptive behaviour through play therapy, which involves facilitating structured play for children with special needs to enhance their adaptive behaviour. Astramovich, Lyons, and Hamilton (2015) reviewed different approaches to utilize play therapy for children with ID. Similarly, a lot of recent research in the domain of play for children with special needs seems to focus on 'teaching appropriate play' to these children (e.g. Barton, 2016). While these discourses are useful, they don't align with the theoretical framework of the reported thesis where focus is on the experiential aspect of play using playfulness as a lens to explore the activities. Our work looks at this often unaddressed aspect of the affective and engagement qualities of play instead of seeing it as a tool for teaching play skills and trying to 'improve' children's performance in play.

Another unique attribute pertinent to research literature for children with special needs is the emphasis on comparative studies, which aim to identify the similarity and differences in the play behaviour of special and typical children. Several earlier research studies have reported that preschool children with developmental disability have been found to lack in advanced or complex toy play types. Blasco, Bailey, and Burchinal (1993) studied the effect of same-age and mixed-age classroom conditions on play complexity. They reported that in same-age classroom condition, children with mild to moderate developmental delays show significantly higher instances of less complex play types like simple manipulation than purposeful and social play, when compared to typical children matched on chronological age. McWilliam and Bailey (1995) further extend this finding in their study showing that young children with disabilities were found to be engaged for less time and at lower levels of play complexity during free play than children without disabilities, even when matched on the developmental age. Sigafoos et al. (1999) corroborated this difference in his longitudinal study with preschool children having developmental disabilities, stating that observed play was primarily functional and exploratory while more complex play types like constructive and pretend play were significantly less prevalent. More recently, Hughes (2010) reported that children with sensory, social, and intellectual impairments engaged in less of imaginative role-play or symbolic play with objects, preferring simpler play forms. However, some of these earlier studies have dealt with mixed populations with varying etiology and severity of disability, which makes it difficult to generalize results to a specific sub-set of population. There is a clear lack of research studies which look at such sub-sets of the population, focusing on a specific etiology and age-groups. Another point of possible difference has been seen in the social play behaviour where preschool children with developmental delays were seen to prefer significantly lesser social play with peers as compared to typical children (Case-Smith & Kuhaneck, 2008). While Hestenes and Carroll (2000) show an agreement on the hypothesis of reduced social play, they report that preschool children with multiple developmental disabilities and typical peers showed a high level of similarity between the types of activities selected during free play. Some studies even report that for preschool children with ID and average mental age 2-3 years, home-based predominant play was same or even more sophisticated than typical peers, contrary to negative stereotypes regarding the play of children with ID (D. M. Malone, 2006b, 2009). However, it is not disputed that children with ID and other developmental delays lack in adaptive and behavioural skills which could affect their play e.g. Memisevic (2015) showed that about one-fourth of his subjects with mild ID had clinically significant deficit in self-regulation skills as compared to their typical peers, which has a significant effect on the way children play. Children with developmental disabilities have also been associated with serious problem behaviours like frequent aggression, or extreme tantrums (Luiselli, Matson, & Singh, 1992). It is safe to say that existing research literature on preschool children with ID does not give a clear comparative picture on play behaviour with respect to typical peers. More importantly, most of the studies as discussed above have targeted play complexity and play skills as the point of interest, and do not necessarily comment on play preferences and experiences of children with ID. The present thesis is an attempt to address this gap by looking at the playfulness of the on-going play activities for preschool children with ID. Studying the qualitative experiential aspects of play of children with ID rather than comparing their skills in a quantitative framework, might lead to new knowledge which could be useful for the special needs domain.

It is worth noting that within the special needs literature, there seems to be more attention given to certain disabilities and discourses e.g. a significant number of recent studies have looked at inclusive play opportunities for children with special needs (e.g. Crawford, Stafford, Phillips, Scott, & Tucker, 2014; Ferreira, Matos, Carvalho, & Soares, 2016; Holt, Moore, & Beckett, 2014; Sobel, O'Leary, & Kientz, 2015; Yu, 2011). While inclusion and equal participation of children with special needs remains as one of the main objectives for the society world-wide, segregated special school settings are still the most commonly available spaces in Indian context. Thus, studies which majorly focus on accessibility and inclusivity may not be as useful in terms of direct application in the practical context of the present work. Another pattern seen in the special needs literature is much higher prevalence of recent studies on play for preschool children having Autism Spectrum Disorders (ASD) (e.g.

Greenberg, Lau, & Lau, 2016; Harris, 2016; Harrop, Green, & Hudry, 2016; Papacek, Chai, & Green, 2015). On the other hand, there are much fewer studies being conducted with preschool children having ID without any other comorbidity, which are also significant in terms of population in Indian context. The present thesis would attempt to demystify the play behaviour characteristics and preferences of this population, in an attempt to create useful theoretical and practical knowledge.

2.4 Designing for play

Having moved from the conceptualization of playfulness as a stable personality trait to being context-dependent, it is worth looking at how different socio-cultural and environmental factors affect the play behaviour and playfulness. This section reports a review of research studies from multiple disciplines showing how different environmental factors have been seen to affect play for both typical and special children. This is followed by discussion of existing theoretical and practical knowledge regarding designing for play, including the contribution from the field of design research.

A number of play theories discussed earlier, make a brief reference to the role of environment in affecting the nature and course of play. Berlyne (1969) in his arousal modulation theory of play stated the need of child to modulate the level of stimulation in the environment, in order to maintain an optimum level of arousal (Saracho & Spodek, 1995). Bateson's (1971) meta-communicative theory also states that play in children is shaped by the immediate context and that play acts as a medium for exploration of the environment and one's culture (Saracho & Spodek, 1995). Bundy (1997) defined play as a transactional relationship between the individual and the environment. Aitken (2001, p.176) acknowledged the role of the environment in constraining play as he stated, “play is the active exploration of individual and social imaginaries, built up in the spaces of everyday life”. More recently, Sameroff (2010) presented a unified theory of development where both nature (genes) and nurture (experiences) dynamically interact, contributing to the development of a child.

Moreover, there is a significant amount of literature based on empirical studies that identifies and corroborates the significance of environmental factors on activity participation of children with disabilities, as seen in a number of review papers (Anaby et al., 2013; Askari et al., 2015; King et al., 2003). However, focus of most of the empirical studies seems to be on socio-cultural environmental factors like interaction among children and adults, staff-child ratio, etc.

For instance, Benjamin, Lucas-Thompson, Little, Davies, and Khetani (2017) discussed about different types of adaptive strategies employed by parents of children with disability which affect their participation. Strauss et al. (2014) looked at the level of structure in facilitating play for children with Autism. A number of research studies have supported that play for disabled children varies as a function of the setting in which it has been observed (Lieber & Beckman, 1991; D. M. Malone, 2006a, 2009; D. M. Malone & Stoneman, 1990). The physical environment which also has a significant effect on participation in play activities for children with special needs seems to have got lesser attention, as stated in the review paper by Jones et al. (2017).

In case of typical children, a dominant discourse while studying the role of physical environment on play activity has been on the role of playground spatial features. e.g. Czalczynska-Podolska (2014) studied the spatial features of contemporary playgrounds and identified factors like variety, challenge, enclosure, zoning, etc. had a significant effect on the playability and sociability. Another set of key features of physical environment in outdoor play related to child development was identified by Herrington and Lesmeister (2006), comprising of: character, context, connectivity, change, chance, clarity, and challenge. Moore (1985) has been one of the pioneers in research on role of physical environment on play, stating that although the design and quality of physical environment has a significant effect on how children play, often the practicing professionals (architects, planners and policy-makers) make decisions with little understanding of the human developmental consequences and scant scientific evidence to support their decisions. Another recurring thread in these studies has been the interest in looking at how playground design supports physical activities in typical children (e.g. Black, Menzel, & Bungum, 2015; Flaes, Chinapaw, Koolhaas, Mechelen, & Verhagen, 2016). When it comes to studies which look at playground physical environment in children with special needs, the focus is generally on identifying barriers and degree of accessibility (e.g. Prellwitz & Skär, 2016; Soltani, Abbas, & Awang, 2012). Doctoroff (2001) presented a comprehensive set of recommendations for adapting physical environment for children with special needs, including factors like arrangement, accessibility and diversity of play materials. As correctly identified by Gray, Zimmerman, & Rimmer (2012), most of the existing research instruments on accessibility do not look at the subjective experiential aspect of the recreational spaces. The present study goes beyond identification of barriers and facilitators in play and looks at the relationship between physical play artefacts and the experiential and affective dimension of play through the lens of playfulness.

It is also worth noting that within the literature on physical environment, much lesser attention has been given to micro-level factors like toy and activity characteristics on special children's play experiences. McCabe, Jenkins, Mills, Dale, and Cole (1999) who studied children with cognitive, language, social-emotional, and/or motor concerns found that play type exhibited was directly related to the type of play material presented i.e. functional (goop), constructive (Lego blocks), and dramatic (Fischer-Price toys). Dicarlo (2005) in her doctoral thesis showed that for children with disabilities, sensory profile of toys had a significant effect on the preference in selection of the toys. However, she did not look at experiential factors like engagement duration and frequency, and enjoyment. A similar preference assessment approach was used in another study while studying young children with developmental delay, not focusing on the experiential factor as well as the design characteristics of toys (Reid, DiCarlo, Schepis, Hawkins, & Stricklin, 2003). Instead they simply identified preference within a set of off-the-shelf toys. In this manner, other research disciplines working in the domain of special needs have attempted to address the issue of toy design for children with special needs by looking at the physical ergonomic effects and trying to remove barriers, making it more accessible. Besio (2004, p.119) explains, "The contemporary toys may not be suitable for children with special needs because they are difficult to manipulate and some building and psychomotor exploration play activities are partially or totally precluded for evident functional reasons". This can lead to frustration and negative reinforcement that prevents improvement in disabled children, and thus they need assistance either on the toy or separately (Bradley, 1985; Kiliç, 2007). To resolve this challenge, a number of solutions have been offered which include adaptive toys (Ferreira et al., 2016; Hsieh, 2008; Kiliç, 2007; Tam, Gelsomini, & Garzotto, 2017) and assistive technology (Ferrari et al., 2010; Johansson, 2009; Patrizia et al., 2009; Prazak et al., 2004; Pykhtina et al., 2012; Salivia, Hall, & Hourcade, 2013). Adaptive toys and assistive technologies offer pragmatic solutions created basically by modifying typical toys and play activities, and emphasizing primarily on ergonomic aspects meant for serving an individual. There are two research gaps which emerge from this literature. Firstly, as in the case of playground design, interventions in the design of toys and play activity have also stayed at the level of enhancing accessibility and removing barriers. Beyond making the toy or activity more accessible, there is a need to look at how the design of toys and activities could become more engaging and enjoyable for children with special needs. Secondly, most of the interventional studies using adaptive toys and assistive technologies either give improvised solutions or address a specific design feature which is difficult to generalize. Hence, there is a need for theoretical development which can look at design characteristics of toys and activities from a more comprehensive perspective through a bottom-up approach using the play interactions of children to guide theory. This would be useful in combining some of the tacit knowledge and piece-wise insights from empirical studies into generalizable practice friendly knowledge which could be used by designers, activity planners and policy makers. More suited to the discipline of design research and practice, the present study is one such attempt to study the effect of toy design on playfulness of children with ID, at the level of generalizable design characteristics.

While design research and practice gives a new perspective to approach the challenges in the domain of play and special needs, toy design as a discipline mostly borrows from other fields like products design, user-experience and new-media design. Guiding theory in the domain of toy design is limited and tools, frameworks and research methodologies are generally borrowed from other design disciplines. It is important to consider that child's play presents a unique context where activity has no fixed structure and sequence, as well as the focus on means v/s ends (K. H. Rubin et al., 1983) i.e. the outcome may not be as important as the experience during the activity. Gielen (2010) uses the term 'aimlessness' as one of the unique characteristic which is difficult to account for by toy designers. Hence, most of the standard design process and methodologies used in product design may not be directly applicable since they work in the theoretical framework of fixed mental models and functional requirements. e.g. fixed functional requirements which form the basis of using axiomatic design process (Suh, 2001) are difficult to determine in the case of designing for children's play. On a similar note, another standard methodology of systematic design (Pahl et al., 2007) sees product design as a multi-level problem affected by various visible and invisible factors of the system. The experiential factors in the form of playfulness or what Gielen (2010) considers a part of play value need to be integrated in these existing methodologies to become useful in toy design. However, designing for play would still be more complicated considering that children may derive unpredicted affordances from the designed artefacts and activities. The present thesis focuses on developing a better understanding of the experiential factors and looks at its relationship with design characteristics of toys to guide practitioners.

Apart from the standard methodologies, universal design has emerged as a sub-discipline in design related to designing for special needs, however the principles of universal design are centred on enhancing usability and inclusivity (Ruffino, Mistrett, Tomita, & Hajare, 2006), and do not address the affective aspects of play. One of the few significant works which contributes to designing for play comes from Kudrowitz and Wallace (2010) who developed a play classification applicable to toys of all ages, which can also be used as a visualization tool for designing toys although there are several issues in their study. The proposed classification and visualization tool has not been developed from empirical data. Also, while the tool gives a broad idea to guide thinking, it does not inform the designer at the level of generalizable design characteristics which could be used as guiding principles. The present study addresses these lacunae, being guided by empirical data and by looking at the generalizable design characteristics of play artefacts that lead to playfulness in preschool children with ID.

While designing for play for children with special needs seems to be an under-researched domain, the advances in technology have led to emergence of application oriented domains like video games. With an ever-growing market, researchers have come up with taxonomies of video game elements, symbolic representation and grammar (Koster, 2005), and even game design patterns aimed at helping the designers to make games more engaging and fun (Björk, Lundgren, & Holopainen, 2003; Falstein, 2002; Kreimeier, 2002). It is clear that this knowledge may not be directly applicable in our context since it has been developed for adult users with different capabilities and interests. On the other hand, available toys for preschool children do not come with any information on its applicability and usage for children with special needs. Hamm, Mistrett, and Ruffino (2006) studied the perceptions of parents of children with disabilities while selecting toys for their children. They commented that there is an incongruity in what parents wanted for the children and what they actually brought, which could be attributed to the lack of information. There is a need to investigate the design characteristics and elements that would be playful in the context of special children's play, which may or may not have overlaps with some of the existing characteristics seen in related fields like video games.

2.5 Summary of the literature review

Having broadly looked at the intersection of the domains of play, design and special needs in the literature review, some of the significant findings are summarized as follows:

Acknowledging the challenges in defining and assessing play, a multi-dimensional and context-dependent theoretical model of playfulness developed by Sanderson (2010) was identified, which forms the basis of the assessment framework used in the present thesis. Studies on play of children with special needs including children with ID showed a lack of consensus on the similarity and differences of exhibited play behaviour in relation to typical peers. There seemed to be a recurrent theme of play being seen for its instrumental role in development leading to the dominance of discourses like play complexity, play skills and teaching appropriate play to children with special needs. A plethora of literature was found on the role of environmental factors on special children's activity participation, but majority of studies seem to focus on socio-cultural factors like facilitation, activity structuring, etc. There was a limited amount of literature on how physical environmental factors affect children's activity, and the studies which look at micro-level factors like toy and activity characteristics were even fewer. Besides, perspective from other research disciplines has led to emphasizing on accessibility and removal of barriers to allow more inclusion of children with special needs, rather than the experiential and affective aspects of the activity. While advances in technology have led to emergence of domains like assistive technology which are offering effective interventions, they are often context-bound and do not look at generalizable design solutions, or theoretical frameworks which could guide the design practice. Toy design as a discipline also lacks well-established methodologies suited to address the context of children's play and there is a need to study the experiential aspects of play activity in relation to the design characteristics. The present study aims to contribute in addressing some of these existing research gaps in the literature through a set of rigorous, empirical studies aimed at understanding the relationship of design characteristics of play artefacts and observed playfulness in preschool children with ID, from the perspective of a design activist.

3. Research Methodology

3.1 Introduction

This chapter summarizes the overall research methodology as well as individual research methods and techniques for data collection and analysis in different phases. The focus of this chapter is to elaborate the rationale for selecting this research design and framework, and the associated assumptions and limitations. Descriptive details of subjects, procedure and instruments will be followed up in the later chapters along with the results from the individual studies.

3.2 Identification of research methodology framework

As discussed in the earlier chapters, the primary aim of the thesis was to identify a set of generalizable design characteristics which would have a significant effect on the playfulness while interacting with the designed artefacts. With lack of previous literature within the context and studied population, it was difficult to frame research hypothesis which could be tested using quantitative research. It became clear that a substantial part of this thesis would be data driven and exploratory in nature and thus better suited to qualitative research which would allow rich data and multiple perspectives on factors relevant to the studied problem. Moreover, quantitative research generally relies on large population set for reliability of findings which was not feasible in the context of present work. However, developing generalizability and operationalization of these design characteristics would require an interventional study which could objectively establish the effectiveness of the identified design characteristics as useful design principles. This would be better suited to quantitative research allowing an objective comparison between the different conditions being tested. Hence, the **present work used a mixed methods research methodological framework and a sequential, exploratory mixed methods research design**, combining the quantitative and qualitative research frameworks (Creswell & Plano-Clark, 2007). Mixed methods framework is found most effective in research problems where combining the quantitative and qualitative models would lead to generation of knowledge which is more meaningful than either of the models used alone. In this manner, mixed methods framework allows checking the possible weakness in individual models by complementing each other through their strengths (Creswell, 2003; Creswell & Plano-Clark, 2007). In the context of present work, the qualitative research stage allowed the embedding of contextual information and individual perspectives in the theory which could be important in understanding a phenomenon, and possible subjectivity due to interpretation and bias from the researcher was checked using quantitative research. As explained by Creswell and Plano-Clark (2007), using the exploratory mixed-methods design is appropriate when results need to be generalized to different groups or to test certain aspect of emergent theory. In our case, the applicability of the generalizable design characteristics has been tested across a different context of challenge-based play. The sequential, exploratory mixed methods design was divided into three phases as shown in table 3.1.

	PHASE 1		PHASE 2	PHASE 3
	Pilot 1a. Competitive play	Pilot 1b. Existing state of play	Exploratory intervention study	Validation intervention study
Major contribution to thesis	Insights on conducting research	Insights on conducting research + understanding existing context in special school	Identification of generative playfulness dimensions	Operationalization of selected dimensions & its combinations
Instrument used	Constructive blocks	None	Existing familiar toys	Designed toy stimuli
Data collection procedure	Experimental	Ethnography based observation, semi-structured interviews	Adaptation of Grounded theory framework	Experimental, repeated-measures design
Data analysis procedure	Quantitative	Qualitative (guided by theory)	Qualitative (Grounded Theory framework)	Quantitative statistical (supplemented by qualitative data)
Use of playfulness assessment	Not used	Used qualitatively	Engagement, joyfulness, social connection (individually analysed)	Engagement duration & frequency + Joyfulness (measured together)

Table 3.1. Research methodological framework and used methods across the studies

The 1st and the 2nd phases were exploratory in nature which led to the theoretical development of generalizable design characteristics of play artefacts (later referred as generative playfulness dimensions) using primarily qualitative data, while the 3rd phase was explanatory in nature which primarily used quantitative data to operationalize selected dimensions individually and in combination, as design guiding principles. It is important to note that one of the pilot studies in phase 1 assessing competitive play in children used a quantitative research framework however the primary intention of the study was to understand the challenges in using quantitative methods for children in the context of special schools, in order to inform the main studies. In that spirit, this study has also been reported as a part of exploratory research in the overall body of thesis. Also, the validation study in phase 3 used qualitative data to understand the quantitative results better, and in that sense, mixed-methods framework was applicable within the validation study (embedded mixed-methods design), as well as, in relation to previous studies (sequential mixed-methods design). Over the three phases, playfulness was used as the primary assessed parameter, iteratively refined in the process as shown in table 3.1. In terms of weighting, it could be argued that each of the main study individually focuses on a research paradigm. However, in the overall context of the thesis, qualitative research paradigm is more heavily weighted as significant part of the contributions has emerged from rich qualitative data, substantiated with quantitative methods.

The use of mixed methods research methodology framework and the adaptation of multiple methods within individual studies are guided by the underlying philosophical perspective of **pragmatism**. As explained by Morgan (2007), pragmatism allows researchers to choose methods which are best suited to address individual research questions, instead of restricting the researcher to only quantitative or qualitative research framework. It can be thus inferred that using pragmatism, the primary focus of the present study was to systematically adapt methods such that theoretical development could be guided in most appropriate manner within the limitations of studied context.

3.3 Assessing playfulness through research

Having been sensitized to the confusions in defining and measuring play for an interventional study context as discussed in literature review (refer chapter 2), playfulness as a construct was adopted for accounting the differences between play elicited with varying toys and contexts and used for all the studies which were conducted. Our definition which was inspired from the Sanderson's (2010) treatment of playfulness as a contextual and multi-dimensional construct states playfulness as '**the expression of the child's drive to freely and pleasurably engage, connect and explore an object during the play interaction**'. However, the Project Joy Playfulness Scale (PJPS; Sanderson, 2010) could not be directly used for the purpose of the present study for multiple reasons (as discussed in the literature review chapter). Using her construct as the theoretical framework, each of the four dimensions was individually explored over the three research phases for possibility of objectively assessing them. These included: Active Engagement, Joyfulness, Social connection and Internal control.

In the 1st phase while studying the existing state and world-view of play in a special school setting (Johry & Poovaiah, 2014), playfulness was seen analogous to the paradigm of play as disposition. During the analysis, playfulness was seen qualitatively being more prominent in some activities over others. In the 2nd phase, while studying the different play interactions of children with a set of familiar toys, each of the four dimensions in the theoretical construct of playfulness (Sanderson, 2010) was analysed separately within the context of study constraints. Through the grounded theory analysis, it became clear that only active engagement could be measured along with joyfulness for expressive children, which formed the basis for understanding the play preferences for children and guided the development of generative playfulness dimensions. In the 3rd phase, using a quantitative research framework required an objective criterion to compare playfulness elicited by a set of designed toy stimuli to observe the effect of adding selected dimensions. Guided by the previous study, playfulness was measured using active engagement duration and frequency along with instances of joyfulness expression as a supporting parameter. While the playfulness assessment informed the development of the theory which led to development of generative playfulness dimensions and its framework, the assessment was itself developed iteratively over the course of the thesis, based on the insights from each subsequent study. It is expected that playfulness assessment in the discussed studies in subsequent chapters would be seen situated in this temporal context.

3.4 Contributions to research methodology from pilot studies (phase 1)

The 1st phase was exploratory in nature and constituted of two pilot studies with the primary objective of developing a better understanding of suitable research methods and techniques to conduct research with children having special needs, and to refine the methodology in the later phases.

3.4.1 Pilot study 1: Competitive play in children with ID

Objective: The pilot study aimed to look at emergence and growth of competition during play in children with ID as a function of mental age.

Summary: The pilot study used a quantitative interventional research framework, involving analysis of how play behaviour characteristics change for children when compared between the two conditions: with explicit introduction of competition, and without it, while playing with constructive blocks. This difference was studied as a function of the mental age of children with moderate ID (IQ = 35-49) in age-group ranges of 2-4, 4-6, 6-8 and 8-10 years mental age. The analytical framework was modified from Greenberg (1932) experiment, by adding relevant categories.

Contribution to research methodology: Based on this pilot study, it was realized that the number of participants would be too small to adopt quantitative research as the overall methodological framework for the thesis. Moreover, even in the qualitative research paradigm, it would be necessary to relax the limits for selection criteria of studied participants in terms of level of ID and/or mental age to reach an optimum number of participants. Another realization in the process of using the quantitative framework was that student's records were not updated in school which made it difficult to control individual variables and assess the current level of ability and mental age. Thus, a fresh assessment of mental, social and developmental age was conducted for participants in the main studies. This study also allowed the researcher to gain useful experience in conducting a controlled, interventional study within the context of studied facility and familiarize with the logistics of data collection and analysis, which would be helpful in the main studies.

3.4.2 Understanding the 'state' of play in special school setting in India

Objective: The objective of this study was to develop an understanding of the state of play in the context of associated environmental factors and world-view of staff at a special school setting in India.

Summary: The 2nd pilot study used a qualitative research framework based on ethnographic observational technique and semi-structured interviews. A thematic analysis was performed guided by theory based on the three paradigms of play defined by Rubin et al. (1983).

Contribution to research methodology: One of the significant contributions of this study to the overall thesis was validating the need for design intervention research to enhance playful experience as there was a lack of playful activities in the school space and there were contradictory opinions by school staff on what constituted play for these children. Furthermore, it became clear that the available infrastructure at school did not offer enough variety in terms of different play types and experiences, which led to selection of an exploratory, interventional research design for the study in phase 2. The pilot study also gave useful experience in working within a qualitative research framework, beneficial over the course of the thesis. Playfulness was seen close to the paradigm of play as disposition and thus found as a suitable parameter to study. Another interesting insight showed that children with special needs were capable of positive peer relationships. Considering the significance of facilitator in their regular play activities, the inclusion of facilitation in research design could become useful as seen in the main studies.

3.5 Phase II: Exploratory interventional study

The objective of the exploratory, interventional study was **to find the relationship between characteristics of play artefacts and the observed play behaviour and playfulness of children, in the context of a special school**. Owing to a small number (N=12) in the selected group of subjects having mild to moderate ID in the mental age group of 3 to 6 years, a qualitative research framework was used with focus on rich data generation and analysis derived from Glaserian grounded theory framework (Glaser, 1998; Glaser & Strauss, 1967). This section elaborates upon some of the important decisions in the research design of this study explaining the rationale for their selection.

3.5.1 Research design & data collection procedure

Following the overall methodological framework derived from Grounded Theory, data collection was not theory-driven and attempt was made to capture rich data in the form of video recorded sessions of play episodes of subjects when interacting with a set of selected toys. However, Grounded theory framework could not be followed in its true sense which is performed in a naturalistic setting as described by Baszanger (1998: 354). In our context, naturalistic setting did not provide sufficient opportunities to observe play interactions of different variety (as seen in pilot study 1b). This led to an interventional approach for setting the research and data collection, which included selection of toys unavailable in the existing environment as well as selecting a play intervention space, as discussed later in chapter 5. Also the present study involved participatory intervention as opposed to focusing on theorizing, as expected in grounded theory. Besides, the role of facilitator itself was iteratively refined in the course of the study. Another deviation was seen when the researcher could not follow theoretical sampling during data collection due to practical constraints of children's availability at the school for study. Video data for each child was collected before analysis, however while analysing the video data for each child, the study derived largely from the Glaserian version of grounded theory by following an iterative coding, memoing and theorising procedure for each play session in a sequential manner.

<u>Selection of context</u>: The role of environmental factors in affecting play behaviour has been emphasized in many studies. Considering that the socio-cultural and ecological context in a special school setting would be uniquely distinct, it was important to situate the study within the school facility. There were two distinct contexts that emerged at the facility – a naturalistic classroom setting (in the presence of other children and teacher), and an experimental play room setting (isolated room dedicated to play). While using classroom setting would have helped finding insights sensitive to real-life situations and also allowed the child with comfort of a familiar environment, it was felt that a lot of variables could not be controlled that would affect child's play behaviour e.g. interruptions from other children, presence of teacher as sometimes found to be intimidating (Johry & Poovaiah, 2014) and visual and auditory noise. There were also a number of practical constraints like difficulty in recording play behaviour of child, affecting the regular class activities at the school, etc. Thus, an isolated, distraction free space was located within the school and used as context for the study, called the play room. Measures were taken to compensate for familiarity with intervention space and facilitator as discussed in chapter 5.

<u>Role of facilitator</u>: Apart from the interventional nature of the present study, another deviation from data collection based on true grounded theory methodology was seen in relation to the role of facilitator in the study. In absence of literature which could guide the role of facilitator in our context, at the start it was not clearly established what would be the extent of involvement of facilitator during the play activity. Besides, due to the unpredictable nature of children's play, it is difficult to predict the possible play situations where facilitator

would be needed. Initially, it was decided that facilitator would play the role of a silent observer during the play session, except when there is a disruption due to some external interference. However, within the pragmatic paradigm of the overall work, it was decided that the role of facilitator would be flexible and aligned with the primary objective of this study, ensuring that children could interact with variety of toys and sustain engagement when they desired. Based on this framework, a number of actions were performed by facilitator during the study. This included: giving verbal and gestural motivation to child was stuck while playing with a toy, playing as a passive play partner when invited by child to join a play episode, encouraging the child to explore if some toys were unexplored over multiple sessions and even modelling play with these toys at the end, if needed.

Due to this implicitly iterative nature of facilitator's role which got defined over the course of the study, it does not align with the data collection procedure of grounded theory methodology. However, considering that the role of facilitator became clear within the initial phase of data collection and most of the children played under very similar facilitative support, it is expected that it did not have any major implications on the overall study. The role and actions of facilitator themselves emerged as a set of significant insights and later studies may benefit using these insights to have a clearer understanding of facilitator's role at the start.

3.5.2 Data analysis procedure

Within the qualitative framework adopted in the 2nd phase of the thesis, there were several methods which could have been used for analysis. The present study used an analytical framework derived from **Glaserian version of grounded theory**, also referred as classical version (Glaser, 1998; Glaser & Strauss, 1967). As explained by Ng and Hase (2008), the primary difference between the two main grounded theory approaches is that Strauss's approach (A. Strauss & Corbin, 1990) focuses on each word and maps possibilities asking 'what if' questions at each step, while Glaser's approach (Glaser, 1978, 1998, 2009) focuses on the meaning and content allowing the story to emerge from the data. The researcher felt that the Glaserian approach aligned better with the overall objective and working style, which involved no strict coding procedure. As a result, each category developed organically and had a different structure and relationship with its characteristics. The data collected in the form of recorded video was transcribed into individual events which were coded. The overall analysis process involved the following steps - open coding and memoing, generation of concepts, and axial coding for generation of categories (shown in figure 3.1 and discussed in more detail in chapter 5). Generation of concepts and its linking into categories occurred parallely in the later stages of analysis till theoretical saturation was reached. The categories generation step also included affinity mapping with experts and categories were reframed and labelled to identify generalizable design characteristics which had a positive effect on observed playfulness of children.

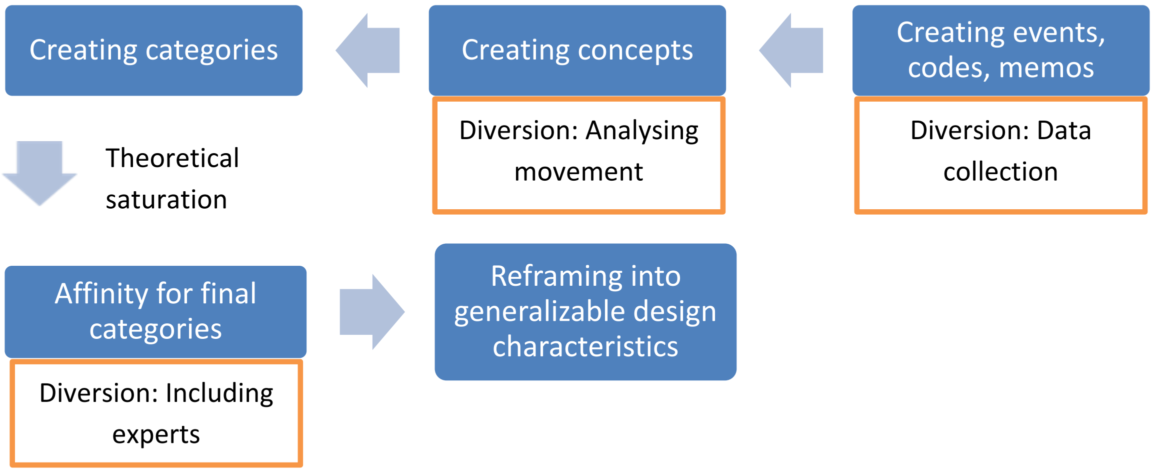


Figure 3.1. Research process map showing steps involved during analysis, based on GT approach

Similar to the data collection procedure, there were some deviations from true Glaserian grounded theory framework during the analysis, allowed within the pragmatism paradigm (refer figure 3.1). At the concept generation stage in the grounded theory analysis, a separate movement analysis was conducted parallely to see if children's movement in space had a pattern and how it varied. Such 'what if' questions are asked in the Strauss and Corbin (1990) version of grounded theory, while Glaserian approach only follows what the data is communicating. However, the nature of data allowed conducting the movement analysis which was useful in reflecting upon children's behaviour in relation to the environment, and contributed in development of the social connection sub-category (discussed in chapter 5). Also, affinity diagramming using expert opinion was conducted to supplement the categorization and theoretical formation process. While Simonsen et al. (2014) have recognized affinity diagramming as essentially rooted in the principle of Grounded Theory, going to the experts for categorization may have led to a deviation. This step ensured that multiple perspectives were covered and categorization step was reliable.

There were several reasons which led to selection of grounded theory based analytical framework as most suitable for analysis in our context. Firstly, there was an absence of guiding theories to study relationships of design characteristics of play artefacts and observed playfulness of children with ID. An inductive approach using empirical observation data seemed most suited to address the research questions, facilitated using the Glaserian grounded theory based framework. Secondly, due to a small number of subjects that fit into selection criteria for the study, there was a possible question on the validity of the knowledge being generated. However, there was a huge amount of rich data in terms of number of play interactions of the children. Constant comparison technique used in comparing slices of data and concepts through the process helped in establishing confidence in the fitness of the emerging categories as they were validated by new data and inconsistencies were resolved. Lastly, using the Glaserian grounded theory analytical framework allowed all the contextual information associated with play behaviour of children to be analysed which not only refined the emergent concepts, but also added width to the generated knowledge. While the focus of the overall work was on design characteristics of artefact and activities, several other theoretical insights related to play related factors have been generated and reported as useful theoretical contributions to research.

3.6 Phase III: Validation interventional study

Following the exploratory phase of the thesis, the 3rd phase was explanatory within the mixed-methods paradigm. The objective of the validation study was **to operationalize and validate selected generative playfulness dimensions (identified in the last exploratory study) as design guiding principles** by implementing them into playful toy design concepts across a novel context of challenge-based play. It was unfeasible to operationalize all of the dimensions, individually and in combination, since it would have led to huge number of their possible combinations. This would become unfeasible to test because of unavoidable practice effects in case of a repeated measure design caused by high number of stimulus exposure conditions. On the other hand, it would have needed multiple dedicated interventions to cover all the dimensions in a between subjects design, which was again unfeasible due to time constraints and scope of the doctoral study. Thus, three of the dimensions, namely: narrative, interactivity and agency were selected based upon the relative possibility of non-intuitive outcomes from their operationalization (discussed in detail while reporting the study in chapter 6).

Despite of reducing the dimensions to be tested, and further deducting the redundant combinations of these dimensions, a total of 5 possible combinations emerged (discussed later in this section), leading to five different stimuli conditions for testing. A between subjects research design testing comparing a pair of stimuli conditions (e.g. condition 1 & 2, condition 1&3, condition 2 & 3, and so on) would need ten set of participants to test all the pairs. However, as mentioned earlier, one of the limitations of working in a special school setting in India has been a small number of children which would qualify the criteria for selection. In the present study, only 14 subjects qualified the required criteria. Thus, a between subject design was found unfeasible and a **within-subject or repeated measures design was selected**. The independent controlled variable was each of the stimuli conditions representing a unique combination of generative playfulness dimensions, while dependent variable was observed playfulness. A number of significant research design decisions along with their rationale are discussed below, taken for conducting the interventional study.

3.6.1 Selection and design of interventional apparatus

Since the objective of the interventional study was to assess the effect of selected generative playfulness dimensions on children's playfulness in a controlled manner, it made sense to frame the design brief on redesigning an existing toy which was found to be non-engaging in the earlier study. This would ensure a fairly known baseline effect, as compared to a new toy design. As a result, it was easier to structure the study allowing the researcher to fix certain variables which were not being studied. Out of the four play types, challenge-based play was found to be least playful in the earlier study. Using the dimensions to enhance the playfulness of challenge-based toy would also bring more impact into the findings. The selection of toy for redesign involved looking at all the challenge-based toys which were used in the exploratory study in the phase 2 earlier. These toys were divided into four quadrants based on two parameters, namely: A. level of cognitive decision making needed in play, and B. level of divergence in process of play (number of ways in which challenge could be completed) as shown in figure 3.2.

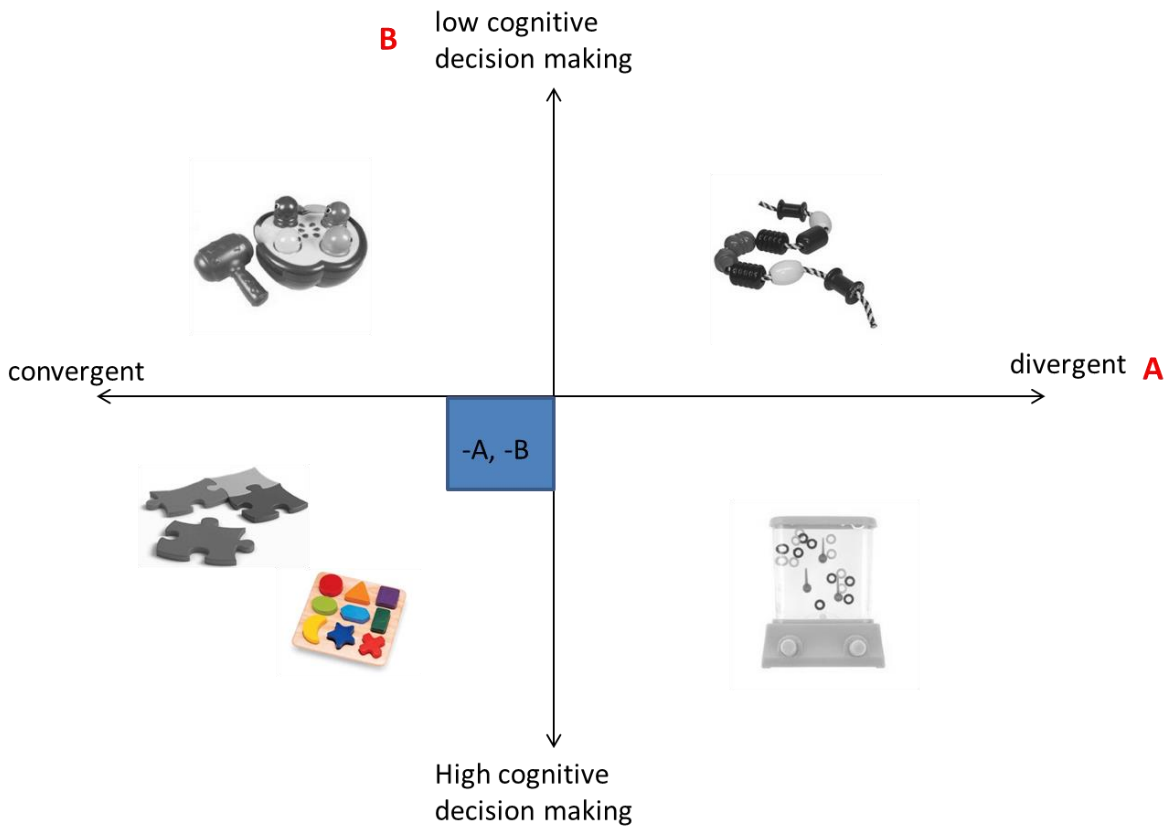


Figure 3.2. Challenge-based toys placed across the two axis of level of cognitive decision making and level of divergence in play.

Example of toy from 1st quadrant (+A, +B) was beads which could be put on thread with any order and manner, and did not require decision making in terms of comparison, identification, etc. No toy from earlier exploratory study fit in the 2nd quadrant (-A,+B) comprising of low level of cognitive decision making but convergent play process . However, for the sake of representation, hammer and popping pegs toys would be an example that fit this quadrant. Most of the challenge based toys fell in the 3rd quadrant (-A, -B) including the shape-matching board, size sorting cups and jigsaw puzzle. Example of toy from the last quadrant (+A, -B) was the ring game pad which was played by controlling the movement of the rings suspended in a small water filled container and guiding them on pegs using buttons on a gamepad. It was noticed that the 3rd quadrant with high level of cognitive decision making and convergent play process was found to be the least playful out of all. Interestingly, most of the developmental aids used for children with special needs fall in this category of challenge-based toys. Thus shape-sorting board/bucket toy (refer figure 3.3) was selected from this quadrant since it had a single learning concept of shape cognition and thus there shouldn't be significant interference due to learning element, which was outside the scope of present study.

Figure 3.3. Shape sorting board/bucket selected for redesign in the design brief

<u>Identifying possible stimuli conditions for testing</u>: The first step in designing toy stimuli for each condition of the interventional study involved determining all possible combinations of the three selected generative playfulness dimensions: narrative, interactivity and agency/control of player. It was consciously decided to assess the effect of removal of one of the dimension from the existing toy, and not just their addition in different combinations, to strengthen the findings about the effect on playfulness. Each of these dimensions was implemented in their most common and practically feasible medium i.e. narrative through visual, interactivity and agency (removal) through auditory medium. It is worth noting that while narrative couldn't have been implemented without the use of visuals, interactivity would have needed sophisticated screens for animation and thus difficult to implement as well as expensive. The possible combinations of the three dimensions (narrative, interactivity and agency/control of player) led to following possible stimulus design conditions.

a) Agency – This stimulus condition represents the existing shape matching bucket toy. There is no interactivity, no narrative and no signal thus child is free to determine which shape block to put or which shape hole to put into.

b) Interactivity – This stimulus condition signifies that interactive auditory feedback is present which includes the intermediate action-fidelity feedback and the success feedback at the end of every shape insertion task. Also, agency is removed by giving a signal trigger (auditory) to determine and fix the sequence in which shape needs to be inserted.

c) Narrative – This stimulus condition signifies that narrative is presented through visuals. Also, agency is removed by giving a signal trigger (auditory) to determine and fix the sequence in which shape needs to be inserted.

d) Agency + Narrative – This stimulus condition signifies that narrative is presented through visuals, while child also has the agency or control to decide the sequence of inserting shapes.

e) Agency + Interactivity – This stimulus condition signifies that interactive auditory feedback (action fidelity + success feedback) is present, while child also has the agency or control to decide the sequence of inserting shapes.

f) Narrative + Interactivity – This stimulus condition signifies narrative is presented through visuals as well as embedded in the interactive auditory feedback, thus both the dimensions operate in combination. However, agency is removed by giving a signal trigger (auditory) to determine and fix the sequence in which shape needs to be inserted.

g) Narrative + Interactivity + Agency – This stimulus condition signifies that all the three dimensions are present. i.e. narrative is presented through visuals as well as embedded in the interactive auditory feedback, thus operating in combination. Also, child has the agency or control to decide the sequence of inserting shapes.

Out of the above-mentioned conditions, b) 'interactivity' was not tested as it was not possible to remove agency in the absence of narrative. The signal triggers would have been difficult to comprehend until the child knew the names of each shape, which would have added an extra variable. Also, condition b) 'interactivity' primarily addressed the effect of removing agency from condition e) 'agency + interactivity', however this effect of removal of agency was also checked between stimuli conditions f) 'narrative + interactivity' and condition g) 'agency + narrative + interactivity'. To reduce the number of possible conditions in order to check serialization effect, this condition was treated as redundant. Similarly, condition c) 'narrative' was seen as redundant as the effect of removal of agency was tested in later conditions. Thus, finally five stimuli conditions are selected to be tested in field interventions – a), d), e), f) and g) as mentioned as follows.

Condition 1: Agency

Condition 2: Agency + Interactivity

Condition 3: Agency + Narrative

Condition 4: Agency + Narrative + Interactivity

Condition 5: Narrative + Interactivity

The design of stimuli corresponding to each of these conditions is described later in chapter 6.

3.6.2 Data collection procedure

Data was collected in the form of recorded videos of play interactions of each child for the five stimuli conditions by **adapting preference assessment technique** to measure engagement. This was achieved by giving controlled choices to subjects at regular intervals, with tested stimuli as one of the options, along with two other toys which subject usually liked to play with. Thus, (re)engagement with the stimuli could be measured based on whether subject chose to continue playing with tested stimuli. The validation study was designed in a quantitative framework so it was important to ensure that all the uncontrolled independent variables were checked and errors minimized to observe the true effect of changing stimuli conditions on child's engagement. One of the most commonly occurring errors in a repeated measure research design is the serialization effect which could lead to learning in later conditions (called as practice effect) or boredom and decrease in interest in later conditions (called as habituation effect). This error is generally checked with the use of full or partial counter-balancing. In the context of our study, five conditions were to be presented serially to fourteen children. It was not possible to present a condition in all five sequential positions, since the conditions were not equal in terms of number of added dimensions, thus presenting a condition with more dimensions first would increase the habituation effect. e.g. In pilot study, it was found that having played condition 4, child was not interested in condition 1 and asked for similar features as condition 4. This presented with a unique challenge, where the conditions needed to be randomized but not completely.

Blocking technique was used to create sequences such that weights of each condition were accounted while randomizing them, leading to the following three blocks:

Block 1: Condition 1 (Base toy - only agency)

Block 2: Condition 2 and 3 (One dimension added to base toy)

Block 3: Condition 4 and 5 (Two dimensions added to base toy)

These blocks were presented in a serial order starting from block 1 to 3, however within each block, conditions were randomized. This lead to four possible sequences: **condition 1-2-3-4-5, condition 1-3-2-4-5, condition 1-2-3-5-4 and condition 1-3-2-5-4**. Children were randomly assigned to these sequences ensuring that these sequences were equally utilized.

3.6.3 Data analysis procedure

Video data from individual play session for each of the stimuli condition was coded by dividing the play interactions with the designed stimuli into events, using *ATLAS.ti* software . These events could be categorized primarily into: selection events and in-play events. Selection events included instances of making choices at regular intervals about selection of which toy to play with, while in-play events included attempts by the subject for insertion of a shape while using the toy stimuli and the outcome. The associated codes were then used to quantify playfulness and other relevant variables which included engagement duration and frequency, frequency of joyfulness expression, total effort time, number of triggers needed, etc. (for definition, refer chapter 6). This quantified data was then analysed using a set of statistical methods. However, a supplementary qualitative analysis was also performed to explore the emerging patterns in behaviour of the subjects. In that sense, **a concurrent, mixed-methods analytical framework** was used with a higher emphasis on quantitative analysis, discussed as follows.

Quantitative analysis: Quantitative analysis was performed initially using pooled data of all subjects in the stimuli conditions for the dependent variables including engagement, joyfulness and effort time. Using *SPSS statistics*, descriptive statistical analysis was performed to develop an initial understanding of the collected data by measuring the means, medians, variances, etc. for the pooled data. This also included checking for normality assumption using Skewness and Kurtosis values, as well as Mauchly's test for assumption of sphericity of data. Thus, parametric statistical tests could be used for testing significant differences between conditions. A one-way ANOVA ($p<0.05$) was conducted to compare the effect of operationalized generative playfulness dimensions on engagement duration & frequency, joyfulness and effort time for the pooled data of all subjects in the five stimuli conditions. Greenhouse-Geisser correction was performed to account for violation of sphericity assumption, when needed. Post-hoc comparisons were conducted using paired t-tests ($p<0.05$) between individual stimuli conditions if ANOVA showed significant difference. Considering the sample size to be small and the nature of data including frequencies, non-parametric techniques could be used to substantiate the results and reduce possibility of errors as suggested by Tomkins (2006). In our study, non-parametric substitutes were used to verify the results from parametric tests, which included Friedman test followed by Wilcoxon signed-rank tests for post-hoc analysis using the same level of significance i.e. $p<0.05$.

Following the analysis of pooled data, analysis was performed at the level of individual subjects to look at the distribution of dependent variables across conditions. This helped in identifying patterns between subjects which might have been missed in the pooled data.

Qualitative analysis: Using a concurrent mixed-methods framework in the data analysis of the validation study, qualitative analysis of the recorded data could help in identifying themes and behavioural patterns between subjects to explain the observed statistical results and if possible, identify the causality. The qualitative analysis was also based on the comprehensive coding and memoing of the video data, performed in the ATLAS.ti software. Demographical data of the subjects collected at the start of the study using school records was also included, which could be used to explain exceptions in the individual distribution of dependent variables as well as observe patterns in children who showed similar patterns in distribution of the observed dependent variables.

3.7 Ethical considerations

A number of ethical considerations were taken into account while conducting the set of studies comprising the thesis. Parents and special school staff was informed about the objective and process involved for each of the studies and a written consent was taken from school principal for voluntary participation. A non-disclosure agreement was given for each of the studies ensuring that data collected would be used only for the purpose of research and would not be disseminated for any other purpose. Also, the personal details of all involved parties would be omitted in the documentation and reporting of the studies to maintain anonymity. The study protocols were designed to ensure children's physical and mental safety, and in most part, free play situations were studied where children had control over the situation and ability to participate voluntarily. Also, trained experts and school staff was often involved during the data collection process.

3.8 Researcher’s bias

Using an exploratory mixed-methods design methodology, a significant part of the thesis is based on qualitative research framework using an interpretative approach. Researcher becomes the primary instrument for data collection and analysis in qualitative research (Creswell, 2003; Denzin & Lincoln, 2008). Besides, most of the participants could not communicate and thus observational techniques became the primary source of data collection, leading to interpretation of occurring events even when quantitative framework was used in the validation study. It is important to identify researcher’s biases, values and personal interest with respect to the research objectives (Creswell, 2003). While the use of grounded theory analytical framework and constant comparison technique in the main exploratory study ensured that assumptions did not get transferred into findings (Glaser, 1978), it is still possible that researcher’s biases may have had an effect on the overall process. Hence, an attempt is made to explicitly state the background of the researcher and his orientation as follows.

The researcher came with a background of design practice, having been involved in a master’s level academic project to develop an aid for enhancing body-image of children with special needs (Johry & Patil, 2011). The orientation of the researcher over the course of this work was to focus on generating knowledge that not only contributes to the design research theory but also be useful for practitioners, and is easy to apply. Based on his previous experience, there was an implicit belief that design interventions could have a significant positive impact on enhancing the quality of life of children with special needs. Furthermore, there was an assumption that in general, special school facilities in India have limited resources and lack of playful opportunities for children. The researcher also believed that children with special needs have certain limitations in their ability to exhibit play of different types and complexity. Some of these assumptions were reconfirmed while others got rejected, based on data from the studies, as discussed in the following chapters.

4. Pilot studies

4.1 Introduction

This chapter reports the two pilot studies conducted in the 1st phase of the thesis with the primary objective of developing an understanding of how play manifests and what are the ecological constraints in a special school setting in India. The identified insights would play a significant role in informing the research design methodological framework of the overall thesis and selection of research methods for the main studies. Hence, the focus of this chapter is on the discussion of findings from the pilot studies that would contribute in setting up the main studies as well as align with the primary objective of the thesis.

Both the pilot studies were approached as stand-alone studies, each exploring the domain of play in the special school facility from either quantitative or qualitative research framework. The research design, data collection and analysis for both the studies has been summarized as follows, and detailed description of the research design of pilot studies could be found in the published articles (Johry & Poovaiah, 2014, 2015) attached as annexure A & annexure B.

4.2 Pilot study 1a: Competitive Play in MR children

The purpose of this study was to identify the presence and degree of competitive play in moderate MR children as a function of their mental age. It was also an attempt to explore the issues and factors associated with studying play in controlled experimental settings with MR children.

4.2.1 Summary of research design

Hypothesis**:** Following hypotheses were framed based on the observation of competitive play in typical children in a similar setting:

(a) Moderate MR children will show emergence of competitive play after mental age of four years.

(b) There is a positive correlation between the mental age and degree of competitive play exhibited by moderate MR children.

Procedure: Using stratified sampling, four pairs of moderate MR children matched on gender (opposite), mental age and level of mental retardation (and hence physical age) were selected as a function of increasing mental age each, in the age group of 2-4,4-6, 6-8 and 8-10 years. They were subjected to two constructive (block-based) free play sessions, while inducing competition in the 2nd session using controlled verbal elicitation by facilitator. Questions of comparison were also asked at the end of each session and the pattern of behaviour was video-taped in both the sessions. Play-space, time, toy and facilitator were kept constant throughout the experiment. Furthermore, level of friendship was checked by pairing children from different classes who didn't interact in regular days. Level of exposure to constructive play was balanced through a number of pre-experimental sessions with a separate set of block toys.

Experimental setup: (Top view)

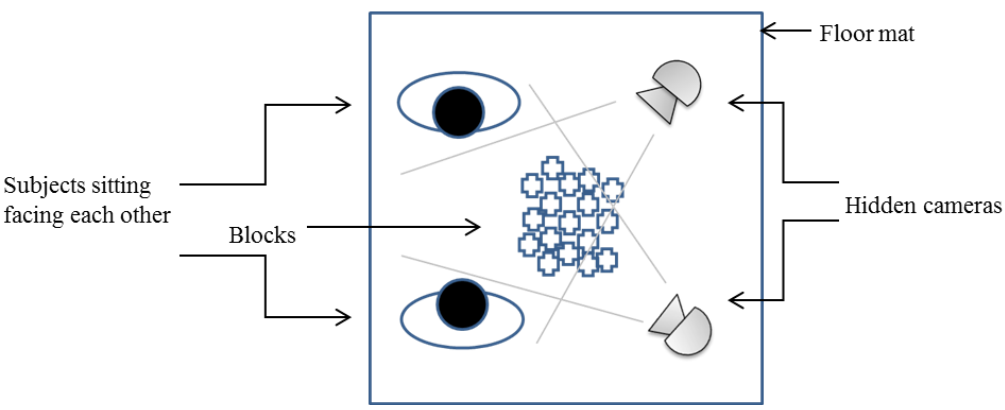


Figure 4.1 Top view of the experimental setup used in the interventional study on competitive play

Analysis: The activities, remarks and the gestures recorded in video data were transcribed into series of events on a time line where each event is an action or a set of repetitive actions that can be grouped together to represent a verbal or gestural interaction with the material, competitor or other environmental factors. These codes were then analysed along with facilitator's notes to draw insights. The aim was to determine presence and to some extent relative degree of competition.

The degree of competition experienced by the subjects was indicated through three parameters - interaction with the competitor, interaction with the material and interest in play activity. The parameters were divided into sub-categories, such that each individual event could fit in one of the sub-category, which could then be compared between the two stages of experiment to support the qualitative insights, based on frequency and duration of occurrence. The operational definition of the sub-categories is given in table 4.1.

Parameter	**Sub-category**	**Operational definition**
Interaction with the competitor	Looked at competitor	Looks or gives a glance to competitor or his construction, but doesn't smile or speak anything or imitate.
	Smiled at competitor	Smiles looking at competitor or his construction, but doesn't speak anything or imitate.
	Imitated competitor	Copies one or more of competitor's action while building.
	Verbal communication	All the verbal interaction directed clearly towards competitor excluding the subsequent statements made in conversation during cooperation.
	Cooperated with competitor	Helps competitor by guiding him on how to build or helping him in imitating.
Interaction with the material	Blocks used as needed	Builds using blocks as needed, reaching out for one or two at a time, either taking those nearest at hand or which seem best fitted to the construction.
	Grabbed	Picks up a block rising from their position deliberately from near the competitor, or from the other side, often disregarding the competitor's activity or cautiously trying to disturb the competitor.
	Given	Offers a block to the competitor to help him or guide him in building.
	Played without building	Holds, fiddles and plays, exploring the block itself but not indulging in the building activity.
Interest in play activity	Distracted	Gets distracted from building without any external influence (self-initiated) and excluding instances of imitation and cooperation since they are a part of building.
	Physical signs	Calls facilitator or competitor to show his construction, shows interest at start, and/or shows hesitation at end to submit and continues building
	Judgement	Selects his or competitor's construction in each question session

*Table 4.1.*Operational definitions of sub-categories of parameters for classifying events.

4.2.2 Results and Discussion

Based on the results, hypothesis 1 was found to be true as competitive play emerged after mental age of 4 years in moderate MR children. Hypothesis 2 was nullified as a positive correlation between the mental age and degree of competitive play exhibited by moderate MR children could not be established. Competitive play was most convincingly seen in age group 4-6 years and seemed to decrease as the mental age increased. The results have been summarized below in table 4.2.

Age group	Relative degree of competition	Signifiers
2-4 years	Absent	Cooperation shown, relaxed state in 2nd session
4-6 years	Clearly Present	Competitive verbal comments, grabbing the blocks, increased interest in building in 2nd session
6-8 years	Might be present	Disliking being imitated, using side-glance to imitate, reluctance to end and submit in 2nd session
8-10 years	Absent	Negligible interaction, anxiety in 2nd session, inability to build of one player, possible error

Table 4.2. Summarized results showing relative degree of competition across age-groups

Inter-rater reliability was assessed for 50% of randomly selected video data by an independent play researcher and 95% of agreement in code assignment was found. However, these findings have been presented as suggestive in nature need to be validated by increasing the number of participants.

While the rejection of hypothesis 2 as seen in the form of possible decrease in competitive play with increasing age, is contradictory to typical children, it could hold true for children with special needs by looking at the sociological perspective of competition. Studies have reported that it is the social and cultural environment in which an individual is brought up that determines the character of their competitive urge (Booth & Nolen, 2012; Gneezy, Leonard, & List, 2009). Vaughn and Diserens (1938) had summed this up well by stating, “The particular form, intensity, and objects of competition are largely dependent on the nature of the social environment. They vary considerably among individuals and groups, and seem to be dependent on the degree of socialization which the individual and the group have achieved.” Children with intellectual disability are subjected to a very different social environment and exposure as they often fail to compete with their typical peers. This vulnerability in social and peer acceptance, and failures in peer acceptance substantiate the negative self-concept among special children (Pijl & Frostad, 2010). This could have led the children to avoid a competitive play situation as their age increased. Thus, in situations of social associative play, competitive strategies should be replaced with cooperative strategies during play activities and pedagogy interventions. Present study reported emergence of anxiety due to competition in two children. Using cooperative learning techniques has been linked with reduction in tension and conflict among typical children (Hertz-Lazarowitz & Sharan, 1984), which becomes more significant considering the existing low self-esteem in these children (Pijl & Frostad, 2010).

The main objective of the pilot study was to develop insights which could guide the methodology for the main studies in following phases. A number of useful insights emerged which helped in decision-making for research design, as discussed earlier in Chapter 3. In summary, quantitative research methodological framework was found unsuitable due to small number of participants. Within qualitative research framework, a need to expand the selection criterion limit of studied participants in terms of level of ID and/or mental age was felt, to reach an optimum number. Other factors were identified including socio-cultural factors like family size, family income, etc., which will be accounted in analysis but were beyond the scope of present work.

4.3 Pilot study 1b: Understanding the state of 'play' in a special school setting in India

The purpose of this study was to explore the existing state of play and the associated factors in a special school setting, including the frequency and typology of play, context of play (social, psychological, or environmental correlates of the event) & perception and belief-pattern of play among school staff.

4.3.1 Summary of research design

Procedure: A qualitative framework was used to study the manifestation of play for children in naturalistic setting of special school, divided into the following two stages. There was no initial hypothesis for testing; instead a thematic analysis was performed to organize the insights from data, framed using existing theory of Rubin et al. (1983).

Stage 1: 12 children with mild to moderate mental retardation and variable etiological conditions, belonging to the same class titled as 'pre-primary' class with mental age between 2.9 to 6.3 years (mean mental age = 4.3 years) were observed during structured and unstructured play situations in different spaces in school using ethnography techniques. The role was of a silent observer with minimal interference in natural settings. Indoor free play sessions was video-recorded to remove observer's effect

Stage 2: Semi-structured interviews were held with school staff using a combination of generic as well as convergent questions on perception of play and the role of environment in supporting play. Information was also collected in the form of time-table of different classes, teaching aids available, etc.

<u>Analysis</u>: Data driven thematic analysis was performed using open coding of diary notes and transcriptions of recorded observation session and audio interview data. Twelve major themes that emerged from the data included play possibility, joy, engagement, intrinsic motivation, social interaction, organization, tangible and intangible artefacts, teaching/therapy strategy, behavioural issues, usability issues, observer's effect and suggestion/discussion.

Patterns were identified within and across the categories and presented along the three paradigms of play given by Rubin et al. (1983), namely: Play as disposition, play as observable behaviour and play as context.

4.3.2 Results and discussion

The results of this pilot study could be discussed from two perspectives – their contribution in guiding the research methodology in main studies (as discussed earlier in chapter 3), and understanding the present state of play infrastructure and world-view of special school staff on play. Following section focuses on the latter perspective on understanding the existing state of play.

Children's play was found to be present in different extents in structured as well as free play contexts across various spaces in the special school. However, **unstructured, free play was much lesser and limited** to the school park where children visited once a week. A common belief among the school staff was that **play of special children needs to be supervised in most situations for safety**. This belief was justified to some extent considering that available play space and artefacts did not acknowledge etiological differences and could be unsafe for children without supervision. The lack of specialized and accessible equipment in special or inclusive schools in India could be attributed to multiple factors like lack of funding, lack of availability in markets, cost involved in maintenance, etc. As Singal (2006) notes, even government efforts in distributing aids and appliances for assistance suffer due to lack of facilities available for their maintenance and regular upkeep. Interestingly, the market also is seen to be limited in range of products and services available for the special population, as discussed in the introduction chapter.

The present study showed that play of children with special needs manifests in **a unique situation where facilitator is present at almost all the time**, unlike typical children who get a lot of opportunities to play without adult supervision in schools. The tendency of supervising play of children with special needs has also been seen in a number of other studies. Facilitators are seen to decide their play interactions and stay physically closer more often than typical children (Guralnick, Connor, Neville, & Hammond, 2006; Luttropp & Granlund, 2010). The introduction of an extra agent in play of children with special needs calls for emphasis on the strategies to be employed by facilitator where he could become a play partner. It has to be ensured that what Corsaro (1997) calls to be an interactive shared space of play, is not intruded by adults. Hanline and Fox (1993) in their study with disabled children state that, “A fundamental role of the adult is to structure the environment to allow children to learn through active exploration and interaction with adults, other children and materials.” The **role of preschool teachers at special schools thus becomes pivotal in maintaining a balance between assistance and supportive guidance** while allowing the child with opportunities to explore and modulate his stimulation during play by following his lead more than participating in the play itself. Thus, acknowledging the significant role of facilitator in play, it should be a point of focus in teacher training.

Based on the semi-structured interviews conducted with special school staff, there was a frequent reference to ‘playway method’ to teach most of the subjects which included action songs, flash-cards, memory games, etc. Playway method is the Indian version of play-based education which derives inspiration from Western play theorists like Froebel, Montessori and Dewey. However, in practice, **play for its own sake was rarely seen and mentioned but rather play artefacts were used as learning aids** in most activities. A **number of activities which were purely challenge based e.g. jigsaw, shape sorting etc., were given as play based sessions** often considering their developmental value, even though the element of playfulness and engagement seemed questionable from observed responses of children. This reduced emphasis on unstructured play can be seen equally in the context of developing and developed nations. In a recent study on changing perception of kindergarten education in US, Bassok et al. (2016) report that child-initiated/ child selected play has drastically reduced at kindergarten and preschool level, replaced by teacher-directed and academic oriented activities. The focus on structured, formal education at preschool level becomes even more visible in regular Indian schools owing to several social factors like over-crowding, competitiveness, parent's lack of confidence in play based methods, etc. due to which the informal, play based structure fails to sustain in developing countries like India (Prochner, 2002). Moreover, in the context of Indian special schools, the stakeholders have emphasized on the need of developing independence and interpersonal skills (Elton-Chalcraft et al., 2016), thus stress on developmental activities could be much more as children 'lag behind' the typical children. The non-engagement however is a serious concern which needs to be addressed even if the focus on formal education is maintained. **While, play and toys are an essential tool for learning and development for children with special needs and not treated as a goal in itself, the present study recommends promoting more unstructured, child-initiated, free play opportunities in the present diagnostic society.** Ansari and Purtell (2017) found that while typical children who were more involved in child-selected activities in kindergarten showed fewer gains in academic achievement, but they showed greater improvements in cognitive flexibility, which taps into children's ability to flexibly use rules to govern their behaviour.

Observed play behaviour, in study 1, was classified based on the level of social engagement using the classic classification by Parten (1933), and **children generally showed inclination of social play manifesting as associative play and some instances of parallel play**. Some of the children got involved in playful interactions like pranking, teasing during the play activity. **A number of pairs were seen who appeared to show association** based on their tendency to play together, however it was not possible to comment upon friendships due to short duration of the study, though there was evidence for potential friendships. Also, a pattern of self-organization seemed to emerge repeatedly during unstructured activities involving children assembling and participating as a group, moving together. Small conflicts that occurred in unstructured play situations were soon resolved among the children themselves. This might not be true when it comes to unfamiliar peers and setting as reported in another study which found peer relationship problems in unstructured play settings for preschool children with mild developmental delay (Guralnick, Hammond, Connor, & Neville, 2006). They also reported that these children often fail to resolve conflicts in appropriate ways. Similarly, Luttropp and Granlund (2010) found that children with intellectual disability (ID) had shortcomings in taking initiatives and interacting with unfamiliar peers. Recently, Parry (2015) conducted a short term study and found that only 2 out of 6 children with special needs played with recurrent playmates, showing established relationship but he conceded that other children showing paucity of recurrent playmates could be due to one week short duration of the study. On the other hand, typical children have shown expanding network of social contacts over time (Kenneth H. Rubin, Bowker, McDonald, & Menzer, 2013). Based on our finding, it seems that **preschool children with mild to moderate intellectual disability (ID) are also capable of positive peer relationships and social play in unstructured situations when given a sufficient time for bonding**. This gives a positive perspective on social competence of these children when the discourse is often focussed on their lacking abilities and behavioural issues. Social play definitely seems to be an area which should be explored in future considering that children find these episodes as playful and are capable of exhibiting it. Besides, a stable social competence becomes an important indicator of future social adjustments.

Interestingly, we found that the **child with most developed communication skills in class seemed to have an authoritative position** and thus influenced the organization of children in play space, acting as the coordinator on occasions. This reflects the significance of communicative ability in the context of social play. Facilitating social play for these children needs to explore ways of augmenting the communication skills through other mediums, which would enhance the engagement in the group activity. As a contrast, structured classroom activities which were generally solitary in nature and had constrained movement, were not seen to be as engaging.

The same study also looked at a classification of play behaviour which was based on the cognitive development stages, and **sensorimotor practice play emerged as the most common form of play** in school. This type of play could also be classified as activity/locomotor play which encompass chasing and climbing as well as rough-and-tumble styles of play (Pellegrini & Smith, 1998). Surprisingly, more advanced sub-types of play like **symbolic play was almost absent**, even though it has been termed to be a significant play type in the preschool children. Thus, the **existing infrastructure did not seem to provide opportunities for all the developmentally appropriate forms of play**. Considering the lack of observational studies in the context of Indian special schools, this becomes an important finding for further research and planning purpose. One possible area of future exploration could be to design a set of recommendations for ensuring that children get exposure to variety of age-appropriate toys and play activity in the special school. Also, recommendations could aim at giving suggestions for accommodating the etiological differences in the mix of special population ensuring that design could become universal. This could be useful especially in a decentralized system like India where expertise is not easily available in a lot of places. Although, these observations are based on the study of a single special school, the situation might be similar or even worse in a lot of other similar schools. Thus, considering that our facility was moderately funded and located in a metro city, the infrastructure and trained staff can be safely assumed to be better than other schools especially in smaller cities and rural areas.

This study also played a significant role in the context of overall thesis by **validating the need for design intervention research** as there was a lack of playful activities in the school space and there were contradictory opinions by school staff on what constituted play for these children. Several insights contributed to the research design for following phases, as already discussed in chapter 3.

5. Development of generative playfulness dimensions

5.1 Introduction

This chapter reports an exploratory, interventional study to understand the relationship between design characteristics of play artefacts and the observed playfulness of children with ID, in the context of a special school. The intervention is informed by the results from the 2nd pilot study which reported that the available infrastructure at special school did not allow exposure to different variety of play possibilities. The present study aimed at addressing this gap by bringing in wide variety of age-appropriate toys within the special school context and observing the play interactions. A rigorous qualitative analytical framework led to theoretical knowledge which was reframed to identify the role of design characteristics of the studied toys and games, adopting the perspective of a design activist. Hence, the objective of the present study is two-fold: firstly, the study attempts to answer if and how design characteristics of play artefacts/activities affect observed playfulness of the children. Secondly, it further tries to define these characteristics in a generalizable manner so that they could be used as design guiding principles in different contexts. The different aspects of the exploratory study are discussed in detail as follows, including the research design, data collection and data analysis procedure which led to the identification of generalizable design characteristics. This is followed by a general discussion on each of these characteristics and how it adds to new knowledge in the existing theory on play of children with ID. A model to use the identified characteristics for idea generation in design process is also proposed at the end.

5.2 Research design

In accordance with the objective of this study, and owing to a small number of subjects that fit into the selection criteria, an overall qualitative methodological framework was adopted, derived largely from the Glaserian grounded theory framework (Glaser, 1998; Glaser & Strauss, 1967). This allowed the researcher to capture the richness of data by using a rigorous approach to analysis which would lead to reliable and valid insights, within the limitation of sample size. The rationale of selection of the overall methodology and individual data collection and analysis techniques has been discussed in the research methodology chapter, answering the 'why' aspect of research design. This section elaborates on 'what' aspect of research design with details of participants and the actual procedure used, discussed as follows.

5.2.1 Participants and facility

Participants (N=12) included 4 girls and 8 boys with mild to moderate intellectual disability (ID) having mental age between 3 to 6 years at the time of the initiation of study. The study was restricted to a single facility since variation in the contextual factors due to different environmental and pedagogical settings of multiple schools might become confounding variables while reporting findings. This, in turn, led to a small number (N=12) of subjects within the school that qualified the criteria for participating in the study. The subjects belonged to different classrooms at the special school facility in Mumbai city, India and all were Indian in ethnicity living in local neighbourhood.

Due to irregularity of school records as seen in the pilot studies, fresh assessments of children's Intelligence Quotient (IQ), Social Quotient (SQ) and Developmental Quotient (DQ) were conducted with the help of a practicing psychologist using the Goddard Seguin form board test, Vineland Social Maturity Scale and Developmental Screening Test, respectively. Table 5.1 represents the demographic data of the subjects including the Chronological Age (CA), Social Age (SA) and Developmental Age (DA) in years and months.

Name[2]	Sex	CA	MA	IQ	SA	SQ	DA	DQ	Etiology
Tan	F	7y 2m	3y 6m	49	4y 6m	63	4y 1m	57	
Par	M	7y 8m	3y 6m	46	3y 5m	45	2y 6m	33	Down S.
Sid	F	8y 11m	3y 6m	39	4y 3m	48	3y 7m	40	
Swa	M	8y 2m	4y 8m	57	4y 2 m	51	4y 1m	50	
Mok	M	10y 2m	5y	49	5y 2m	51	4y 6m	44	Down S.
Sum	M	8y 6m	4y	47	4y 7m	54	3y 4m	39	Down S.
Kri	M	10y 3m	4y 6m	44	6y	59	5y	49	
Aai	F	7y	3y 8m	52	2y	29	1y 3m	18	Down S.
Poo	M	8y 2m	3y 6m	43	4y	49	3y 9m	46	
Rev	F	8y 11m	4y	45	2y 7m	29	4y 1m	46	Down S.
Kus	M	9y 11m	5y 5m	55	4y	40	3y 7m	36	
Adi	M	7y 7m	3y 3m	46	3y 8m	48	2y 2m	29	

*Table 5.1.*Demographic data of the subjects obtained from school records and assessments.

5.2.2 Selection of toys

To address the lack of variety in existing toys at the studied facility, the present study introduced a set of age-appropriate toys which were commonly available in the market. A primary list composed of around 22 toys was created to maximise variety in play affordances offered using a set of criteria (refer table 5.2). This list was prepared in consultation with a practising psychologist and occupational therapist.

Variable	Range of selection
i. Toy characteristics	
Age-appropriateness	3 to 6 years
Representation of all play types	Sensory toys, constructive toys, fantasy toys, challenge based toys
ii. Play interaction characteristics	
Social interaction involved	Solitary play
Physical activity involved	No gross motor activity

Table 5.2. Variables controlled in the selection of primary list of toys for the study

To ascertain the variety in play affordances of the toy, a classification was used dividing toys equally into four categories – sensory, construction, fantasy and challenge-based toys, loosely based on Piaget's four stages of development (Kudrowitz & Wallace, 2010). This

[2] Name and personal details of the subjects has been purposely omitted and represented by the first three letter of the name in this study.

classification was adopted because it has been specifically designed from toy design perspective, applying to any toy or play, doesn’t depend on age and categories are distinguishable from each other. It is important to note that classification of toys based on ‘play affordance offered’ implied that a specific toy has been designed or advertised to afford one of the four play types. It is possible that a toy may belong to two or more of these categories offering multiple affordances, or at times unexpected affordance. As rightly stated by Sutton-Smith (1986), children often interact beyond the apparent character of the toy. However, distribution on the basis of play type allowed variety at least in terms of perceived play affordance by toy designer and manufacturer.

Langdon, Lewis, and Clarkson (2007) point out that prior experience with an artefact has a significant contribution in the formation of mental models related to its usage thus affecting the interaction with the artefact. The role of previous experience or familiarity with a particular toy becomes prominent in the way a child would approach and play. It was felt important to identify the level of familiarity children had with the set of toys. Moreover, other play related information of children like how children involved in play daily, their play partners and any particular likes and dislikes would be useful while analysing the data. Since the subjects could not be interviewed directly due to lack of communication ability, a structured interview was held with the parents of each child. Some of the questions included: “What type of toys or games does the child likes to play? What are his/her favourite play activities?”, “How often does your child play in a day”, etc. Parents were also provided with a set of coloured photographs of the twenty two toys in the primary list, to assist them in recognizing it when commenting on the familiarity of each toy to the child. Figure 5.1 shows three of the toy photographs presented to the parents on a sheet. Parent’s response on child’s familiarity with each toy was used for selection of toys, while other information on child’s play was referred at the time of analysis.

Figure 5.1. Photographs from the list of selected toys presented to parents during interview

5.2.3 Selection of context

The present study chose an interventional space within the special school facility to control additional, unaccounted variables which would be present in the naturalistic classroom setting. Besides, it was much more feasible to collect data in an interventional setting. Called as ‘play room’, the interventional space was a distraction-free, well-lit room. There were two door openings in the room and all the furniture was removed except a wardrobe with glass panes (refer figure 5.2 for plan view). The room not completely unfamiliar as it was located next to speech therapy room and children regularly passed through the space however it was isolated from the regular classrooms to reduce the visual and auditory noise. Despite the existing familiarity, two rapport-building play sessions of 30 minutes duration were conducted with each child in the play room and in the presence of the researcher as facilitator. These sessions involved facilitator engaging in gross motor play activities like catching balls, playing football and jumping. Apart from developing familiarity and comfort among the subjects with respect to the play space and facilitator, these sessions also gave the facilitator an opportunity to identify any possible errors that might occur during data collection pertaining to child’s behaviour.

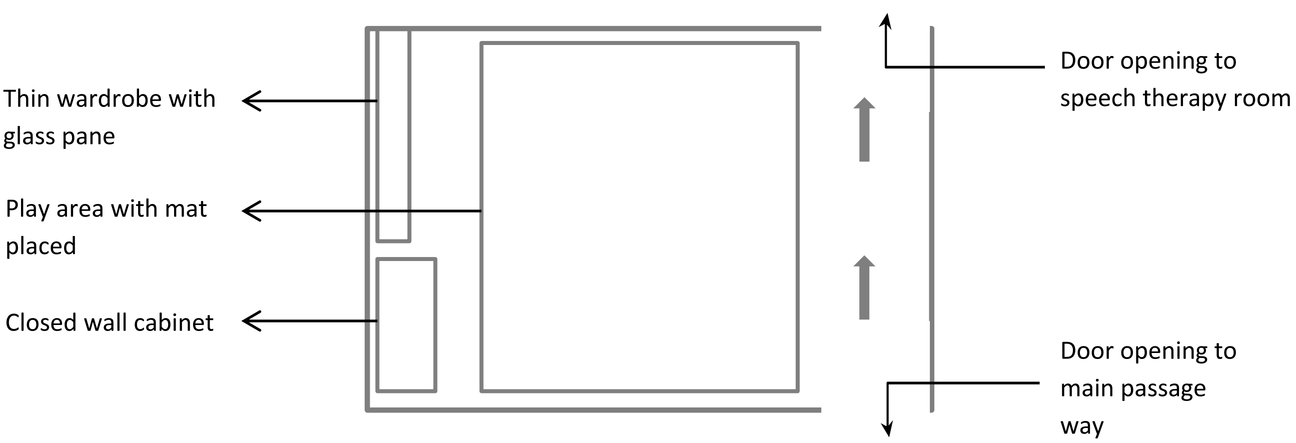


Figure 5.2. Top view of the interventional space (play room) used for the study

5.2.4 Pilot test study

While most of the relevant study parameters had been defined in the research design, some decisions were still needed to be taken e.g. it was decided to introduce 8 familiar and unfamiliar toys (2 from each toy category) in separate sessions but it was not clear if all the toys should be presented together, or in two groups of four toys (having one toy from each toy category), or in four groups of two toys (each toy category presented separately) or lastly one toy at a time, presented serially. There was also no criterion to identify how long a child should be allowed to interact with the toy. It was thus decided to conduct a pilot study to determine the optimum strategy for presentation of toys and tentative time involved in a session. It would also allow the user to check other parameters of research design and identify possible field issues if any, thus reducing the probability of unwanted errors in an already small sample size of twelve subjects.

The pilot study was conducted with a child called 'Nis' who was not a part of final study. He is a boy with age 7 years 4 months (chronological), IQ SQ and DQ as 89, 98 and 72 respectively thus making his mental age 6 years 6 moths at the time of data collection for pilot study. He had behavioural issues showing repetitive behaviour at times and had deficits in verbal communication. The pilot study was conducted in the play room and followed the same research design as detailed in earlier sections involving three stages – rapport building, a familiar and an unfamiliar toy session. It was decided to introduce all 8 toys together in the toy sessions and then make appropriate changes based on the response. Since the school lacked furniture that would allow child to explore all toys comfortably, the toys were placed on a floor mat in a staggered arrangement at random positions and a hidden camera was placed to record child-toy interaction, as shown in figure 5.3 (each toy is a symbol for one of the four toy categories). Facilitator remained present throughout the three sessions and changed roles as per the need of the situation.

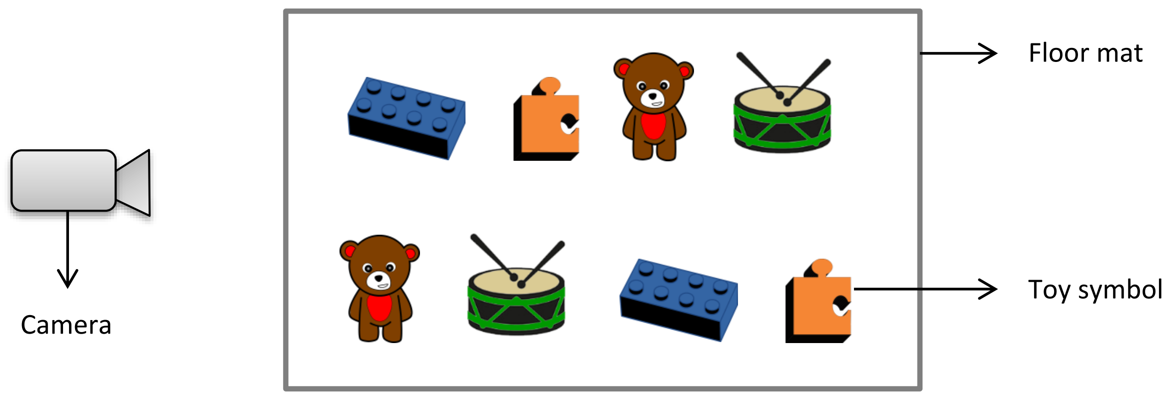


Figure 5.3. Arrangement of toys in staggered positions for pilot study toy sessions

The data was recorded in video format and later coded loosely for analysis to understand and eliminate errors that might occur. Following insights emerged which led to modification in research design –

i. It was realized that in the present setup, *data could not be recorded efficiently* as the child would often play facing his back in the direction of the camera. Also, some of the toys were at a disadvantage as they were *placed farther than other toys* for the child to approach.

ii. In the session with familiar toys, the *presence of facilitator was found to be necessary* in some situations since the child would not interact with all the toys and needed triggers to facilitate play. However, in many other occasions, the child could play on his own.

iii. Since the child did not approach a number of toys in the session with familiar toys, it was felt necessary to include at least two toys from each category to give sufficient choice to the child. Also, introducing only one or two toys in one play session would have involved serialization effect as other toys would be presented later. Moreover, it was not possible to conduct more than three sessions with a child (on separate days) due to time and availability constraints. The final study thus involved *presentation of all eight toys (two from each category) at same time*.

iv. In the session with unfamiliar toys, it was *difficult to explain how to play* with a toy to the child due to his lack of comprehension and verbal skills. Also, since the child had a small attention span, he would not focus on facilitator's modelling and rather look around at other toys available.

v. It was also noticed that *facilitator at times showed bias without realizing*, by giving higher number of triggers for a particular toy thus affecting the overall play interaction in the session. The facilitator needs to be conscious and avoid this error in the main study.

Apart from these insights, the video coding yielded some interesting patterns relating child's play behaviour to characteristics of toys. The pilot study thus gave enough support to carry on with the final study with some modifications.

5.3 Data collection procedure

As discussed in last section, the pilot study highlighted some of the inherent issues like lack of communication skills and small attention span of the children, which would make it difficult to conduct session with unfamiliar toys. Besides, there was no estimate of the amount of time it would need for child to show stability in behaviour with an unfamiliar toy. As a result following the rapport building session, data collection was done only for the sessions with toys to which child had been exposed earlier. There were two sessions with the familiar toys, ending when either the child expressed the wish to leave or till one hour, depending on which condition was met first. This maximum duration of a session was based on the time constraints of the school, and it seemed sufficient to allow free play interaction with all the available toys. There was also a third and last session which specifically focused on facilitating play with toys that were previously unexplored. Data collection was done through the use of hidden cameras by recording children's play interaction during the session. Based on insights from pilot study, the need of repositioning the toys and camera was felt for capturing all the activities. A number of possible arrangements were explored and a conical arrangement of toys was finalized with child at the centre of the cone, facing the front camera, as shown in figure 5.4. Front camera was placed in the wardrobe kept near the wall at an appropriate height to capture facial expressions of the child, while another camera was placed from top to capture children's activities. The advantage of this arrangement is that the child would naturally face the camera at all times and would also be at an equal distance from the toys. The order of placing the toys along the circular arc was decided using random permutation of the eight toys. Figure 5.5 shows the camera view as captured from the front and the top camera during one of the play sessions.

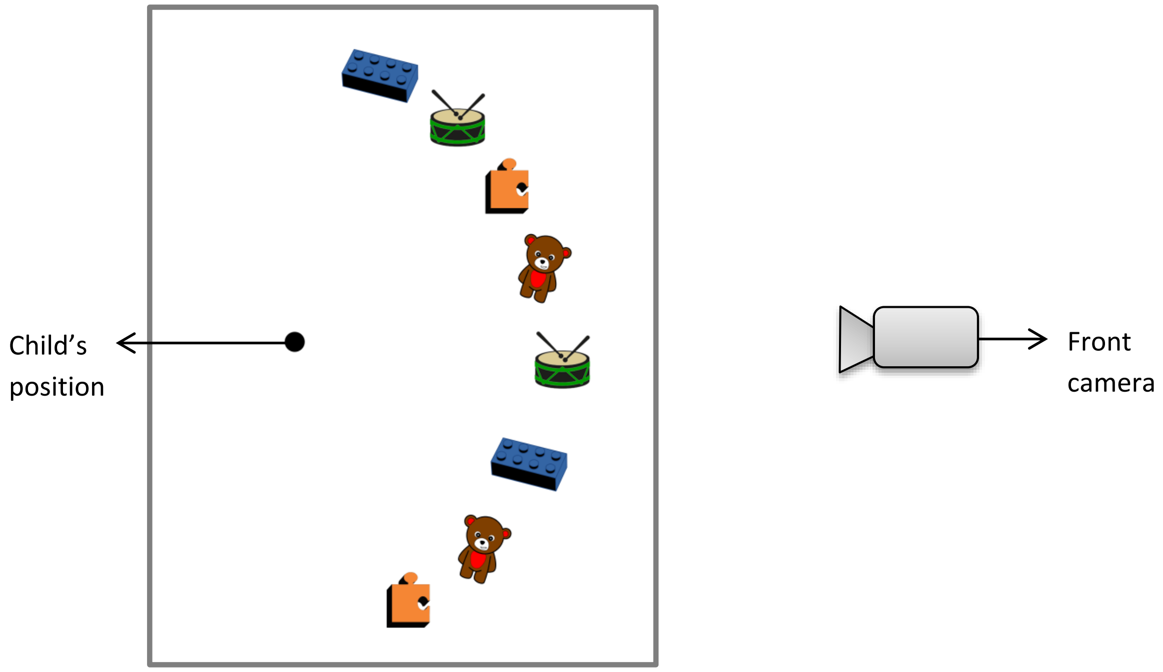


Figure 5.4. Conical arrangement of toys for the main study with toys from different play types randomly distributed in a circular arc, and child sits at the centre

Figure 5.5. Top and front cameras capturing the play activity and child's expressions respectively in one of the play session

Following the rapport building sessions, the procedure in each toy play session was as follows: The facilitator brought the child into the play room ensuring that he was in a good mood. The child was told to play with the toys as long as he wanted, without directing child to any particular toy. After the child settled, facilitator went out of the play space for 10 minutes by making an excuse, to capture child's play interaction with toys in the absence of facilitator. He remained present during rest of the session intervening in the following situations –

i. When the child was involved in playing with a toy for a long time (more than 10 minutes), facilitator would give verbal and gestural triggers introducing the toys not played so far and asking if he wanted to try. However, if the child denied or ignored the trigger, the facilitator did not force the child to play.
ii. When the child was stuck while playing with a particular toy, he gave assistive verbal and gestural triggers.
iii. When the child himself asked the facilitator to join in play with a toy, facilitator played a passive role and followed the child's lead as a play partner.
iv. When a toy or set or set of toys was not played with, during the two initial sessions, facilitator introduced each remaining toy one by one to the child, modelling the play and leading him if needed, on the third and last session.

A total of around 18 hours of video data was collected consisting of toy play sessions with each child except 'Adi' who did not cooperate due to behavioural issues showing symptoms of hyperactivity, at the time of data collection.

5.4 Data analysis procedure

The present study used Glaserian grounded theory based analytical framework, resulting in a number of core categories which organically emerged from data. The analysis process was divided into the following steps – transcription of video data, open coding and memoing, generation of concepts, and axial coding for generation of categories. This process continued till theoretical saturation was reached. The formation of categories was also informed by affinity mapping from experts. The emerging categories emerging from interpretive analysis of empirical data provided useful theory on the manifestation of play for children with ID but it was not limited to or specifically focused on design characteristics of toys. Aligning with the central objective of the thesis, it was decided to relook at the final list of concepts to segregate those which would have design application significance and see for affinity within them, leading to reframing of the theory. This exercise led to a set of generalizable design characteristics of toys that would enhance playfulness. The steps involved in the analysis process are briefly discussed below.

5.4.1 Coding and memoing

The present study reports analysis performed with seven of the ten children who were a part of data collection, namely 'Tan', 'Par', 'Sid', 'Swa', 'Poo', 'Mok' and 'Kri', since theoretical saturation was reached by this stage. The video data was converted into *.wmv* format and coded using a computer based qualitative data analysis and research software called *Atlas-ti*. A total of 713 events were coded, where an event is defined as –

- A single uninterrupted play episode with a toy or set of toys, or
- An action with the toy in play which is felt distinct from the other actions in the on-going play episode, or
- A display of emotion or body gesture to express during an on-going play episode, or
- An action involving a specific toy (not being played in that episode), facilitator or the environmental artefacts during an on-going play episode

A total of 132 codes with varying frequency and 180 memos were created, related to the coded events. The complete list of codes along with their frequency has been attached in Annexure C, while selected memos which are cited in the thesis are reported in Annexure J. Codes were generally assigned corresponding to – toy and its characteristics, child's interaction with toy and his feelings, child's interaction with facilitator and environment, and contextual factors. This allowed the author to analyse the same data from different perspectives and also notice connections among events occurring at the same time.

A number of nested codes emerged over the course of the analysis which allowed the analysis at multiple levels e.g. 'Interaction with facilitator – verbal/ gestural trigger' was a code which consisted of codes like 'trigger – introductory', 'trigger – assistive', 'trigger – enacted', 'trigger – denied', 'trigger – ignored'. Since the process was iterative, a number of codes which are a part of the final list (appendix C) were modified or dropped over the course of the analysis. Some of these codes are mentioned along with the reason of their modification or deletion in table 5.3 as follows.

Codes that were modified	Reason
(a) Feeling uninterested >> Feeling bored (b) Child singing & blabbering >> Makes sounds (c) Toy affordance - light >> Feedback – sensory ball light	Merged due to similarity
Codes that were dropped	**Reason**
(a) Interaction with toys – played as intended (derived play was more relevant) (b) Toy affordance – bouncing (balls) (c) Toy affordance – moving a car (functional play) (d) Multiple color blocks (constructive play)	Too many instances/ too common to be considered as a code
(e) Possible gender issue (f) Uses previous construction (happened due to error while starting)	Very few instances due to study design limitations
(g) Opening the sound ball (h) Toy affordance – Pressing buttons (ring game) (i) Toy affordance – Not understanding cup size difference (stacking cups toy) (j) Adjusting her handkerchief	Very few instances because used by one child

Table 5.3. Some of the codes modified or deleted during analysis using grounded theory

Apart from the coding process, memos were actively created over the process of analysis, documenting the thought process and emerging ideas from the researcher. As discussed by Glaser (1978, p.83) writing memos allows the researcher to express ideas about conceptual categories and its relationships as they arise. Moreover, these memos were also very useful to relook at the evolution of a category, capturing the process and allowing revaluation whenever needed.

5.4.2 Generation of concepts

This step involved analysing the generated codes for patterns in the associated instances. A constant comparison method was used where occurrence of a code was checked for similarities on a case by case basis. As and when a pattern emerged, negative cases were also searched consciously to further refine the definition of that concept and its characteristics. Being iterative in nature, a concept definition often changed substantially over a period of time. A number of concepts were also dropped or discarded at they showed strong contradictions within the data and thus lacked clear definition. Some of these discarded concepts are mentioned in table 5.4. A total number of 66 concepts made into the final list with varying grounding (based on how often and how many children's data corroborated that concept) in the data, which are listed as Annexure D.

Concept that were dropped	Reason
Creative play can be assessed and is variable	***Dropped due to vagueness to define.*** Creative play would include pretend play, constructive play and play for derived affordance, and difficult to assess on a whole. Besides, using toy in a manner other than intended does not always imply that child is creative.
Jigsaw puzzle become too difficult when 5 pieces are introduced (threshold)	***Dropped due to contradiction*** Children were found to fail even when 3 or 4 pieces were used, in some occasions.
Outcome is not important in play	***Dropped due to contradiction*** Meaningful, outcome oriented constructive play was seen in a number of children. Also, in some occasions, children focused on the outcome or challenge in challenge based play, when assisted by facilitator.

Table 5.4. Codes discarded over the course of the analysis

5.4.3 Analysing the movement of children in play space

While following the constant comparison method during the analysis, one of the insight that emerged was that the movement of children in play space (based on their order of toy selection) seemed to follow distinctive patterns. These patterns were separately analysed, deviating from the core principle of Glaserian Grounded Theory approach. Using the video data, child's movement was drawn on top view of the play space and sequence of toy selection was represented by numbers. A sample of this visual representation is shown in figure 5.6 for 'Tan', where she always seems to move from left to right, selecting each toy, after playing with her favourite toy which was construction blocks. There was one exception to this pattern in session 2 when she picked play doh out of the serial order. Two significant concepts that emerged from analysing the movement of children which were included in the list of concepts are described below.

(a) Order of selecting toys depends on child's nature and how free he feels in play space. We can see it on a scale from "ordered, moving along one direction" e.g. 'Tan', to "staying in the vicinity of present toy" e.g. 'Par', 'Mok', to "random and organic".

(b) Order of selecting toy was also defined by facilitator's triggers as some children always listened to him and followed e.g. 'Kri' and 'Poo'.

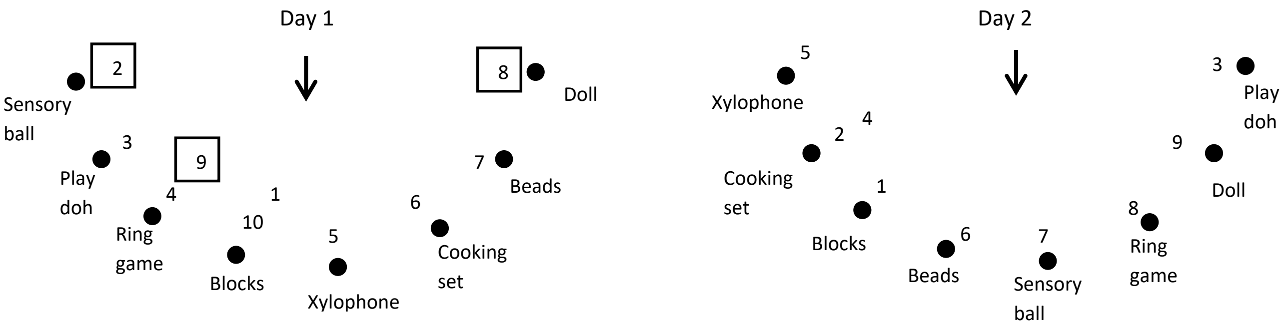


Figure 5.6. Top view of play space showing order of toy selection on session 1 and 2, for 'Tan'. Numbers in box represent that this selection was based on an introductory trigger by facilitator.

5.4.4 Generation of categories

Some of the concepts started merging into higher order concepts over the course of the analysis, while new concepts emerged at the same time. The merging of concepts was based on affinity, building into common themes called as categories. This process was iterative as concepts were aligned or discarded from a specific category and labels got clearer over the period of time. Having used Glaserian's approach, there was no attempt to create a uniform structure within the categories. As a result, each category developed organically and had a different structure and relationship with its characteristics. A total of 9 categories were identified at the end of the analysis that would accommodate most of the concepts, discussed in a later section. These categories were represented as substantive theories, by elaborating upon their characteristics based on the conceptual development. Unlike the standard Grounded Theory procedure, an attempt was not made to generate an over-arching core theory which could accommodate all the emerging substantive theories.

5.4.5 Affinity mapping using expert opinions

To supplement the process of theory structuring through category formation during the analysis, it was decided to include opinions of experts on how they would form categories from the set of 66 concepts which had been identified. This would allow multiple perspectives to theory building, checking the limitation in the form of single interpretation from the researcher. An affinity diagramming method was used to achieve this by writing each concept on a piece of paper and asking the experts to arrange it into groups, based on affinity. The experts included a practicing psychologist (denoted by P), an occupational therapist (denoted by OT) and another research scholar with experience in interaction design (denoted by RS). The purpose was to use their categorization as a supplement to the ongoing analysis, by adding the categories which had been missed, instead of comparing the categorisation of each concept. Simonsen et al. (2014) have recognized affinity diagramming as essentially rooted in the principle of Grounded Theory and hence it would not be a deviation from the methodology, however we have included expert opinions during the process of affinity diagramming to ensure that multiple perspective had been taken into account for the formation of theory.

Three unique categories emerged, which were not identified in the analysis earlier, namely –

A. ‘Constructive play’ (by OT), similar to ‘Play affordance and constructive play’ (by RS)
B. ‘Distraction’ (by P)
C. ‘Expression/ Emotion’ (by P)

However, affinity diagramming using experts showed that most of the categories which were identified had already been included in the theory formation. Out of unidentified categories, ‘distraction’ and ‘expression/emotion’ was found to include concepts which had been accounted for in multiple other categories so they were dropped in the final list. However, ‘constructive play and its properties’ was included as one of the final category. A number of issues were identified in the process of affinity diagramming like sometimes experts were seen superficially selecting concepts by reading a keyword like ‘pretend play’ or ‘play affordance’ and not seeking higher connections. Due to limitation of time, experts did not look to sort the concepts iteratively in multiple categories. Also, after discussion with experts on their categorization, it was realized that some of the sentences representing concepts were perceived erroneously as experts had not followed upon from the initial stages and their interpretation was different. Since the purpose of this exercise was only to supplement our analysis, it is expected that such issues would not affect the theory generation.

5.4.6 Reframing theory from design practice perspective

The output of the analysis process was a set of core categories which could be used to theoretically explain the play manifestation process. However, the focus of the present study was on identifying the relationship of design characteristics of toys and observed playfulness, and not all the categories shared this concern. Hence, a restructuring step was taken to align the emergent knowledge with this focus which involved relooking the final list of 66 concepts and identifying concepts which were related to toy design characteristics and/or gave insights for design application. The selected concepts were again categorized based on affinity and reframed as design guidelines. This led to a set of decontextualized, generalizable design characteristics of toys that would enhance playfulness. The following sections briefly report results in two stages – Initially, results are reported as a set of core categories which emerged directly from the grounded theory based analysis. Next section reports the results focusing on the generalizable design characteristics which emerged from restructuring process.

5.5 Results: Core categories

As discussed in the last section, a total of 9 core categories emerged from the affinity of concepts seen as substantive theories elaborated with their characteristics based on data. The present study did not attempt to unify these emerging theories into a single overarching theory and they may be treated as a set of potential research hypothesis or guiding theories for research and practice and its extensibility will have to be checked in different contexts. According to the classical grounded theory, the validation of emerging theory is taken care in the process with the use of constant comparison method. The validation of each of these substantive theories or hypotheses is beyond the scope of the present study. The core categories are described below along-with concept maps showing the sub-categories, concepts and codes/memos which led to the emergence of these categories. Some of the relevant concepts and related insights will be discussed in relation to existing literature in another section while elaborating on the generalizable design characteristics.

5.5.1 Significance of pretend play, its characteristics and assessment

Pretend play emerged as one of the core category in the analysis, with several concepts establishing its significance, characteristics and possible indicators for assessing its complexity, as shown in the accompanying concept map (figure 5.7). The present study was designed to ensure that children would have equal opportunity to interact with all the four types of play, namely sensory, constructive, pretend and challenge based play. In the analysis, one strong concept emerged showing that **pretend play and constructive play based toys were able to engage children more than the other types**. Several other concepts further showed pretend play as the most significant play type for the studied population like:

- **Maximum instances of joyfulness were seen during pretend play session.** One possible explanation for this concept could be seen in relation to another concept showing that almost all the instances of joyfulness shown by children were related to facilitator's presence and interaction. Such facilitator interactions were more prominent in pretend play sessions because it was easier for the facilitator to join the on-going play narrative as a play partner, unlike some other play types where he could only play a role of supervisor or exhibit parallel play.
- **Pretend play toy sets were explored more** than all other toys. The activity of toy exploration was operationally defined as checking, moving/fiddling with the toy without a purpose or without exhibiting any of the play type. It is difficult to deduce what could be the possible reason of this preference from children, as the past experience is unknown and thus we did not attempt to look for causal relationship.
- **Children derived maximum play affordances from non-pretend play based toys (including environmental objects) in pretend play**, where play affordance for a toy is operationally defined as the number of possible ways toy could be used in play apart from its intended purpose.

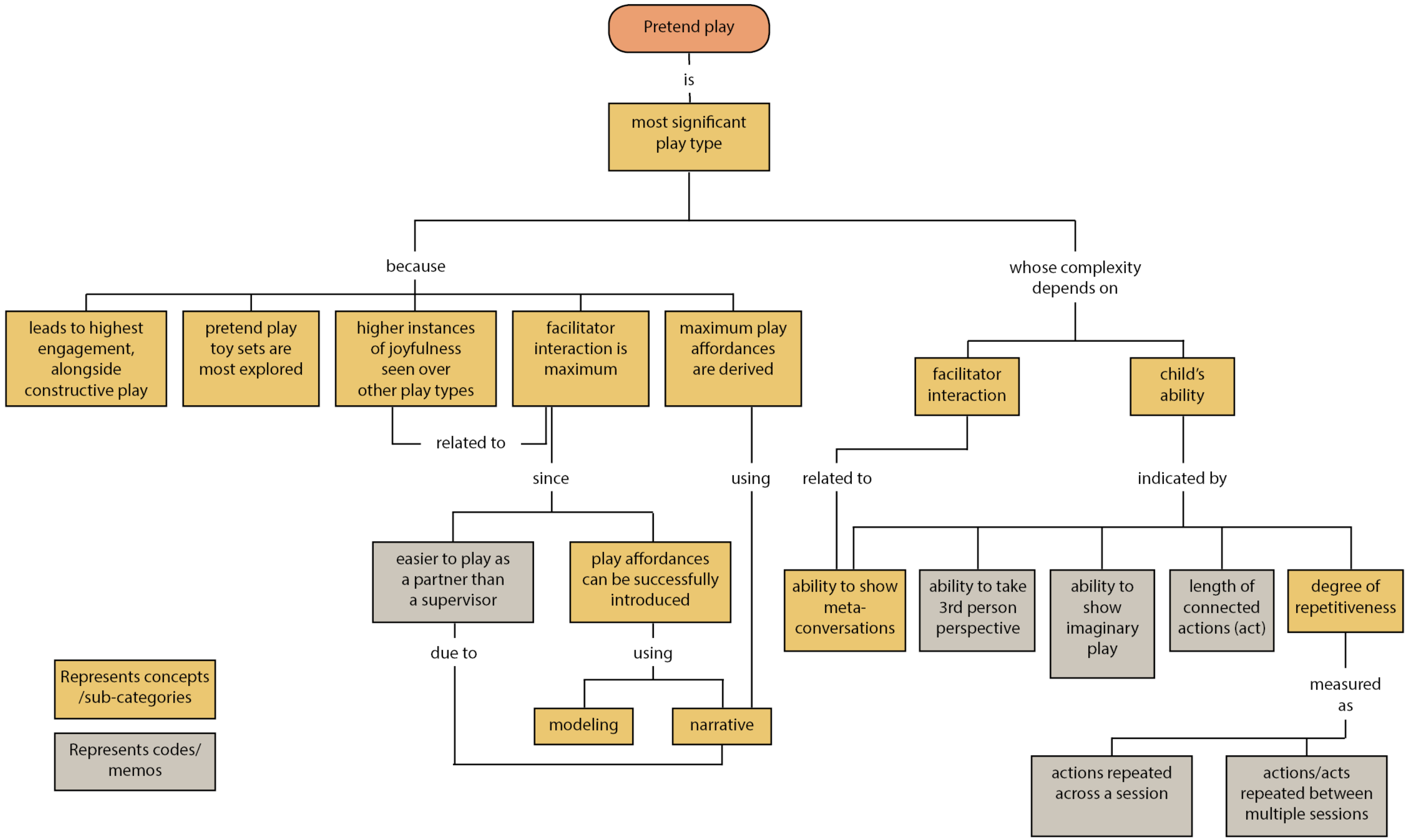


Figure 5.7 Concept map of '**Significance of pretend play, its characteristics and assessment**' category

There could be several reasons which could explain preference seen for pretend play like higher possibilities of exploration and free play, or presence of narratives which could be used to derive affordances from different objects. Hence, it would be beneficial to concentrate research efforts in developing better understanding and design solutions in this domain. Besides, pretend play provided with unique opportunities for facilitation. As seen in one of the concepts, **introducing a new play affordance (possible usage of toy, unexplored earlier) of a toy was often successful** and was understood by the children as the facilitator could contextualize it in the on-going narrative as well as model the introduced play affordance by enacting it. On the contrast, modelling an action in challenge or constructive play will be seen as a leading action affecting the subsequent play behaviour of children. e.g. when facilitator modelled how to drop a square shaped block in shape-sorting bucket (challenge-based play), the child may or may not learn it still and besides the action itself could not be repeated in the on-going sequence of events until play is restarted by taking the block out.

In the course of the analysis, it became clear that variation in the level (complexity) of pretend play shown by children was noticeable. The level of facilitation had to be balanced based on the need of each child since their abilities differed. This difference in abilities when accounted as a whole could be helpful in assessing and comparing the level of pretend play each child showed. Some of these factors which led to variation in complexity of pretend play are:

- **Repetitiveness in pretend play** varied at two levels – actions or acts (sequence of connected actions in the context of a narrative) repeated between separate sessions, as well as actions repeated across the same session. Two objective variables that could be measured to determine this repetitiveness were the number of unique actions and acts, performed by the child over the multiple sessions. The lesser the number, more repetitive and less complex the pretend play was.
- **Length of the act** also seemed to be a relevant variable in determining the complexity of pretend play. This could be measured by counting the total number of actions which were connected in a sequence in the context of an ongoing narrative. Again, increase in the length of acts pointed to a more complex pretend play.
- **Presence of 3rd person perspective** in pretend play was another variable which was seen in some of the children and hence made their pretend play more complex. This

would mean that children could create a narrative from the point of view of a separated character and separate it from their own ego.

- **Presence of imaginary play** would make the pretend play more complex. Imaginary play would include children creating narratives based on objects, characters and events which were not physically present in the play space, either substituted by an artefact (not having semantic relation to represented concept) or simply assumed in absence.
- **Instances of meta-conversations** allow more complexity when pretend play is seen in a social context, as seen during interaction with facilitator. Meta-conversations in our context refers to child's ability to switch between a narrative world by acting as a character and the real practical world by acting as the facilitator, to negotiate and sustain the pretend play. Thus, this indicator may not be applicable for solitary play situations since a child might still has an ability to show this duality but wouldn't need to communicate.

While the set of variables listed above may not be comprehensive but it does bring in a different set of abilities together to assess the complexity of pretend play being exhibited. Following excerpt taken from one of 'Sid's pretend play episode acknowledges some of these factors:

> 'Sid' seems to exhibit the longer and more complex of pretend play episodes compared to some other children like 'Tan' and 'Par'. In parts, her behavior seems very focused. She pretended to first make food using kitchen set and play doh and then fed the doll with food and water. She acted scenes like blowing the vessel containing water as it was hot to make it cooler for doll (imaginary play). Again she went back to make something using play doh. She used the 'kaddukas' to shred the playdoh like done for vegetables. She also brushes her hair using the sticks of xylophone and puts jigsaw piece in her hair (derived play). She talks to the doll, beats and gets angry on her and pats her like a play companion it seems. At the end of the first session, she tries to do the beads and xylophone through doll's hands while talking to her (3rd person perspective). Here play doh is being used as pretend as well as constructive toy since it is being molded to make something meaningful by the child. Again playing with doll and beads/xylophone together, led to mixing of play categories. ('Sid', Memo 41, July 8th 2014)

It would be interesting to compare these identified parameters to determine complexity in pretend play with some of the existing play assessments for typical children like Child Initiated Pretend Play Assessment (ChIPPA: Stagnitti, 2007), or Penn Interactive Peer Play Scale (PIPPS: Fantuzzo et al., 1995).

5.5.2 Play affordance of toys

The core category of 'play affordances' led to a number of interesting insights, as shown in the accompanying concept map (figure 5.8). Norman (1999, 2002) differentiates the affordances as real affordances, which comprises of what actions are possible with an object, and perceived affordances, comprising of what actions actors perceive as possible to do with an object. In our study, we measured **play affordance for a toy as the number of possible ways toy could be used in play apart from its intended purpose** (as stated by the manufacturer/designer) i.e. perceived affordance minus real affordance of the toy, in Norman's terminology. Thus, subsequent use of the term 'play affordance' of a toy in this chapter would exclude real affordance or usage for intended purpose.

One of the most prominent concepts observed in the analysis was that **children derived maximum play affordances with toys during pretend play.** One possible explanation could be that deriving sensory play may be too trivial for the children in the studied age-group while deriving challenge-based play would be difficult as child would have to manipulate and recreate rules. However, the correlation with pretend play could also have been due to the presence of an on-going narrative that gave cues to look for play affordances in other toys or objects present in the play space, beyond their functional properties.

Another, interesting concept that emerged was that among various available toys, **children derived maximum play affordance from beads and playdoh**. Affording which involves making meaning should be strongly related to the mental structures which depend on the prior experience of the child. However, the role of form and functionality of play material offered can't be neglected in affecting their play affordance. One commonality that emerges from the observed higher play affordance of beads and playdoh is the **level of abstraction and flexibility** in their physical form. Also, having multiple components in beads may have allowed possibilities of substituting them for different purposes, which aligns with the preference seen for arranging behaviour of toy components. A lot of observed play narratives

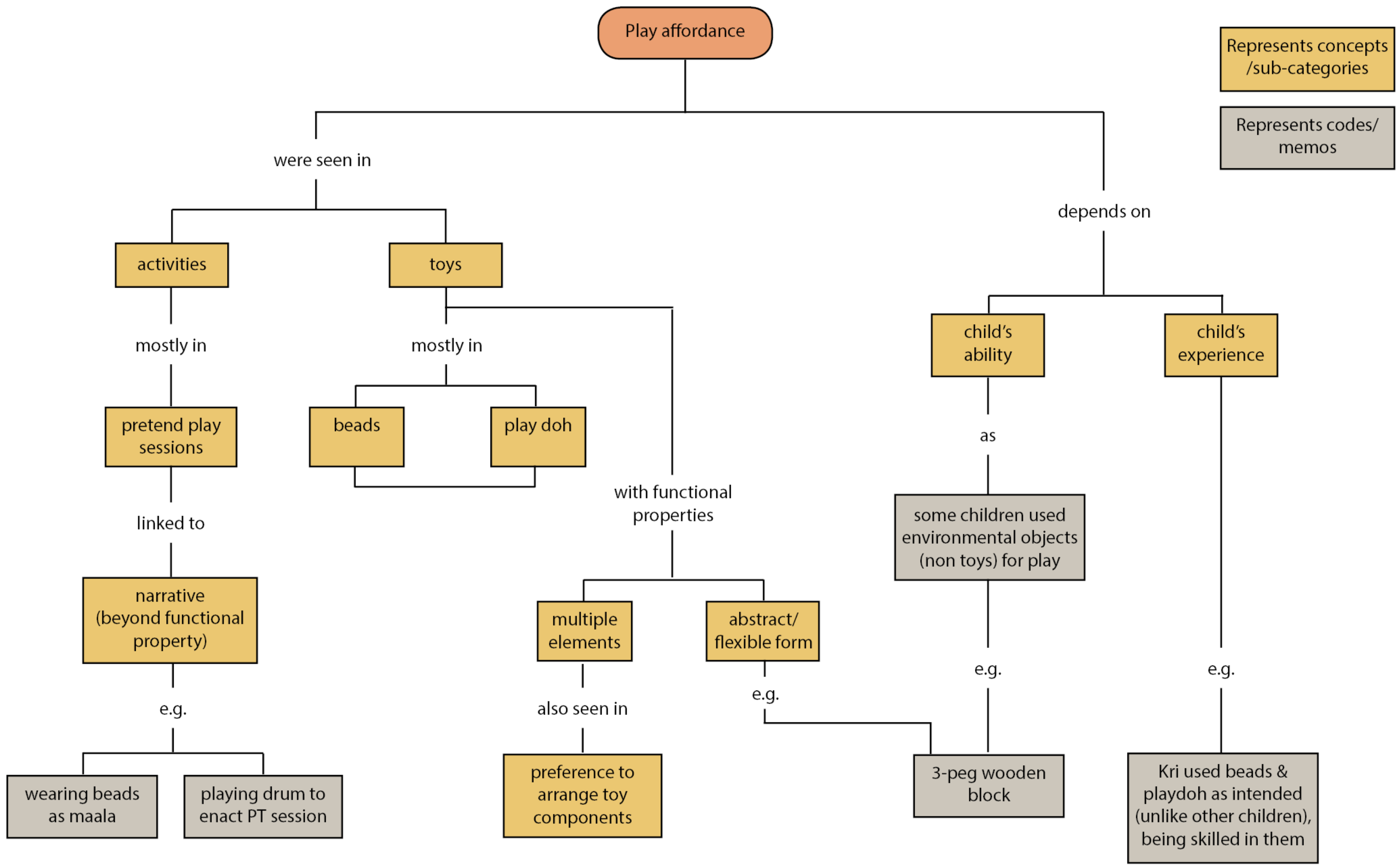


Figure 5.8 Concept map of '**Play affordance of toys**' category

used contextual elements like kitchen set equipment along with abstract elements like play doh and beads. As a scope for future work, it would be interesting to look into how different combinations of contextual and abstract elements affect the play affordance of a pretend play toy set.

5.5.3 Failure of challenge based toys to engage children

In the present study, challenge play was one of the four types of play for which specific toys were presented to the children. Challenge based toys refer to the set of toys which are played primarily for the motivation to complete a target or challenge, and is a common category to implement 'educational toys'. Several concepts emerged in this category showing that most of the **challenge based toys failed to engage children and sustain challenge play**. These toys were broadly divided into easy and difficult based on the level of challenge offered to the child. Playing with beads, which involved putting them into a thread till the thread was exhausted, was always found easy for the children as it hardly involved any cognitive strategy, apart from eye-hand coordination and fine motor skills. On the other hand, playing with jigsaw puzzles was found to be difficult for most of the children as they had to be often assisted and guided. Children had problem in identifying the correct location and orientation of individual pieces. Slightly different outcomes emerged from the two categories of easy and difficult toys shown in accompanying concept map above (refer figure 5.9). In the case of toys which offered easy challenge –

- children were often seen **deriving other play possibilities** like pretend or constructive play, i.e. play affordances were non-challenge based, or
- children would **lose interest mid-way** and leave the toy, unbothered about the target.

Following excerpt illustrates this behaviour seen in 'Sid's interaction with beads:

> 'Sid' did not seem as excited as in earlier session on seeing just the beads. She does play but seems distracted throughout the session. She is easily able to put beads in thread but after a few she looses interest and takes them out. She wraps string on her hand, and tries to derive play. ('Sid', memo 43, July 11th 2014)

However, there were two exceptions seen in this pattern, namely from 'Tan' and 'Kri' (memo 178, 160, 169 – refer Annexure J) as shown in one of the following excerpt. Both of them finished the task of putting all the beads into a thread while showing focused behaviour.

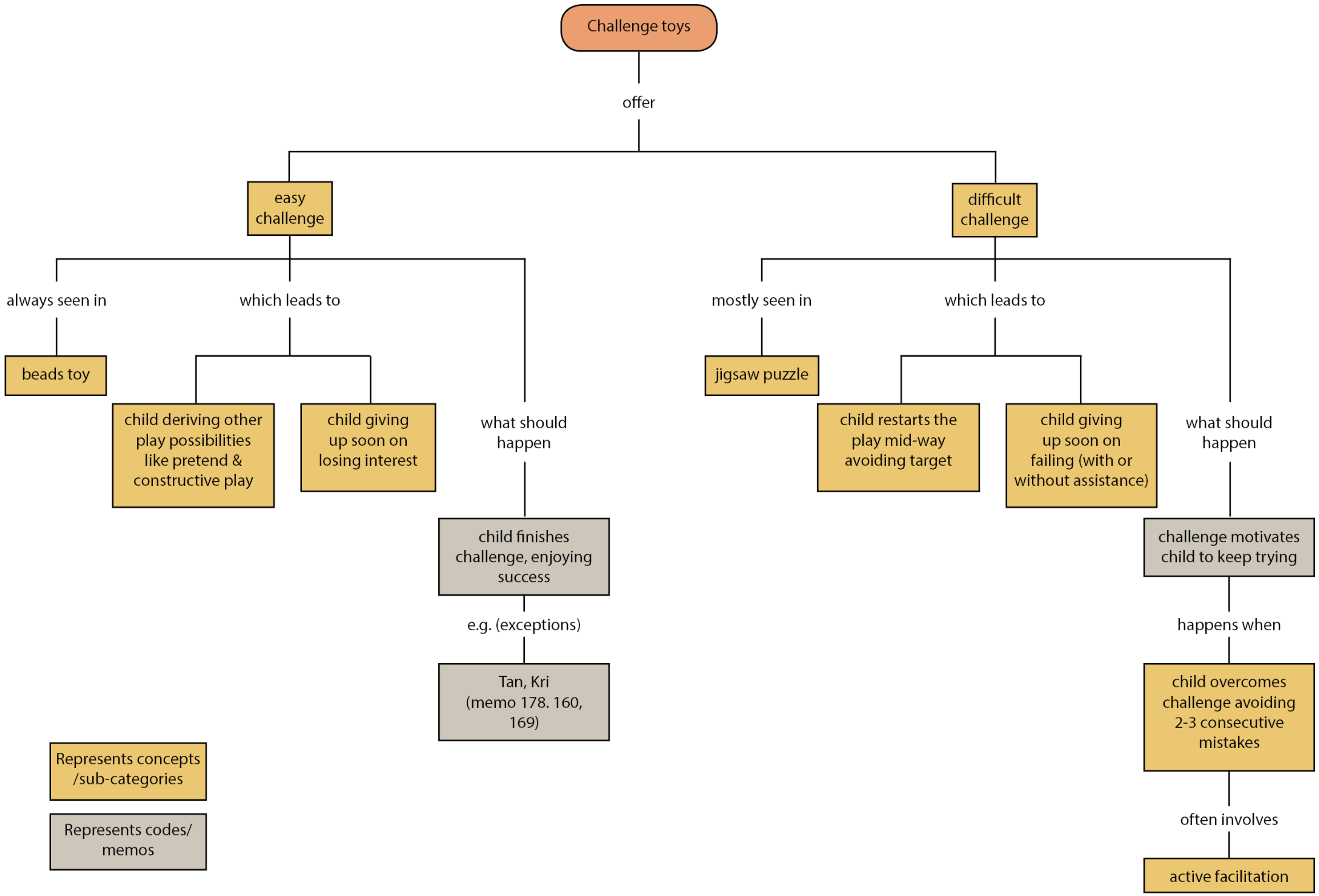


Figure 5.9 Concept map of '**Failure of challenge based toys to engage children**' category

> 'Kri' keeps on playing with beads till the thread ends and had to be asked to try out other toys to make him change it. However, he is seen distracted most of the times, often exploring other toys kept around him, to the extent that couple of times he picks up something else apart from beads because he is looking and thinking about something else. 'Kri' shows a little bit of motor difficulty at times while putting beads in thread, which might have led to task not becoming too trivial. He seems to be getting more interested and excited as the thread comes close to finish, as seen from his gestures like sitting upright, increase in speed, etc. In the end, 'Kri' could not hold the thread and some of the beads fell out, but he again resumed putting them and was trying hard till the end. ('Kri', memo 160, Nov 16th, 2014)

Whereas in the case of toys which offered difficult challenge –

- children **gave up play mid-way on failure**, irrespective of the fact that they were given facilitation or not, or
- children left the ongoing play mid-way and **restarted the play sequence**, ignoring the target as seen in the following memo based on 'Tan's behaviour.

> It became clear in this session that she knows how to play ring game by inserting rings in the needles. She also seems to have a control on how much and often to press the button, however she did not care to wait till the end to complete all rings and shook the gamepad after she had completed 3-4. This also shows that target is not as important for her. She does not strive for going beyond her usual limit. After 2-3 turns, she loses interest. ('Tan', memo 3, May 5th 2014)

There were few instances however when children were motivated and seen to continue the play till they reached the target. Most of these instances involved **active facilitation** where facilitator assisting the child to **ensure that they did not make more than 2-3 consecutive mistakes at each step**, and there was some progress. Children did not tolerate sustained failure and would simply switch from the challenge play.

5.5.4 Significance of facilitator during play interaction

The present study was designed with the idea of having minimal facilitator interference and allowing free play to children, however after the pilot study it became clear that facilitator's needed to be present during play sessions as children's response would vary and some children might need triggers for motivation. Still, intentionally facilitator made sure that he left the play space by making an excuse for a brief duration of 10 minutes at the start of the sessions to capture how children would behave in his absence. As the data collection phase continued, the role of facilitator emerged as increasingly important as child interacted with facilitator on a number of occasions and often made him a play partner. Analysis showed that **pretend play sessions showed the most number of instances of child-facilitator**

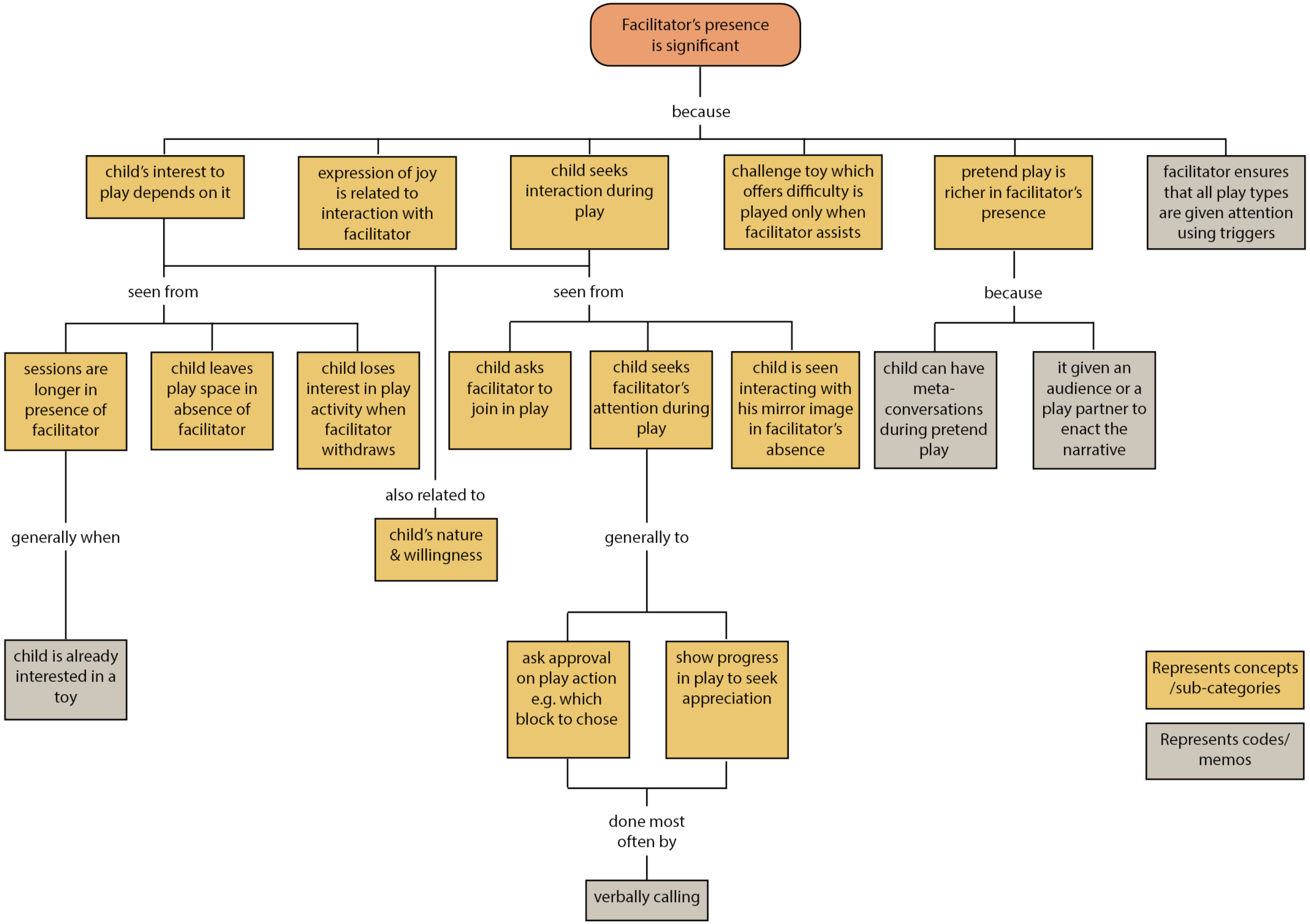


Figure 5.10 Concept map of '**Significance of facilitator during play interaction**' category

interaction, often involving the facilitator as a play partner in the sessions. A number of concepts and memos vindicated his relevance in the overall setup, as mentioned below briefly (refer figure 5.10 for concept map).

Child's interest in play activity and hence engagement was seen depending on facilitator's presence. This became clear from a strongly grounded concept which showed that **most of the sessions which were long in duration involved facilitator's interaction** in the activity. However, it is also apparent, these sessions often involved toys which child was already interested and wanted to play with. There were two exceptions to this rule, 'Tan' and 'Kri', who did not show a lot of interaction with facilitator during play sessions. While these children were generally seen as less 'socially connected' (explained later in playfulness assessment section) and thus it could have been due to their nature and temperament, the interesting commonality for this pair was that both of them did not play with pretend play toys at all, which was when maximum probability of facilitator interaction was seen. The significance of facilitator was further supported by a concept showing that at times, children would lose interest in the ongoing play activity when facilitator withdrew from it (e.g. memo 64, 148, 155 – refer Annexure J). Infact there were instances when 'Swa' and 'Mok' **left the play space completely in absence of facilitator** (memo 27, 73, 117), as shown in excerpt below.

> It seemed that when facilitator left the child initially, he lost interest in all the toys after some time but when facilitator came back, he could play with the same toys for a much longer time as he could talk to him or in some cases make him play partner. Thus, it is possible that presence of facilitator may enhance the duration of engagement. ('Swa', memo 27, July 19th, 2014)

Hidi and Renninger (2006) while studying triggers and engagement in general, emphasized on phases of interest, stating that in the earlier phases triggers are primarily external including facilitator, and in later phases, trigger are more intrinsic. Facilitation becomes much more important in the initial phases to trigger interest.

Also, as noted earlier, almost all the **children were seen seeking interaction with facilitator** during play in a number of occasions. This included the instances where children (5 out of 7) tried to **catch facilitator's attention**. Most commonly (50% of the times), children used verbal communication to catch facilitator's attention, however most of the times speech was not clearly understood due to speech deficit. Attention was sought generally to show progress and state of play, at times to get appreciation (memo 30, 22, 77, 157, 175 – refer Annexure J), or to ask/ take approval for play action (e.g. memo 127). It was interesting to note that positioning of facilitator in the play space might have affected this pattern, as for the few children who didn't seek much of interaction with facilitator, it was found that facilitator was sitting very close to them. It is possible that the mere presence of facilitator nearby might have been sufficient for these children. The concept of children seeking interaction was further supported by instances where **children asked facilitator to join** in the ongoing play activity and become play partner, shown by all children except 'Tan', as illustrated in one of the excerpt below (some other examples include: memo 23, 35, 70, 111, 141, 171; refer annexure J).

> Child asks facilitator to make 'kursi' with blocks which he had done in the last session, although he himself doesn't play with it. Later in the same session, he again asks facilitator to make a 2nd kursi after facilitator has made one. In 2nd session, it is the child who has invited facilitator to participate – for blocks and pretend play with mobile. ('Swa', memo 23, July 18th 2014)

'Mok', 'Sid' and 'Par' were seen **interacting with their mirror image** (seen from the glass on cupboard kept in front of them). While this was an unintentional stimulus, it is possible that this phenomenon was seen because the mirror image could give a sense of companionship to the children, as a lot of these instances occurred when facilitator was absent from the play space.

Also, **expression of joy** was seen almost always associated with facilitator interaction. Thus, facilitator's presence might have given an outlet for child to communicate his feelings. This is also significant because if joyfulness is assessed for such play sessions, it would be important to have a facilitator or play partner for capturing such instances.

Pretend play exhibited by children was seen to be more complex and meaningful in facilitator's presence. This was because facilitator could be easily accommodated as a play partner in the ongoing narrative, which would allow possibilities to have richer narratives and even meta-conversations to children. In other instances, facilitator could simply be present as an audience during pretend play sessions and it still led to increase in complexity of narratives, as shown in the excerpt involving child named 'Mok' below.

> On 2nd instance, he shows connected sequences of imaginary play where he makes food, roti using utensil and gas and serves to facilitator 3-4 times (trigger was given). The overall act seems repetitive but actions are not always the same. This more complex version happens when facilitator is introduced in play, making it more meaningful. Also, to note, that earlier

> instance was much shorter and 'Mok' lost interest much sooner when playing alone. ('Mok', memo 110, Oct 9th 2014)

Challenge toys which offer high difficulty were played only when facilitator gave assistance and motivated the child to continue. In such situations, the role of facilitator becomes very important to ensure that child persists and to locate the roadblocks child is facing, and give balanced assistance to him without leading the play.

5.5.5 Strategies used for facilitation during play interaction

As the role of facilitator became increasingly important, a number of facilitation techniques were used for a variety of purposes, of which some seemed to be much more successful than others. This evolution in the functioning of facilitator did not happen consciously and became apparent only during the analysis of data. Some of the concepts which showed successful facilitation techniques are discussed below along with context (refer accompanying concept map in figure 5.11).

<u>For giving triggers</u> – Two different types of triggers were given by the facilitator based on their purpose, namely introductory and assistive triggers. Introductory triggers were given for introducing toys left unexplored by the child during the ongoing session to ensure that child noticed their presence. An interesting concept emerged showing that **non-verbal (purely gestural) introductory triggers were ignored** by the children. These triggers were often employed for introducing sensory toys e.g. creating sound by beating drum or xylophone, or by squeezing a sensory ball. These triggers might have been ignored because they could be treated as instances of parallel play by the child, thus not bothering him to focus on it, as shown in the following excerpt.

> It has been seen in this and earlier instances that 'Mok' does not respond to gestural triggers with drum, sensory balls. In this instance, he finally enacted on introductory trigger when facilitator explicitly asked him if he wanted to play with sensory balls. He probably saw playing of drum or sensory ball squeezing as facilitator is playing with it, and it did not bother him and affect his ongoing play. ('Mok', memo 130, Oct 16th 2014)

There were few instances when non-verbal introductory triggers were successful in catching child's attention and guiding his behaviour. In these situations, toy being introduced had already been played by the child briefly, and/or trigger was intrusive as facilitator was too close to the child during play.

Assistive triggers were the second kind of triggers given generally as a part of an ongoing play episode when child was stuck in play and needed help e.g. jigsaw puzzle, or when facilitator had to play as a partner in the narrative during pretend play (following child's lead), or when facilitator felt that an intended play affordance of toy had not been realized by the child. Here the emerging concept showed that **assistive triggers were more successful when gestures were used in combination of verbal communication**, as compared to the instances when only verbal communication was used. This could have been due to the poor speech as well as comprehension ability of these children, hindering verbal communication. Using simple gestures for pointing or modelling would allow children to understand the message despite of language barrier, as illustrated in following excerpts.

> Child constantly communicates back and forth with the facilitator by humming and nodding. While I was not able to understand exactly what was being conveyed, he seems to be comfortably communicating. He even plays an imaginary play episode with facilitator using hands as gun to shoot each other. Without language, play can also be used to communicate? ('Par', memo 49, June 26th 2014)

> In this instance, facilitator tries to explain how to play xylophone verbally and the child does not seem to be understanding, while later in 2nd session, she is able to learn play affordance after it has been modeled by the facilitator. ('Tan', memo 176, Jan 2nd 2015)

'Swa' and 'Mok' showed an exception as both of them were seen to have good communication ability. Also 'Kri' had very few opportunities during his play session when assistive triggers were needed.

<u>For building rapport with children</u> – It was important to build a rapport with children so that children feel comfortable playing around the facilitator during play sessions. The study design involved conducting two rapport building sessions where facilitator played with the child in the designated play space. Moreover, facilitator had been interacting with children for last one year and children recognized him very well. Apart from this initial consideration, two interesting strategies emerged that helped facilitator to build rapport with children as a play partner. One of the concept showed that **allowing child to lead in play and letting him take decisions about play, adopting the role of a follower** contributed to children easily accepting facilitator. This strategy worked irrespective of what play type was exhibited by the children, except when children had to be assisted to overcome challenges which would require a temporary, leading role. So the power of control kept shifting between facilitator and the child, generally in favour of the child.

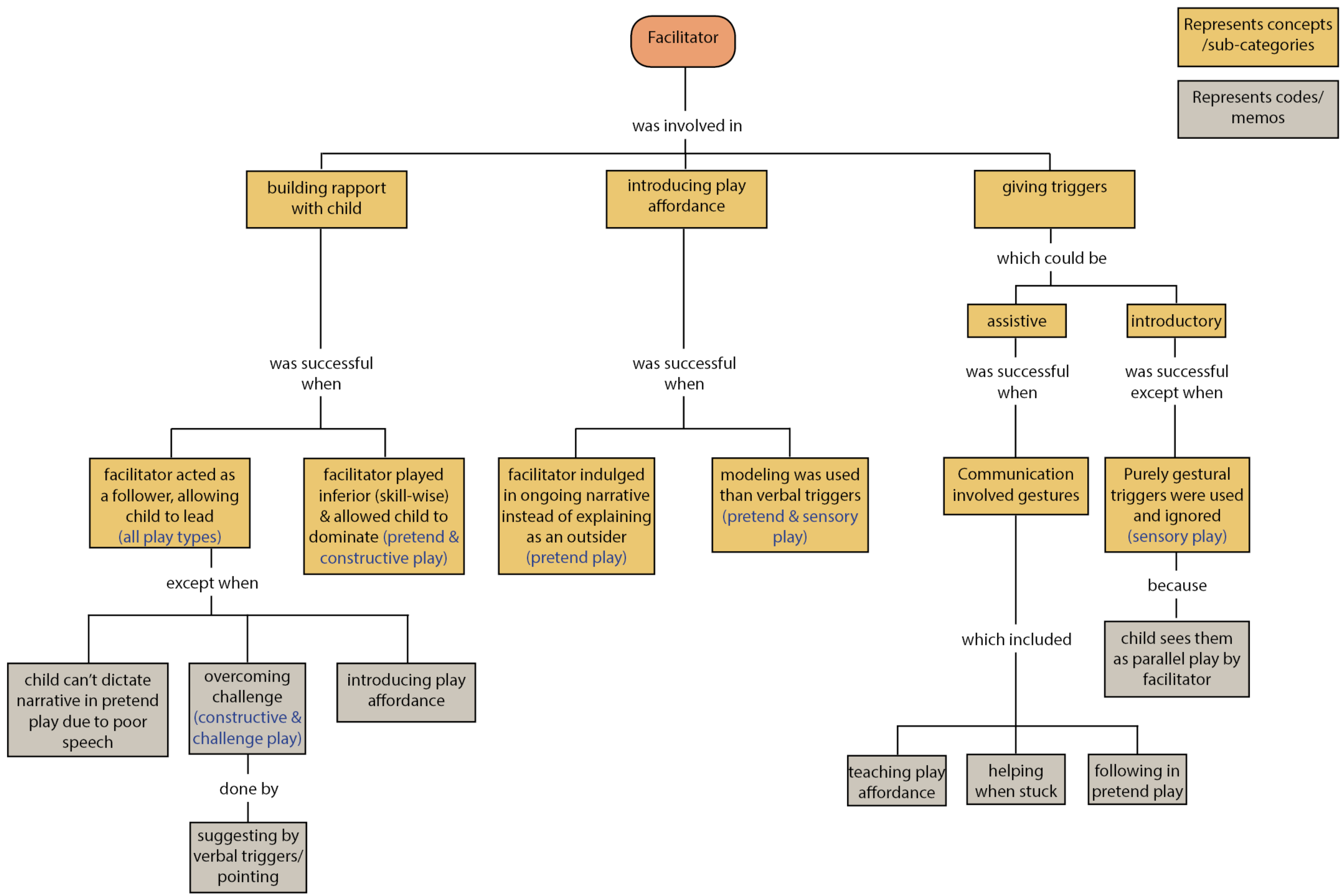


Figure 5.11 Concept map of '**Strategies used for facilitation during play interaction**' category

Another strategy which helped in building rapport could be seen in the concept stating that **facilitator was accepted as a play partner more easily when he intentionally played inferior to child in terms of skill and acted as dependent on the child by letting him dominate** during play. Hanna, Risden, and Alexander (1997) in their guidelines for usability testing with children have also mentioned that pretending you need help in doing an activity encourages young children to try it. However, their work was not based on a research study but more on their experience in the field. This strategy was seen working in constructive play e.g. when playing with 'Par', facilitator intentionally showed that he was not able to make a stable tower which would fall, and 'Par' would laugh. He soon invited facilitator showing him his construction. Other instances of this strategy were seen in pretend play where facilitator would let child to ascertain power in the ongoing narrative, as shown in an excerpt below.

> After exploration, 'Mok' invites facilitator to play..... He is the leader most of the time, while facilitator plays along. He also seems to smile and become happy when facilitator acts as if he is afraid of injections when 'Mok' attempts to inject him.... ('Mok', memo 111, Oct 9th 2014)

It is worth noting that this particular strategy was not observed in other play types like challenge based play and sensory play.

For introducing play affordances – In few occasions, facilitator introduced a play affordance of toy being played in the ongoing play episode which child had failed to notice. Two strategies seemed to work successfully in introducing the play affordance, noted as concepts. Introducing play affordance of a toy was achieved by becoming a play partner and **indulging in the play act of the ongoing narrative**, rather than informing the child externally (memo 62, 29, 140, 141, 171 – refer Annexure J). Using the ongoing narrative helped in contextualizing the play affordance and thus aided in understanding its use. However, this strategy could be used only during pretend play, as illustrated in an example below.

> Facilitator explains about the injection by modeling it on himself. He produces a sound while pushing the injection. The child seems to like it and laughs at it. Later, child also uses the injection and gets surprised when the facilitator produces the sound which makes child laugh. ('Swa', memo 29, July 17th 2014)

Modeling the play affordance to the child seemed to be much more successful than explaining it through verbal triggers (memo 62, 35, 29, 114, 140, 141). Verbal gestures were successful only when the child was already interested in play, understood the communication and knew the play affordance of toy from before, which was often not the case. This strategy was found being used in pretend and sensory play illustrated as follows.

> 'Sid' invited facilitator to play couple of times and likes playing with him. She followed him as he swept over the planks of xylophone serially. This is another instance of learning an affordance from facilitator. There is an interesting interaction between the two as they both play together. ('Sid', memo 35, July 8th 2014)

Using a combination of above strategies in pretend play led to almost 100% success in introducing a play affordance.

5.5.6 Constructive play and its properties

Constructive play was found to be **one of the most engaging play types**, slightly lesser than pretend play. While the nature of play was not constrained by any external rules, a strong concept emerged showing that children were seen to engage in **meaningful constructive activities**, by setting up target on what they wanted to make (refer accompanying concept map in figure 5.12). However, it was not possible to deduct what child was attempting to make based on their final construction, probably due to lack of ability, but they often communicated to the facilitator about their target, as shown in one of the excerpt below.

> In this sequence, we notice that the child takes apart blocks from what she was doing and redoes it with changes, which could mean that the child is not randomly connecting and might have some idea for construction. Also, in a number of occasions later, the child is seen to make constructions from blocks of different size and colors which are not linear thus again leading to a possibility that the child is making something not random, however due to lack of communication ability, we could not ask what she was making. In third session, she is actually conversing and tells should i make this? She does seem to have an idea of what she is making. However, in no occasion one could figure out from the shape as it looks random. ('Tan', memo 6, May 2nd 2014)

Also, another concept seen for some of the children stated **children would show attachment to the construction** they had made, thus target seemed to be an important factor motivating them for constructive play. This attachment can be observed in the excerpt below.

> 'Swa' asks the facilitator not to break his construction but to keep it as it is on the shelf. Some of the earlier children did not show any attachment to their creation - related to process over outcome category (edit - this category had been later rejected) ('Swa', memo 34, July 18th 2014)

Lastly, children were often seen arranging elements of a toy including beads or blocks as a part of their play. This kind of play activity could also be broadly classified as constructive play.

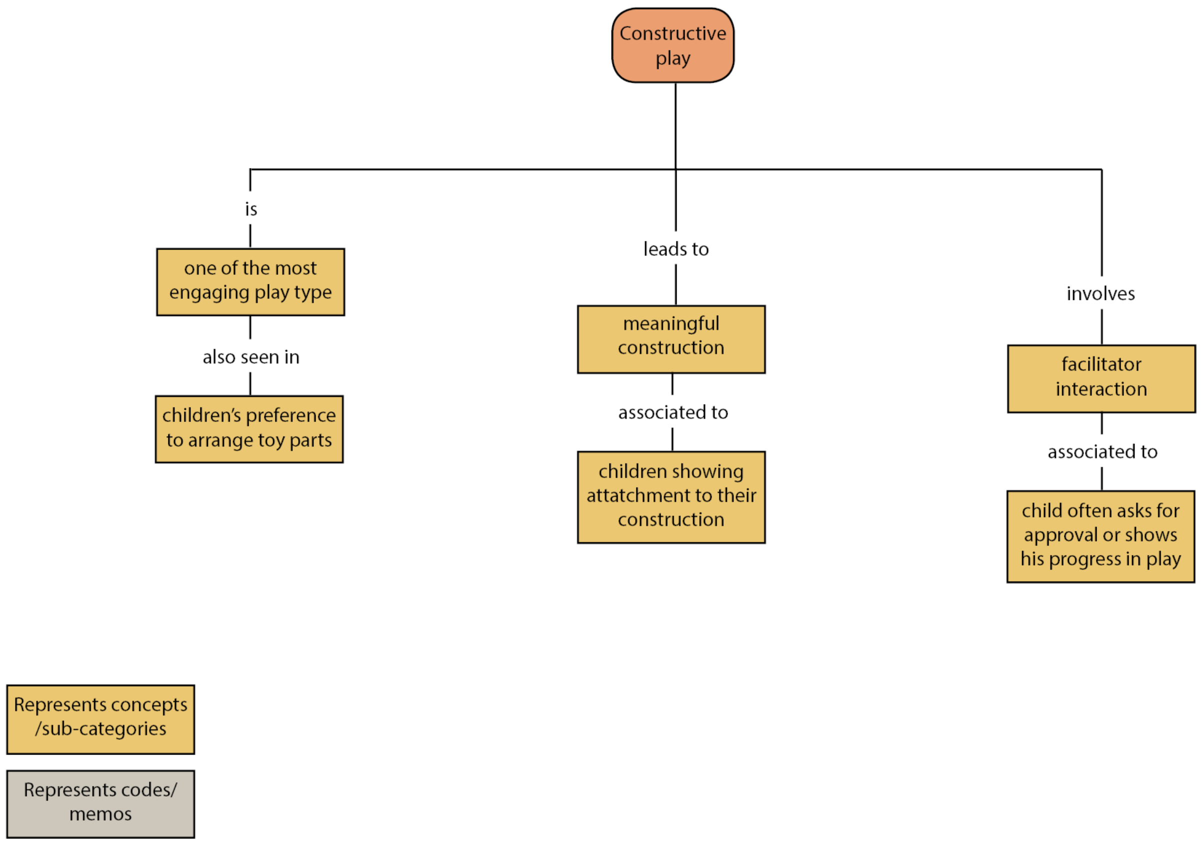


Figure 5.12 Concept map of '**Constructive play and its properties**' category

5.5.7 Preferences of children during play interaction

This was a broad core category which encompassed all the concepts looking into preferences of children at different levels from the observed play behaviour. Preferences were seen in terms of individual toys, play type, play environment and behaviour, each mentioned below briefly (refer figure 5.13 for concept map).

Individual toys – In terms of toy features, **auditory feedback emerged as the preferred feedback** type for most of the children. This could be seen based in the concept stating that **Sound feedback led to expression of joy** in all children except 'Tan'. However, sensory play itself was short in duration lasting for less than 3 minutes in most occasions. Another concept showed that **xylophone or drum was found to be the most preferred** sensory toy. Apart from the preferred auditory feedback, the **ability to modulate that sound by physical action** may have made the play more engaging to the child.

Play environment – Three of the children, namely 'Tan', 'Swa' and 'Poo' were seen to show **preference for an enclosed play space** when an unwanted noise or physical intrusion was encountered. However, the physical boundaries and entry/exit points (like doors and windows) did not have any significance as the same child would also cross them during a play session, as shown in the following excerpt.

> When a child from outside starts peeping from the door which eventually disturbs the doctor-patient pretend play inside, facilitator asks him to go and pushes the door. 'Poo' also gets up and asks facilitator to lock the door showing that he wants to create a play space uninterrupted by external interference. ('Poo', memo 132, Nov 10th 2014)

Other children however did not show any effect of noise and physical intrusion on their play behaviour. Infact, 'Par' would smile and wish some of the other students who passed by the room.

Play types – Out of the four play types, either **pretend or constructive play led to highest engagement** for all children. Both of the play types have a strong free play element, in which the target and rules of play are set by the child himself. **Social play was seen to be preferred over solitary play**, as seen in the concept showing that most of the interaction which were longer in duration involved interaction with facilitator, often involving him as a play partner. Children also showed a **preference for physical activity in play**, often manifested in the form of gross motor play. It is worth noting that the toys were selected in the present study for solitary, table-top kind of activity and inherently did not involve gross motor play.

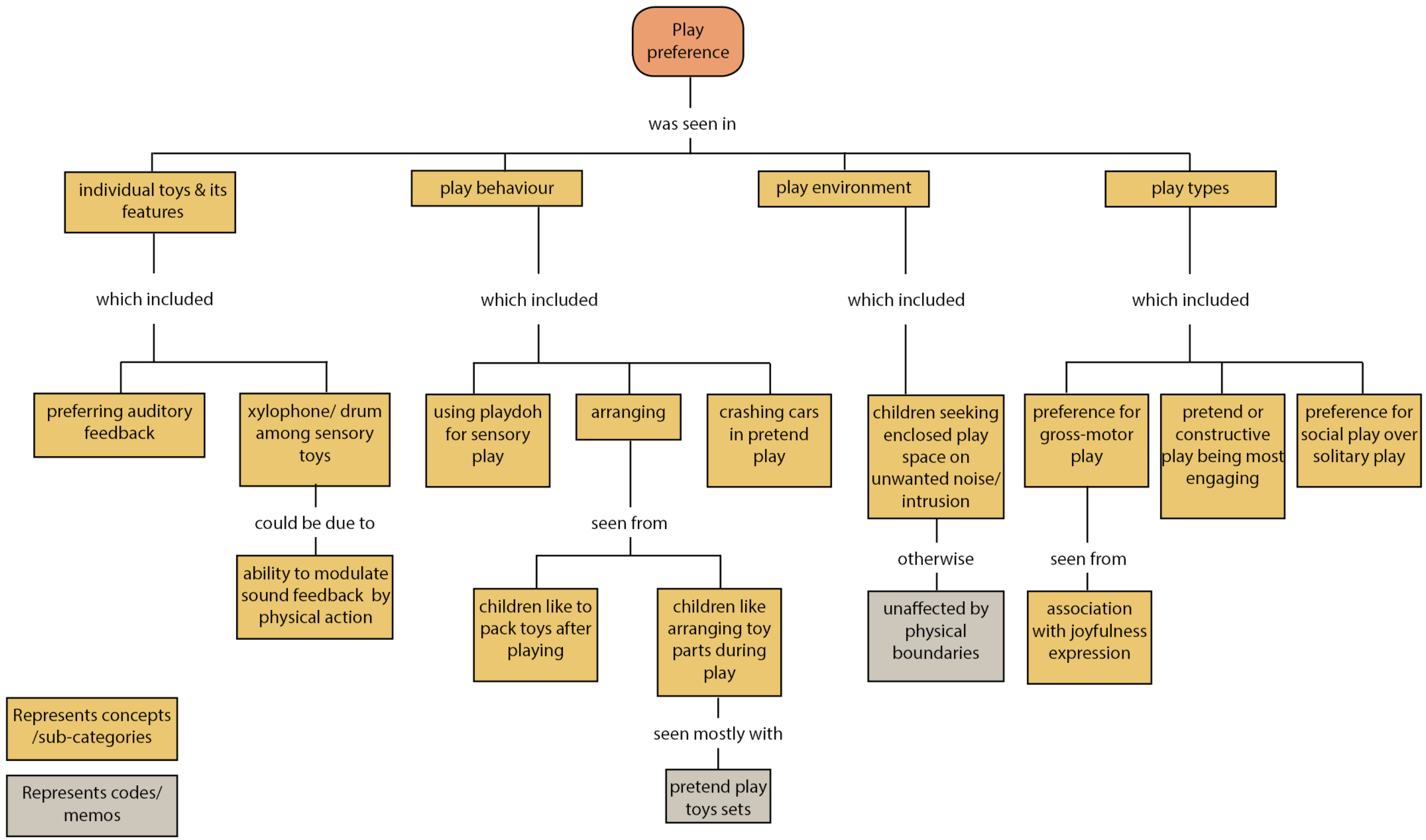


Figure 5.13 Concept map of '**Preferences of children during play interaction**' category

However, **children improvised to create situations for gross motor play**. This preference was substantiated by a concept which showed that **all instances of gross motor play involved expression of joy and excitement from children.**

Play behaviour – One of the prominent patterns seen in play behaviour of most of the children showed a **preference for arranging** play objects. This was visible within play episodes where children often arranged elements of a toy as a part of their play. Generally, these were elements of a pretend play set like doctor set, kitchen set, cars, etc. Apart from this, another concept supported this pattern stating that 5 of the children liked to pack and store all the toys at the end of play sessions, and would not leave the play space until finished. However, this behaviour could also be due to their playing habits at home or school so it would be difficult to conclude on it. Following excerpt shows an example of such behaviour:

> She is keen on arranging and tiding while playing - 1. She took out all the blocks after playing and stored them (no attachment to what she made), 2. She took out the beads also, 3. Uses Handkerchief and folds it very meticulously ('Tan', Memo 13, May 4th 2014)

5.5.8 Issues in play interaction with toys

Broadly, two kind of issues were identified during play interaction with the set of toys presented to the children, as discussed below (refer figure 5.14 for concept map).

Ergonomic issues – Most of the children faced **fine motor difficulty in connecting two blocks** (lego-like) during constructive play. These blocks were larger than the usual lego blocks in size for better grip but the problem was the application of force by children at wrong angles (i.e. pushing blocks diagonally) while trying to fit one block into other, leading to blocks slipping over each other. This difficulty was often overcome by hit and trial procedure and in few occasions, child will switch to another set of blocks. Apart from this, **toys were not robust and strong enough to handle rough and tough use**, as needed for the studied population, and often broke down. This included doctor set equipment like scissors, stethoscope, etc. The positive aspect of doctor set equipment was that they could be joined and reconnected easily as they had a modular design. Other toys which broke down included sound making ball (nested balls) and drum with sticks. There were ergonomic issues in the doctor set equipment as some of the elements like stethoscope, spectacles, etc. were **too small to wear and use**. This could simply have been an issue specific to the selected toy, but it seems plausible that **differences in cognitive and physical ergonomic aspects** may be unique to our population and thus demands attention from designers.

<u>Issues related to lack of appropriate feedback</u> – Construction blocks included blocks of different color, shapes and sizes but they had same method of connecting them, except purple colored and wedge shaped blocks which could be used in a specific manner only. Even after explaining to the children, they were **not able to differentiate these two type of blocks with the usual set of blocks** and would lead to failed attempts to join them in the standard manner. This problem could have been solved if there was appropriate feedback to differentiate these unique blocks and also transparency in how they were to be connected. Lave and Wenger (1991) have used this term 'transparency' implying that the user should be able to understand the inner workings of an artefact. Again, what might have seemed simple for typical children may not be enough to give correct play affordance for the special population. Similarly, light and sound feedback based sensory balls which were similar in shape and size and differed only in color were given to children as sensory toys. Again, after explaining how the **two balls differed in functioning and feedback, children would get confused** and could not get to actuate feedback with them as intended. Again, there is always a possibility that verbal communication by facilitator was not understood by the children so the design itself should be able to explain how the toy could be used (transparency of play affordance). It is worth noting that some of these toy issues are related to that particular design of toy used in the study and so it will not be reliable if we draw generalizable conclusions from them.

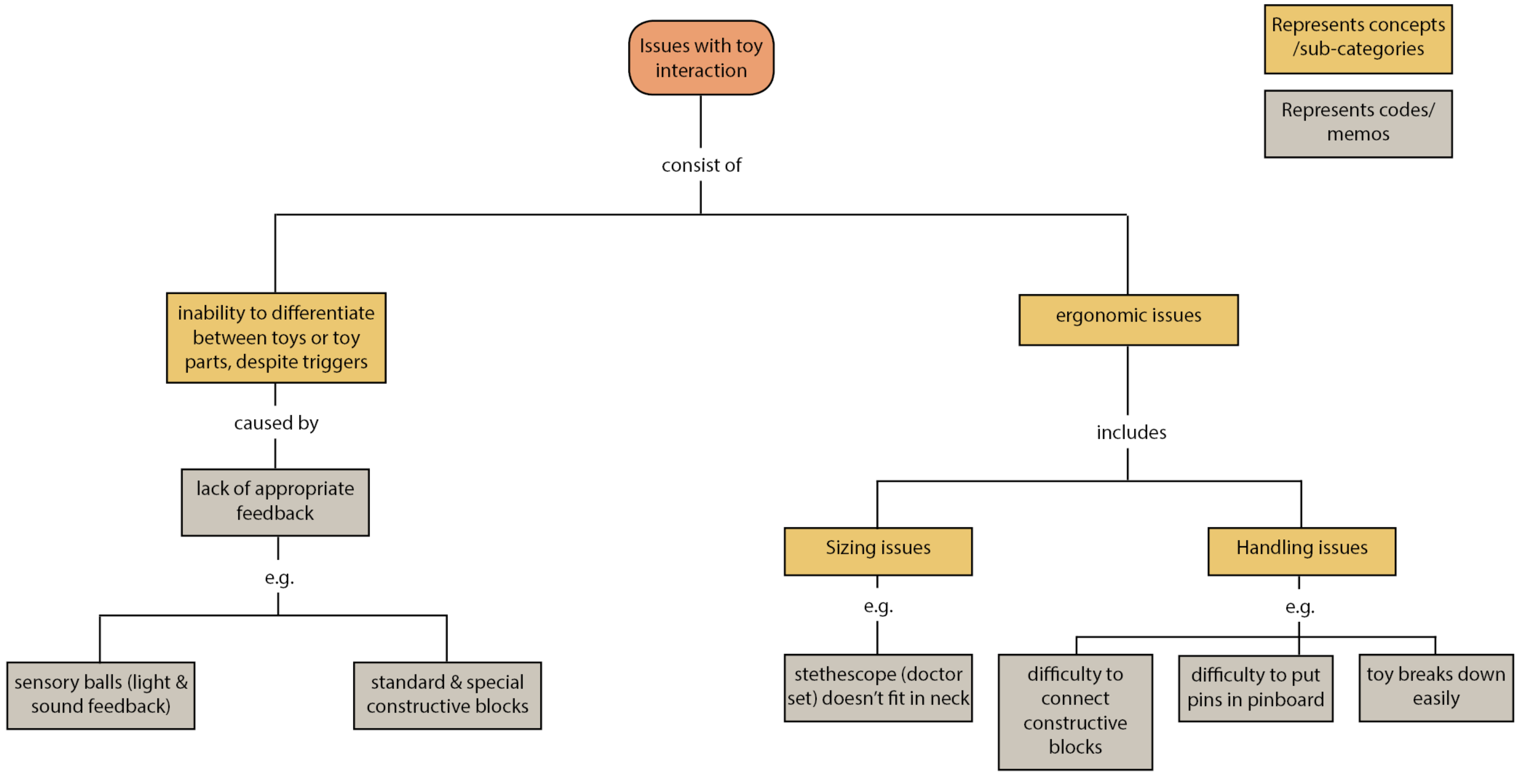


Figure 5.14 Concept map of '**Issues in play interaction with toys**' category

5.5.9 Assessing playfulness and its components

The researcher was already sensitized with the construct of 'playfulness' from existing research literature, prior to the qualitative study. However, to adhere to the core principles of grounded theory, it was decided to start the theoretical development from scratch. While analysing the data, a number of possible indicators of measuring different aspects of playfulness emerged. These insights were later compared in light of the existing theories. Inspired from Sanderson's (2010) definition and informed through data from the present study, playfulness has been redefined as: "**the expression of the child's drive to freely and pleasurably engage, connect and explore an object during the play interaction**". Playfulness is seen as a multi-dimensional construct whose dimensions could be assessed in our context as follows.

<u>Social connection</u>: This dimensions refers to the 'child's cooperative interaction with others and the surrounding world' and depends on how safe the child feels in the environment (Sanderson, 2010). A number of codes related to interaction with toys, environmental artefacts and facilitator could be used as indicators to assess the level of social connection as shown in the following concept map (figure 5.15) and described as follows –

- **Interaction with toys** – Interaction with toys comprised of several codes whose frequency and level varied between the participants like level of toy exploration, instances of combining multiple toys of different play types in a single play episode, order of selecting toys (based on the movement analysis explained in the analysis section above), among others.
- **Interaction with facilitator** – Used as another indicator to assess social connection, it looked at variation in frequency of codes like seeking attention, verbal communication, playing with facilitator, power dominance with facilitator and mischievous behaviour. Higher instances of all these indicators observed showed that child felt free and safe to connect with facilitator.
- **Interaction with environmental artefact** – This indicator looked at frequencies of codes like exploration of non-play intended objects in play space (including mirror which was a part of play space in the present study) and using these objects to derive play.

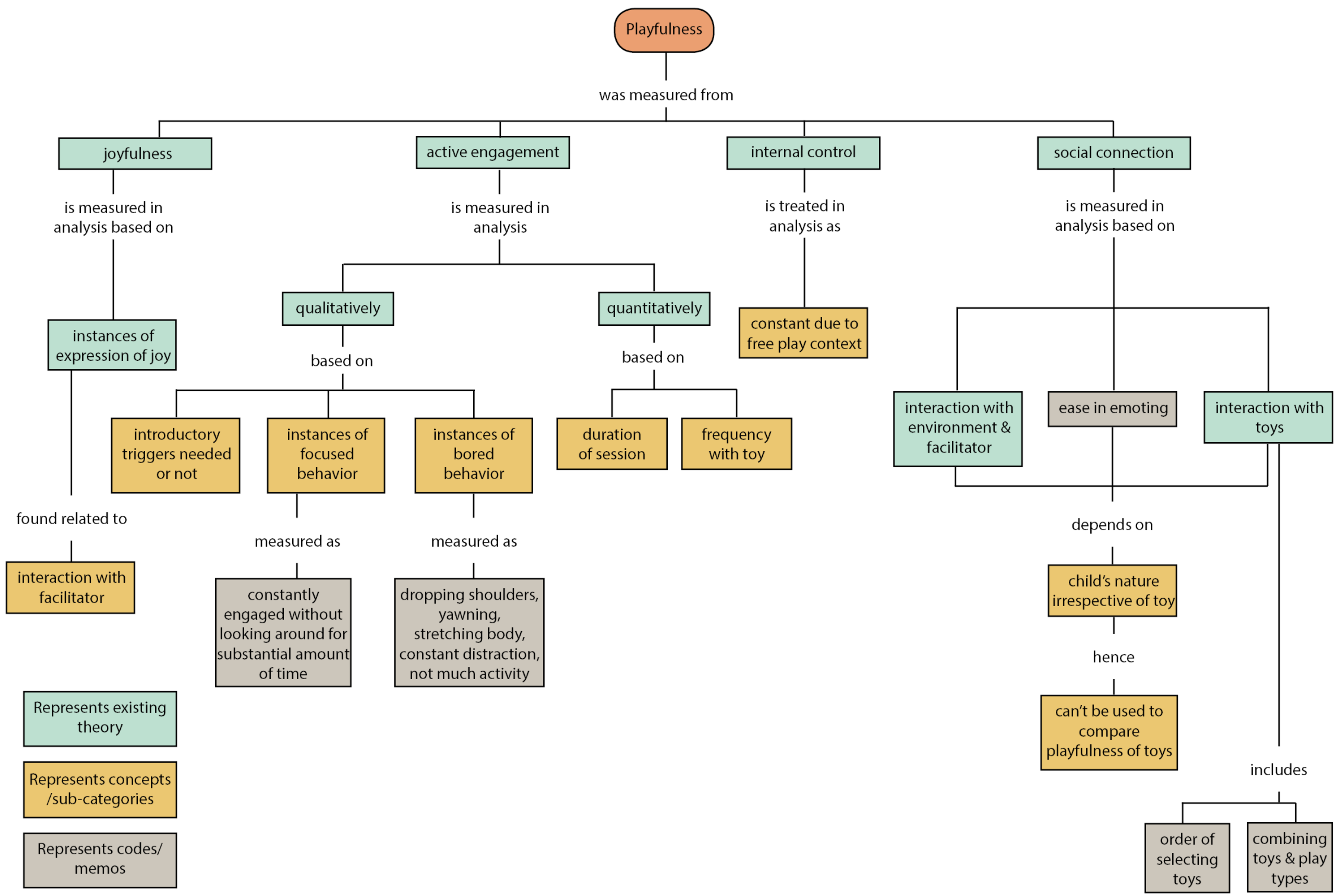


Figure 5.15 Concept map of '**Assessing playfulness and its components**' category

- **Emoting or expressing** – Apart from the activities, child's ease of expressing was also seen as an indicator of social connection he had with the environment. This included expression of joy, discontent or disagreement as well as freely using his body by rolling or making sounds/ singing etc.

Comparing children's behaviour for these codes showed that the dimension of social connection depends on child's individual nature and was a **stable-personality trait, and would not vary much across play interaction with different toys**. e.g. 'Tan' seemed to have a more introvert and subdued presence which reflected in her play interactions irrespective of the toys. While analysing these codes, a strong concept emerged showing that these **indicators seemed to remain consistent for a child across the various play episodes** with different toys. e.g. 'Tan' who had an introvert presence was seen low in interaction with facilitator, environment, emoting and toy interaction. On the other hand, a child like 'Par' or 'Sid' who were much more expressive and extrovert, showed high instances of each of these indicators without any contradiction. However, these parameters may need more refinement and testing, and may be helpful for researchers working in the domain of playfulness in better understanding of the dimension of social connection. This finding also stresses on the need to understand child's nature and temperament to make meaningful deductions from his observed play interactions. It is clear that **in the context of our study, the dimension of social connection will not help in comparing play interaction** with different toys for the same child in a fixed environmental space.

<u>Active engagement</u> – This dimension refers to the 'child's enthusiastic and complete immersion in an activity' as stated by Sanderson (2010). Active engagement was found to be the **most useful and objectively definable dimension** to assess playfulness. While analysing the data, a set of both qualitative and quantitative indicators emerged that could comprehensively assess the level of active engagement in a play interaction. Quantitative indicators included the **duration of play interaction** with a particular toy as well as the number of times (**frequency**) a toy is selected for play interaction. Play interaction excludes the cases of exploration of toy (holding and checking the toy for a brief duration) and includes only those instances when one or more forms of play (sensory, pretend, constructive or challenge based) were exhibited by the child during the interaction. It was important to consider both frequency and duration because it would help in differentiating those instances which led to long duration episodes from the ones which were short in duration but occurred

frequently, thus indicating difference in the nature of play behaviour exhibited. However, quantitative indicators did not give the complete picture as they do not look into the quality of engagement during free play. To address this issue, a set of qualitative indicators were identified which could be useful for complementing the quantitative indicators. These included –

- **Instances of bored behaviour** measured by facial gestures like yawning and body gestures like dropping of shoulders, child stretching his body, not much activity with toy and constant distraction (seeing around).
- **Instances of focused behaviour**, measured by identifying those instances where the child was constantly looking and interacting with a toy for a 'substantial' amount of time, except when an external interference caused him to lose focus. There is no way to determine what exactly should be the threshold value after which an episode can be associated with focused behaviour. In present context, a duration of more than 5 minutes of interacting with a toy was approximated as an instance of focused behaviour.
- **Occurrence/absence of introductory triggers** to initiate interaction. Introductory triggers were occasionally given by the facilitator to motivate a child to interact with a toy which he himself did not approach earlier during the session. This indicator was important to differentiate those instances of play interaction which were intrinsically motivated and thus would be rated higher on active engagement than the ones where motivation was given by an external agent like facilitator.

A combination of these qualitative and quantitative indicators helped in assessing and comparing the level of engagement between individual play episodes, and these results helped in the development of subsequent theories of play interaction which were related to engagement. It is important to note that some of these qualitative indicators would be more relevant in longer free play episodes similar to the sessions in present study. It might be difficult to identify instances of bored and focused behaviour in sessions having smaller duration.

<u>Joyfulness</u> – Joyfulness addresses the emotional aspect of engagement and refers to the 'child's sense of love, fulfilment, and hope that is expressed with displays of pleasure and exuberance' (Sanderson, 2010). Since the only way to collect data was through observation of play sessions, it was assessed by identifying the instances where child expressed joy

through smile and laughter. A very interesting relationship that emerged from data could be seen in concept stating that the **instances of expression of joy were almost always occurred when child interacted with facilitator**, which involved playing with facilitator or offering him to play (shown by 'Swa', 'Tan', 'Par', 'Sid', 'Mok', 'Poo'), or responding to a verbal/gestural trigger of facilitator or verbally communicating with him (shown by all children), or responding to facilitator's smile and eye gaze (shown by 'Par', 'Sid', 'Mok', 'Kri'). This relationship was further supported by the concept focusing on intensity of expression wherein **expression of joy in presence of facilitator was more profound and longer lasting than the few instances where facilitator was absent**. Infact, three of the children namely 'Mok', 'Poo' and 'Kri' were seen searching for facilitator to share their joy during play interaction e.g. when they started beating the drum. The underlying reason for this relationship could be that expression of feelings is most commonly associated with communication and facilitator's mere presence can give that sense of acknowledgement to the children. Some of the cases when children were seen smiling looking at their mirror image could also be seen in this respect, as there is a need of companionship for children to express. More importantly, it seems that the **dimension of joyfulness can't be assessed in play sessions which involve solitary play and don't have a facilitator**, as the instances would be too few and not a reliable source of assessing playfulness.

<u>Internal control</u> – This dimension refers to 'the child's sense of safety, balance, and competence that allows her to comfortably engage with the surrounding world' (Sanderson, 2010). By the very nature of design of the interventional study, the child was free to explore or interact with any of the toys available. The facilitator spent enough time with the child to develop a rapport as a play partner by conducting rapport building sessions in play space. Moreover, facilitator had been interacting during play with the children for 1 year before the start of the study. Thus, all children were subjected to the same condition of free play and could exercise internal control on the overall play session. Hence, **internal control as a dimension could be seen as a constant in the context of our research design, also applicable to other interventional studies** where free play is studied.

5.6 Results: Development of generative playfulness dimensions

A total of nine core categories emerged from the analysis process, as described in the previous section. While these categories were more comprehensive in terms of explaining how play manifested in different situations, how playfulness could be assessed and the role played by contextual factors including facilitator, it was important to refocus the findings to align with the main objective of the thesis. The final list of 66 concepts that had been developed through the rigorous constant comparison process was reviewed to identify those concepts which looked into design characteristics of toys and play activity, and/or gave application or practice related insight, by taking the point of view of a design activist. This step led to reduction in the total number of concepts. An affinity mapping process was performed with the remaining concepts to identify a set of strongly grounded design characteristics of play artefacts or activity which would lead to enhancement in observed playfulness for the participants. Furthermore, these design characteristics were checked for their level of generalizability and **those design characteristics which were broad enough to be applied out of their original context (based on their conceptual origin) are reported as the main contribution of the thesis, termed as 'generative playfulness dimensions'**. Other design characteristics which were pertinent to a specific toy, play activity and/or context have been reported as actionable design recommendations in the contribution chapter, and could still be useful for designers.

The significance of the identified generative playfulness dimensions lies in a strong grounding in data and their generalizability, which allows them to be used as design guiding principles. These dimensions include: 'narrative', 'interactivity', 'player's movement', 'agency', and 'showcase outcome'. All these dimensions were found to be present to different extents in the play episodes of the four play types, playing a crucial role in affecting the playfulness. In terms of origin, some of the dimensions are based on concepts related to design features of a toy, while others are based on concepts related to improvisations made by the child himself or the facilitator's strategies which led to higher playfulness. Figure 5.16 shows this difference in origin of each of the dimension treating child (improvisations), facilitator (strategies) and toy (features) as individual nodes, such that placement of the dimension represents their source of origin approximated through proximity to each of the nodes. The aim for toy designers would be to shift all these dimensions closer to the toy (features) node thus embedding them into the design itself.

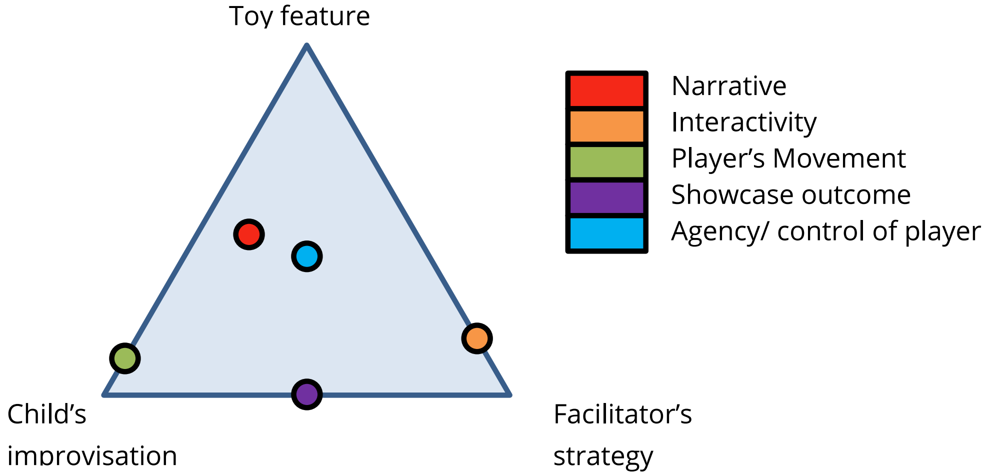


Figure 5.16. A two-D representation of dimensions showing their proximity to source of origin being child (improvisations), facilitator (strategies) and toy (features).

Each of the dimensions is defined below with an example to explain its application, along with a brief discussion on its origin tracing back to the concepts and theory leading to its development.

5.6.1 Interactivity

Interactivity as a dimension is defined as making toy/activity interactive and responsive to player's actions by giving instantaneous feedback on fidelity of the action (being a success or failure) as well as the state of play and its progression. The feedback needs to be contextual to the action being performed to make the activity more meaningful and thus contribute to the engagement. As a result, it is also suggested that breaking down a process into discreet states would be useful when using this dimension.

Example of application: Facilitator often responded to child's actions during a pretend play episode by being a play partner but in his absence the toys can give a meaningful response e.g. brushing doll's hair v/s patting her to sleep v/s touching cup to her lips could each give a contextual feedback making the activity more meaningful. Another example in the category of challenge-based toys like shape-sorting or size sorting toy would be to give feedback on whether the on-going action is correct or wrong thus assisting child in determining the achievability of the target.

Figure 5.17 An illustration of applying interactivity dimension in pretend play with doll to enhance its playfulness

Theoretical grounding: Interactivity developed as a dimension primarily based on the concepts that were related to the strategies and interventions made by the facilitator during play episodes. The presence of facilitator was found to be very important as could be seen from the concept stating that **most of the sessions which were long in duration involved facilitator's interaction** in the activity. Although the present study tried to limit the scope to studying solitary play, **children would often seek response from facilitator on their actions, and even invite the facilitator to join as a play partner**. This concept was found to be present among all the children except 'Tan', as seen in some of the excerpts below.

> After exploration, 'Mok' invites facilitator to play. He pretends as a doctor using all the equipments unlike 'Swa' who used only few and shows connected set of meaningful actions. Overall act of treating the patient is repeated with some new actions during the act. Also, use of mirror, card and thermometer does not seem clear to him. He is the leader most of the time, while facilitator plays along. He also seems to smile and become happy when facilitator responds to his actions especially when facilitator acts as if he is afraid of injections when 'Mok' attempts to inject him. ('Mok', Memo 111, Oct 9th, 2014)

> 'Kri' is able to derive pretend play with interactive phone without any trigger, and initiates the conversation by saying hello and looking at facilitator. Facilitator replies and has to often create conversation as 'Kri' can't frame sentences.... This is the 1st time when 'Kri' does not communicate properly and is not understood well by facilitator, however he seems to understand facilitator's statements and replies everytime. Due to lack of communication, the conversations are relatively small. ('Kri', Memo 171, Nov 17th, 2014)

One of the strategies that helped in easily building rapport with the child during the play episode involved **allowing child to lead in play and taking decisions about play, adopting the role of a follower**, especially in pretend play episodes. An example of this strategy could be seen in the pretend play session with 'Mok' as described in the excerpt above. Thus the position of facilitator was more of a responsive agent reacting to child's actions and triggers instead of guiding his play. The idea behind using this dimension is to embed some aspects of the responsiveness of an active facilitator in the design of a toy or play activity.

Another concept which strengthens the need for responsiveness to support children's play could be seen in the challenge-based play episodes where children did not tolerate sustained failure and would simply switch from the challenge play. Out of the few instances when child was motivated and continued the challenge-based play till he/she reached the target, most of them involved **active facilitation** where facilitator assisted the child to **ensure that they did not make more than 2-3 consecutive mistakes at each step**. Again, the interaction of facilitator in letting child play and intervene when he continued making mistakes showed him being responsive to his actions instead of pro-actively guiding them, as seen in the following excerpts.

> Mok started with 5-piece puzzle and had a lot of difficulty in completing. He needed a number of assistive triggers. However, he was able to complete 4-piece and 3-piece puzzle with relative ease. He did not leave play on facing difficulty however he was assisted when he failed consecutively and did not have to struggle too long. ('Mok', Memo 121, Oct 11th, 2014)

> Kri seemed interested and quickly started playing with stacking cups on trigger however he did not seem to understand the size variation between the cups and thus could not connect them in right sequence. He was able to complete it with the help of assistive triggers (facilitator correcting the sequence after some trials by Kri) and showed happiness on completion. ('Kri', Memo 161, Nov 16th, 2014)

The need of these children for seeking interaction during play could be seen in another concept showing that some children were seen **interacting with their mirror image** (seen from the glass on cupboard kept in front of them). Thus, there is a clear role of responsive agent during the play activity and design of toys and activity needs to account for this need of interactivity sought by children. One of the concept which could be useful in implementing the interactivity dimensions is related to the preference of auditory feedback, as **sound produced from toy interaction by all children (except 'Tan') while playing with toys (mostly sensory toys) led to expression of joy** in many instances and was a major source of expression of joy.

5.6.2 Narrative

Narrative as a dimension refers to the usage of relatable narrative and/or role-play, externally introduced through design to complement the events and process associated with a specific toy play. The child either assumes a character in the designed narrative or just acts as an audience to the narrative which enhances his/her engagement in the play activity. It is expected that usage of narrative will not necessarily lead to pretend play and narrative could in-fact be used as a toy characteristic to support other play types.

Example of application: Shape matching board toy which was used in the earlier study as a challenge-based toy could have embedded narrative to make the activity and events related to matching the shapes more meaningful and thus engaging. An instance of this could be that all diverse shapes could be visualized as fantasy characters and the holes as their homes/caves while the child as a player gets involved in the narrative of helping the characters find their homes after they are lost in the city (refer figure 5.18 as follows). Similar, possibilities can be explored in the domain of constructive and sensory play to utilize narratives as a tool for engagement.

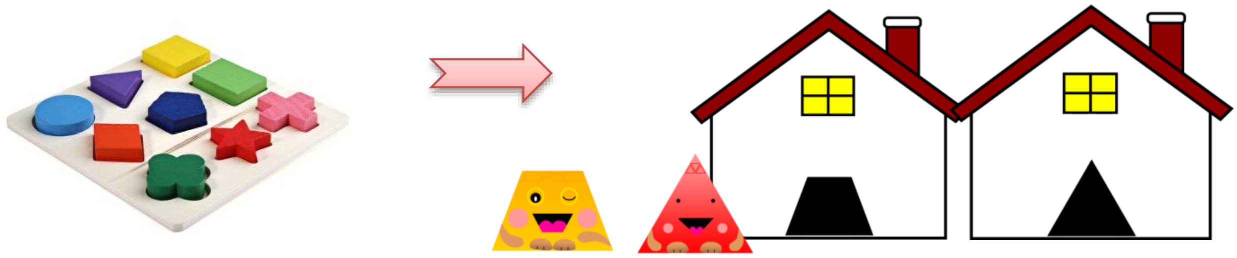


Figure 5.18 An illustration of applying narrative dimension in the design of shape matching toy to enhance its playfulness

Theoretical grounding: The identification of narrative dimensions is based on a number of strongly grounded concepts from the analysis. Clearly, **pretend play was seen as the most playful play type** for the studied user group. The uniqueness of pretend play activities lies in the presence of narratives improvised and role-played by the players while toy objects acted as an anchor in the narrative. The significance of narratives as a tool for engagement can further be noted by the concept showing that **unexpected play affordances of a toy** (which includes all non-pretend play toys) **was related to its use in pretend play sessions more than any other play type**. This implies that children would often use a sensory, constructive or challenge-based toy to facilitate a pretend play session by associating them with a narrative. e.g. 'Poo' was seen using drum not for sensory play but to enact a pretend play sequence where he acted as a P.T. instructor playing the drum as shown in the excerpt below.

> Child starts enacting the PT sessions that he has (supposedly happening outside) by playing the drum and telling facilitator steps of PT while facilitator enacts role of a child following his instructions. Again, child dominates and tells facilitator to follow his commands, at times getting angry, when facilitator is not performing like he wants. Here also, child invited facilitator to play. There is a clear communication gap this time as facilitator fails to understand what 'Poo' is trying to tell him to do. It is interesting how 'Poo' makes notes in

notebook (like a real teacher would), also using environmental artefacts in social connection category. ('Poo', memo134, Nov 10th, 2014)

Another example shown by both 'Par' and 'Mok' was the use of beads being put into thread used as a *maala* (garland) which they would put across their necks and check in mirror or show to the facilitator. (e.g. memo 74). Both of these examples showed that children used these non-pretend play toys as a part of a narrative deriving newer play affordances.

Apart from the engagement, **maximum instances of joyfulness were also seen during pretend play session**. However this could be explained by much higher facilitator interaction in these sessions, since it was easier for the child to invite facilitator as a play partner in the ongoing narrative. Also, in terms of toy exploration, **pretend play toy sets were explored more than all other toys**. While story-telling element would implicitly lead to pretend play, narrative as a stand-alone design characteristic could be applied across other play types and activities. However, when narrative is introduced through the design of play artefact, it has to collaboratively constructed between player and the artefact through interaction, similar to the conceptualization by Young and Cardona-Rivera (2011) when they refer the use of narrative in an interactive context.

5.6.3 Player's movement

Player's movement as a dimension refers to designing play affordances in toys and activities that involve gross motor skills and moderate to heavy physical activity. This may include child moving around in play space, dancing, rolling over, swinging/throwing his arms and/or head playfully (not because of visible dis-comfort or anger), etc. during the play episode. This is synonymous to what Pellegrini and Smith (1998) refer to as physical activity play involving a playful context (irrespective of exhibited play type) combined with moderate to vigorous physical activity, such that metabolic rate exceeds noticeably from that when resting. It is worth noting that movement of child's limbs when seen on a scale would show that some movement is present in most of the play episodes. The present dimension proposes that the movement of limbs and locomotion should be increased and gross motor activities like running, climbing, throwing and catching, etc. would lead to higher playfulness in the activity.

Example of application: One of the ways to add more movement and physical activity to an on-going play episode would be to increase the scale of toys and related actions in terms of their size and area, respectively. e.g. constructive blocks could be made bigger allowing children to make constructions, to which they can interact by moving around and through them (refer figure 5.19). Another example could be integration of music and dance elements in the on-going play activity.

Fig 5.19 An illustration of applying player's movement dimension in the design of block toy, by increasing its scale to include gross motor activity

Theoretical grounding: The emergence of 'player's movement' dimension was interesting especially considering that the present study tried to limit toys to support table-top play activity expected to be performed usually while sitting. However, **children were seen to improvise in a number of instances by creating physical activity play out of available toys**. This would include enacting P.T. sessions as a part of pretend play, swinging thread with beads, using sensory ball and construction blocks for catch and throw, etc. as shown in some of the following excerpts from the observations.

> 'par' is seen deriving play from beads toy by swinging the thread with beads. He shows joy while swinging. ('Par', Memo 180, January 18th, 2015)

> 'Poo' always seemed interested in what was going on in PT drill. He is seen getting exciting and shouting *Saavdhaan* (attention) in two different occasions. It could also be seen with his pretend play session with drum where he enacted the PT drill. In the present instance also, he got up, leaving the toys and started enacting the drill listening to the drum beats coming from outside. ('Poo', memo 138, Nov 10th 2014)

This aspect was substantiated by the concept stating that **all instances of gross motor play (seen in four of the children) involved expression of joy and excitement from children**. However, generally these sessions could not be sustained for long and had to be stopped due to the play space constraints. The role of physical activity could be seen from the concept that stated **xylophone or drum as the most preferred sensory toy**, as the interaction involved aspects of responsive auditory feedback along with the **ability to modulate that sound by physical action**.

5.6.4 *Showcasing outcome*

Showcase outcome as a dimension refers to the addition of affordances in the design of toy and activities that will allow the child to exhibit the outcome of play or the progress in play (**while playing with constructive or challenge-based toy**) to another person, or to preserve the showcased outcome for future, as a sign of achievement. Also, the showcasing action by the child needs to be followed by appreciation or motivation either from an external agent or the design itself. However, it is important to note that the choice or volition for showcasing the state of play lies with the player, instead of being a fixed property of the toy. This dimension is limited to constructive and challenge-based play only since these play types are associated with a definite outcome which the child would be interested in showcasing. This outcome is generally defined by external rules in challenge-based play while in constructive play the outcome is determined internally by the child in the act of meaningful construction.

Example of application: Design of toys can have an element of recording child's progress over time e.g. having a meter that indicates number of jigsaw puzzles the child is able to solve on a particular occasion, which could be shown to others by the child. This dimension could also be implemented by involving facilitation, where child may carry different badges as to showcase his progress in terms of actions performed in the constructive or challenge-based play activity. Similarly, constructions of children from constructive play activity could be displayed by adding a display unit in design. Some of the existing aids for application of this dimension could be seen in figure 5.20 as follows.

Fig 5.20 An illustration of applying showcasing outcome dimension in the design of constructive toy (play doh) using display pedestal. Second figure illustrates possibility of simple stickers which could be used to showcase children's progress in play.

Theoretical grounding: This dimension emerged from multiple perspectives. While a number of concepts showed the relevance of facilitator's interaction in contributing to the playfulness of a play episode, mostly this interaction was initiated by the child himself. A concept stated that **almost all the children were seen seeking interaction with facilitator** during play in a number of occasions. This included the instances where five out of seven children tried to **catch facilitator's attention generally to show progress and state of play, often accompanied by appreciation from facilitator**. Some of the excerpts from the observation of children could be seen below.

> In the end he shows off his construction to not only the facilitator but also the teacher in the next room. This tendency of showing and seeking appreciation was seen in playing with beads too. ('Swa', Memo 30, July 18th, 2014)

> 'Kri' does not show many instances where he seeks facilitator's attention and generally is focused in his play. There are only two instances where he seeks facilitator's attention, including the present instance where he wants to show his final progress after he makes a fish from play doh, probably to get appreciation. ('Kri', Memo 175, Nov 19th, 2014)

It is worth revisiting the idea that in most of these occasions, child decided when he wanted to show his progress during play. Another interesting pattern which showed the importance of having an audience in the form of facilitator could be seen in the concept stating that **some children left the play space completely in absence of facilitator**. Following excerpt for child named 'Mok' clearly shows the importance of mere presence of facilitator as audience.

> Mok is seen to leave the play space and go to the adjoining rooms whenever facilitator is not with him. He picks up any toy he can find from there and brings it in the play space. It could either be that he wants to bring more toys or just that he does not like to sit and play alone in play space. However, it is important to note that he resumes play from where he left as soon as the facilitator sits. ('Mok', Memo 117, Nov 10th, 2014)

Children's tendency to display the progress of their play could be seen in another concept when **children were seen showing attachment to the construction** they had made, thus target seemed to be an important factor motivating them for constructive play. It is important to add that insights showed that children were actually engaging in **meaningful constructive activities**, as illustrated in the following excerpts.

> 'Swa' asks the facilitator not to break his construction but to keep it as it is on the shelf. ('Swa, Memo 34, July 18th, 2014)

> 'Kri' again shows focused play after being given the introductory trigger for blocks. He shows meaningful play and seems to be making buildings (or may be walls of a house). When asked, he says, he is making a house. Another interesting point is that he chooses blocks of same color and size for building except at the end. ('Kri', Memo 164, Nov 16th, 2014)

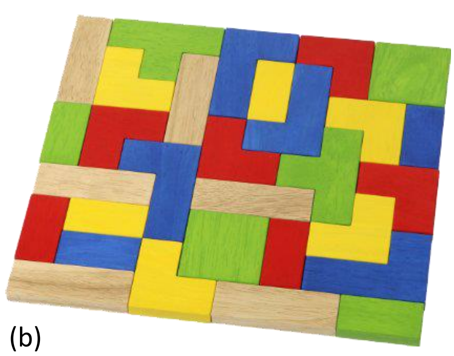
Thus, progress and state of play seems to play an important role for children during challenge and constructive play and adding an affordance that gives choice to the children to display and share this progress would add to their motivation and lead to enhanced playfulness.

5.6.5 Player's agency

Agency/control of player as a dimension refers to allowing the player to have more freedom to manipulate a toy and derive play as he intends, and being less bounded by any external guidance or intrinsic rules or conditions embedded in the design of play artefact. e.g. conditions or rules embedded in playing with jigsaw puzzle and other challenge based toys would reduce the agency of player and thus make it score lesser in this dimension. However, it might not be possible to completely eliminate conditions or rules in challenge based play since it is outcome oriented but designers can attempt to reduce the rules.

<u>Example of application</u>: In the context of pretend play, an application of this dimension could be seen in the form of facilitator's strategy allowing the child control the unfolding narrative and not leading in play. In challenge-based toys, the design should add affordances that allow multiple ways of achieving the target instead of a fixed route e.g. in the ring-game where the child is supposed to put rings on a set of pegs by pressing buttons on gamepad (refer figure 5.21a). There is no one certain way of putting the rings on pegs and every time a new combination if button presses may lead to achieving the target. Similarly, teaching shape matching to children could use a design of toy that allows multiple ways of interacting to achieve the target instead of the standard shape matching boards, as shown in figure 5.21b.

(a)



(b)

Figure 5.21 An illustration of applying agency dimension in the challenge-based toys where figure a shows a game of stacking rings using buttons. Figure b illustrates a design variation of shape matching toy where child has more freedom to explore combination while learning shapes.

Theoretical grounding: The research design of the present study allowed agency and freedom to the children at the level of overall play activity since children had the choice of selecting toys and playing as long as they wanted without any interference or guidance from an external agent. The role of facilitator was also more of a silent observer until the child invited him to play where again facilitator followed child's lead in play. However, between play interactions with toys from different play types, the dimension of player's agency emerged based on several concepts. e.g. a concept stated that out of the four play types, either **pretend or constructive play led to highest engagement** for all children. Both of the play types had a strong free play element, in which the target and rules of play were set by the children themselves. On the other hand, challenge play was the only play form with constraints and rules. As seen in another concept, **challenge based toys failed to engage children and sustain challenge play, making it least playfu**l. The most intuitive explanation to this difference across play type was the level of agency or control that child could enjoy in pretend play episodes and constructive play where he sat his own rules, as opposed to challenge-based play where the toy often had embedded rules and structure to the play process. Moreover, when children gave up challenge-based toys mid-way, some of them were seen **deriving other play possibilities like pretend or constructive play from challenge based toys**. Some of the excerpts which show this pattern are presented as follows.

> Child showed a number of creative derived play possibilities with beads - rotating, wearing it like a garland, arranging it on ground, wearing it in fingers, striking them like in carrom. These affordances were all drawn by him without any trigger. ('Par', Memo 51, June 26th, 2014)

> Mok is seen to follow a similar strategy where he puts 2-3 beads at a time and then takes a break. Infact, there is only small amount of time he spends in challenge play but mostly he is interested in deriving other play uses from it e.g. swinging the thread with beads, wearing it like maala, etc. ('Mok', Memo 123, October 11th, 2014)

Furthermore, in one of the pilot studies, the researcher had noted that in special schools, **unstructured-free play activities were found to be more playful than structured play activities** (Johry & Poovaiah, 2014). Thus, there seems to be a pattern independent of the toys involved where children prefer play activities which allow more agency.

5.7 Discussion: Theoretical & practical implications

Having developed the generative playfulness dimensions, along with other theoretical knowledge on manifestation of different types of play in a special school context represented in the form of a set of core categories, this section follows it up by a general discussion with focus on theoretical and practical contributions from the present study. The section is structured along the generative playfulness dimensions, elaborating on their characteristics and how their emergence adds new knowledge in relation to the existing literature on play of children with ID. Finally, a model to use the identified dimensions as design guiding principles in the design process is also proposed at the end.

5.7.1 Pretend play and narrative

Pretend play, of all play types, has been of most interest for researchers due to its non-literality, unseen in other play types. Our study showed that **pretend play emerged as the most playful play type in 3 to 6 years mental age group for children with mild to moderate intellectual disability (ID)**. **Pretend play toys were also the most explored out of all available toys presented to children.** Pretend play seems to emerge in typical children as early as 18 months of age (E E Barton & Wolery, 2008) and follows a typical order of progression, as reflected in a consistent pattern of change across four underlying processes of cognitive development: decontextualization, decentration, sequencing and planning (Morelock, Brown, & Morrissey, 2003). A number of studies have supported the delayed development hypothesis for children with ID, stating that a similar sequence of development could be seen however pretend play develops at a slower rate in these children (Cicchetti, Beeghly, & Weiss-Perry, 1994; Gowen, Johnson-Martin, Goldman, & Hussey, 1992). However, it is important to note that discourse in such studies seem to focus on pretend play skills rather than preference for pretend play seen in terms of engagement and playfulness as a child could be engaged but not show high skill or level of pretend play. The present study thus looks at a different aspect related to pretend play in children with ID. In case of typical children, pretend play has been seen as one of the preferred play types along with physical, manipulative and constructive play, further affected by individual factors like gender and cognitive styles of children (Saracho, 1995). Among the few studies which looked at preference for preschool children with ID, Case-Smith and Kuhaneck (2008) reported on the preferences of children with and without developmental disabilities aged 3 to 7 years (chronological age) as a function of age by surveying their parents. They found that pretend play was not among the most preferred play types for both typical and special children. This is contradictory to our findings where pretend play emerged as the most predominant play type during free play with toys of all play types. However our study was based on direct observation of children in a free play context, ensuring that children had access to all the primary play types, which should be more reliable an indicator of children's preferences than parent's opinion reported by Case-Smith and Kuhaneck (2008). It is possible that their study may have had some error due to personal bias in parent's opinion as well as the possibility of highly variable environmental factors during children's play at home. Furthermore, our study looked at a mental age of 3 to 6 years for children with ID which does not match with their studied population. We could not find more studies which reveal the progression of preference for play types as a function of mental age, especially in the concerned age group for children with ID, as most of the available research has studied children with Autism Spectrum Disorders (ASD). The issue becomes even more complicated considering that there have been inconsistencies in the characterization of the emergence of pretend play in children with disabilities across the literature, mainly owing to inconsistency in the definitions of pretend play across the play intervention research (Erin E. Barton, 2010; Erin E Barton, 2015). **Acknowledging the gap in existing literature that looks at preference for play types during free play situations in preschool children with ID, our study uses a rigorous methodological approach based on direct observation and reports pretend play as the most playful play type in the mental age-group of 3 to 6 years. This finding is also relevant considering that we did not find any earlier study that looked into preference for different play types in preschool children in a developing country like India**. We believe that more of similar studies in other contexts would help in reconfirming these children's preferences for play typologies as a function of their age, and contribute in its characterization based on observed behavioural traits.

The present study showed that pretend play of most children was repetitive – a) in terms of repeating the same actions in an ongoing play episode (e.g. 'Par' would use toys to shape play doh pretending it to be a food item and store it in kitchen set rack), or b) in terms of repeating the acts (sequence of connected actions in the context of a narrative) between separate play episodes (e.g. 'Sid' played the narrative of cooking with kitchen set but individual episodes had unique actions and sequence), and c) in terms of repeating both actions and acts. However, our study did not find any other kind of repetitive or stereotypical behaviour as reported in literature for children with developmental delays (Goodman & Linn, 2003). Specific to pretend play behaviour, Krakow and Kopp (1983) compared children with and without delays and found that children with delays at around 2 years of developmental age engaged repeatedly in the same actions without change or elaboration, as a part of narrative of bathing and feeding dolls**. Our study confirms that repetitiveness in pretend**

play is unique characteristic of children with intellectual disability even in the age group of 3 to 6 years mental age varying between children. This finding seems contradictory to the strongly held notion in research and design practice that advocates adding more variety and novelty in content (e.g. Dickey, 2005; O'Brien & Toms, 2008; Ryan & Deci, 2000)**. The idea of building intentional repetitiveness in the design of toys and activities could not only answer the cost v/s novelty dilemma, but actually be a useful design input for creating engaging play artefacts for the studied population.** Existing literature does not seem to have looked at the idea of building intentional repetitiveness for enhancing playfulness, except for children with autism as seen in the study by Yuill, Strieth, Roake, Aspden, and Todd (2007)

The present study showed the **presence of instances of meta-conversations by the children with facilitator**, when he was treated as a play partner. Meta-conversations in our context refers to child's ability to switch between a narrative world by acting as a character and the real practical world by acting as the facilitator, to negotiate and sustain the pretend play. Use of meta-communication to establish and maintain play sequences with a partner happens at 3 years of age for typical children, and improves in quality with increasing age (Vriens-van Hoogdalem, de Haan, & Boom, 2016). In our context, this ability was observed in the instances where child expresses (discusses or performs action) to facilitate play in real world during an ongoing narrative. This could become a limitation as most of our subjects had speech delay and language impairments. Jester and Johnson (2016) studied children with specific language impairment (SLI) and stated that they may be delayed in their meta-representational development, when compared to typical children. Our study did not compare meta-representation with typical children, but its presence was indeed seen in some of the children, showing **similarity to typical children when matched on mental age**. It would be interesting to explore if the children who show meta-communication have some common user characteristic to target interventions in future.

The purpose of this thesis was identifying the generalizable characteristics of play artefacts which could enhance the playfulness of toys and activities when operationalized in design. As discussed above, pretend play clearly emerged most preferred and playful over other play types in our study. The unique elements of process of pretend play include – narrative and storytelling. In our study, narratives were generally constructed by children themselves (child becoming the story-teller), sometimes even from play artefacts which were not introduced for pretend play and facilitator was often invited to be a part of pretend play. Since storytelling element suited only a free-play scenario, the **element of narrative was selected and operationalized as a generative playfulness dimension**. This dissociation of narrative from story-telling (child narrating the story) element allowed us to explore the inter-play between narratives and play interactions with non-pretend play artefacts like challenge based, constructive or sensory toys. As defined earlier, narrative as a dimension refers to the usage of relatable story-telling and/or role-play externally introduced through design to complement the events and process associated to playing with a specific toy. In his context, the player relies on the game to communicate the appropriate cues or prompts indicating when and how she should act, and in turn, is expected to behave cooperatively in the construction of the narrative through her actions. The challenges faced and the insights gained in the operationalization of narrative as a dimension is discussed in the next chapter.

5.7.2 Social play, sensory play and interactivity

As discussed in the earlier sub-section, challenge-based toys were generally seen as non-preferred and didn't engage the children. A pattern emerged showing that the point of departure from challenge-based toys when children did engage with them initially, often involved 'sustained failure' by the children. On the other hand, in the few instances **when child was motivated and continued the challenge-based play till he/she reached the target, most of the instances involved active facilitation where facilitator assisted the child to ensure that they did not make more than 2-3 consecutive mistakes at each step**. The reaction to failure during task is an important parameter which characterizes the emotional regulation of children. For typical children, a strategy termed 'productive failure' has been used which involves learning from failed problem solving attempts and applying the knowledge to subsequent attempts (Kapur, 2014; Watts et al., 2016). For these kinds of educational interventions to work, it becomes important to determine the threshold of failure which does not lead to disengagement for our population.

Previous research has attempted to address similar behavioural characteristics, by looking at mastery motivation, which involves persistent task-directed behaviour and requires focused attention. Low attention span has been found associated with DS children who often have high prevalence of ADHD (Attention Deficit Hyperactivity Disorder) as an unreported comorbidity (Ekstein, Glick, Weill, Kay, & Berger, 2011). However, if low attention span was the major cause of children leaving challenge-based toys, it should have been seen in episodes involving other play types also. Perhaps, **one needs to identify if attention span of**

children is correlated to the play context and if it has a specific connection with challenge based play. While not in play context, some studies have looked at persistence during challenge based tasks specifically e.g. Niccols, Atkinson, and Pepler (2003) reported that the persistence scores for DS children and typical peers in a similar mental age range (1–5 years of age) calculated during the challenge based tasks did not show a significant difference. However, informant (parents and teachers) ratings for persistence in DS children were significantly lower than norms for non-delayed children, based on their general response to activities in daily life. It is important to note that environmental factors like low parental warmth, support, family conflict, etc. have been suggested to have had a noticeable impact on attention focusing and persistence of the child (Smiley, Tan, Goldstein, & Sweda, 2016; Zhou et al., 2007). This could be one of the factors due to which persistence seen with challenge based toys during our study seemed to be low as often these children have to experience stressful social situation. Niccols et al. (2003) generally measured persistence by looking at the percentage of appropriate play episodes (e.g. 15 sec intervals) in a fixed duration of time, however unlike them, the focus of our study was not to study persistence per se but to look into the engagement with challenge based toy in a free play context, which gave us the opportunity to look at the construct of persistence during a task when child has other options available. More importantly, **the notion of looking at the threshold for errors or failures has not been seen in referred research literature. Our finding thus throws light on the idea of persistence from the perspective of its application, directly in design practice. We claim that when playing with a non-responsive, challenge based toy in free play context at special schools, children with intellectual disability get disengaged or stop 'persisting' after 2-3 consecutive mistakes**. It is possible that the threshold for errors or failures would be different for typical children as children with ID have been seen to be related to the attitude of *learned helplessness* which leads to lack of persistence. Learned helplessness usually occurs in these children because they have often had unsuccessful and negative learning experiences earlier (Bayat, 2011). It would be interesting to test more variations in the toy characteristics to see if the error/failure threshold value is stable, which could then become a very useful contribution in application and designing artefacts especially for our population with special needs. It seems that the lack of appropriate feedback when children made mistakes led to ambiguity and frustration, thus giving an opportunity for design intervention or developing strategies for active facilitation which focus on failure recognition and timely assistance.

While the scope of the present study was limited to looking at solitary play situation, children often invited and engaged the facilitator into their play episodes. As the children interacted with facilitator, a common pattern in **children's behaviour included them often seeking feedback on their state of play from facilitator**. The pattern of seeking facilitator's attention has been found to be prevalent in children with Down's Syndrome (Feeley & Jones, 2006; Wilde, Mitchell, & Oliver, 2016). Fittingly, the presence of facilitator emerged to be very important as could be seen from the insight that **most of the sessions which were long in duration involved facilitator's interaction in the activity.** This insight aligns with what was seen in one of our pilot studies where children showed a significant amount of social associative play in unstructured play context (Johry & Poovaiah, 2014). Similar behaviour was seen in 2-3 years old typical children in childcare centres where physical proximity and bi-directional interactions with teachers led to significant increase in play engagement (Singer et al., 2014). On the other hand, most of the earlier literature on children with intellectual disability has shown deficits and problems in peer relationship and social play specially when the peers were unfamiliar (Case-Smith & Kuhaneck, 2008; Guralnick, Hammond, et al., 2006; Luttropp & Granlund, 2010), **our finding is a contradiction to this belief where facilitator was easily accepted and invited as a play partner by most children, considering that there was only a brief period of familiarity involving couple of warm-up play sessions**. One of the strategies that helped the facilitator in **easily building rapport with the child during the play episode involved allowing child to lead in play** by taking decisions about play, while facilitator adopted the role of a follower, especially in pretend play episodes. Thus the position of facilitator was more of a **responsive agent** reacting to child's actions and triggers instead of guiding his play. This conception of facilitator's role aligned with what was seen in case of challenge-based toys also where facilitator would let child play and intervene when he continued making mistakes, being responsive to his actions instead of pre-emptively guiding them. It is interesting that the idea of responsive interaction does not directly correspond to one of the most common principles of universal design referred as 'tolerance for error' which suggests that possibilities for error should be minimized (Center for Universal Design, 1997). This is primarily due to the inherent nature of play as a process, thus instead of guiding the child in achieving the target in any other process as suggested by Wehmeyer, Smith, Palmer, and Davies (2004), we found that **it is more engaging to let the child attempt by himself and even experience failure, but ensure that the failure does not get prolonged. This need of responsive agent was operationalized into the generative playfulness dimension of interactivity**, to be embedded in design, as discussed in the previous section. Carr (2000) takes inspiration from Montessori materials and stresses on the quality of play material being ‘autotelic’ i.e. material should signal if the learner is on track or has made a mistake. It seemed worth exploring if the role of facilitator as a responsive and interactive agent could be replaced by the design of toy itself.

Sensory play toys were also one of the play types presented in the present study. While children were often seen approaching these toys, most of the individual sensory play episodes were small in duration, lasting less than 3 minutes approximately. Hence, **while children were often attracted to sensory toys initially, they could not sustain his interest for long**. It is possible that for the age group being studied, sensory play may have been trivial based on Piaget’s theory (1962). Messier, Ferland, and Majnemer (2008) based on interviews of parents of children with intellectual disability reported that children showed interest in sensory elements but their study did not specifically look into engagement episodes. The market survey done by Kudrowitz and Wallace (2010) does show that purely sensory toys are not popular in preschool period anymore and the sensory play element is often in combination with fantasy or challenge based play. **Our findings support the claim that sensory play is no more engaging at the age group of 3 to 6 years, however it still succeeds to attract and catch initial attention of the child which could be a useful characteristic in design**. Our results further showed that **auditory feedback was almost always associated with expression of joyfulness from children**. While this insight could not be appropriated into a generative playfulness dimension since it was too specific to be treated as a broad design direction, it could be used as a guideline for embedding interactivity dimension which would require sensory output from the toys, as hooks or action events at specific locations or time to catch child’s attention. Baek (2009) acknowledged the role of sensory stimuli in the field of digital games in attracting players to the gameplay. The operationalization of interactivity and use of sensory elements at different stages during play has been discussed in the next chapter based on the findings from the validation study.

5.7.3 Challenge-based play and agency

Challenge-based play was one of the four types of play which was included in the free play of the children during our exploratory study based on the classification by Kudrowitz and Wallace (2010). Challenge based toys acquire more significance in the context of play at special schools as often the objective of play is to scaffold learning and development (Johry

& Poovaiah, 2014). Our findings showed that during free play, **challenge-based play was the least playful of all play types and in fact, children often derived other play possibilities from challenge based toys** like using it for pretend play, constructive play, etc. Research in the field of education with typical children has showed that a pleasurable and engaging experience in learning should involve intellectual challenge or stimulation (Douglas & Hargadon, 2000). A lot of research literature on games has identified challenge as a positive component for engaging players and achieving a state of flow. It has been stated that satisfaction in games comes from accomplishing difficult tasks (Lazzaro, 2004; Lazzaro & Keeker, 2004), testing and mastering skills (Fullerton, Swain, & Hoffman, 2004; Lazzaro, 2004), and reaching a desired goal (Federoff, 2002), among others. Lazzaro (2004) further advocates the use of challenge stating that the process of challenge-based play is its own reward, for example the feelings of personal triumph. Most of these studies however seem to focus on adult perceptions and focus on current trends like use of multimedia with narrative in the form of video games. The discourse seems different when it comes to toys meant for children e.g. Kudrowitz and Wallace (2010) conducted a market survey looking at popular toys available for typical children and found that purely challenge based toys were seen to be popular only after 8 years of age, and the challenge-based toys in 3-6 years age group also included significant elements of fantasy play or sensory play. The preference of challenge-based play for typical children aged around 8 years was also seen in the study by Hung, Sun, and Yu (2015) who found that challenging difficulty level in a touch-based learning game led to better flow experience and satisfaction. This is synonymous to the influential Piaget's development theory who introduces problem solving after 7 years of age in the concrete operational stage (Ginsburg & Opper, 1988). All of these studies report that **challenge play became significant at an age, beyond the studied age-group for typical children, which is supported in our findings for preschool children with ID**.

Another line of thought in research on challenge based activities refers to 'mastery motivation' to engage players, conceptualized as striving to achieve competence (Morgan, Harmon, & Maslin-Cole, 1990). Fidler (2006) looked at children with Down's Syndrome (DS) and proposed that they show secondary phenotypic pattern of mastery motivation that is characterised by low levels of engagement and persistence. However, in a recent study by Gilmore, Cuskelly, and Browning (2015), no difference was found in preference for challenge as well as persistence during tasks between children with ID and typical children in mental age group of 3 to 8 years. Yet, the same study reported that parental ratings of mastery motivation were significantly higher for typically developing children. While our study did not compare motivation for challenge based play with typical children, our observation of children with special needs showed low playfulness and engagement in challenge based play with respect to other play types. It is important to remember that lot of play activities at special schools used challenge-based toys like jigsaw puzzles, shape sorting, shape matching, etc. in their daily routine presented as playing aids (Johry & Poovaiah, 2014), despite of sufficient existing literature pointing to a later age for predominance of challenge-based play. With lack of empirical research studies on play preference which can inform on playfulness in challenge based play and other play types for our population, our study gave concrete evidence based on direct observation of children during free play, stating that **purely challenge-based play artefacts and activities are not playful for preschool children with ID, thus the developmental aids should focus on adding design characteristics from other play types for enhancing their effectiveness.** Some of these design characteristics have been identified as a major contribution of this thesis. Also, policy making and curriculum design may also need to shift the focus from purely challenge-based play activities, as seen in the present context. This insight on challenge-based play preference has been further confirmed during the operationalization of different playfulness dimensions, discussed in the next chapter.

The pattern of children being disengaged in challenge-based play was reflected in one of the pilot study where emergence and growth of competitive play was studied for children with moderate intellectual disability at the same facility (Johry & Poovaiah, 2015). Results showed that competitive play emerges at the same age (around 4 years) as seen in typical children when matched on mental age, however **competitive play seemed to decrease with growing mental age, contradictory to the pattern seen for typical children** (P. J. Greenberg, 1932; Knight, Berning, Wilson, & Chao, 1987; Toda, Shinotsuka, McClintock, & Stech, 1978). Since our study had limitations in generalizability due to small number of subjects, the findings are suggestive in nature.

As discussed above, the element of challenge does not engage children in play activities seen in both the pilot and main exploratory study, which is surprising considering its prevalence. While the least playful play type in the exploratory study was seen to be challenge based play, either pretend play or constructive play emerged as the most playful play type for every child, and some of the children were seen deriving other play possibilities like pretend or constructive play from challenge based toys. The most intuitive explanation to this difference across play type would be the level of agency or control that child could enjoy in pretend play episodes and constructive play where he sat his own rules, as opposed to challenge-based play where the toy often had embedded rules and structure to the play process which constrained the possibilities. The author has earlier noted in study 1 that in special schools, unstructured-free play activities were found to be more playful than structured play activities (Johry & Poovaiah, 2014). Since it might not be possible to completely eliminate rules from challenge-based play since it is an outcome/target oriented play, **player's agency/autonomy could be varied on a scale and was operationalized as a generative playfulness dimension**, as discussed in the previous section. The effect of reducing constraints and increasing player's agency has been discussed in the next chapter on its operationalization into a challenge based toy.

5.7.4 Physical activity play and movement

While the present exploratory study was designed to ensure that all primary play types were included to maximize variety in offered play affordances, it was also necessary to limit the scope of the study on certain parameters to have selective focus and a feasible amount of data which could be analysed. It was decided to restrict the study to an indoor play environment and the toys were intentionally selected to support sitting play activities. Despite of this constraint, it was surprising to see that a **number of children improvised in multiple instances to create physical activity play using the available toys, not intended for this purpose**. This included enacting P.T. sessions by moving around and repeating exercises as a part of pretend play, swinging thread having beads with arms, using sensory ball and construction blocks for catch and throw, etc. In a number of these instances, child moved freely in play room and involved facilitator to create play situations. Another insight which substantiated the preference for such activities showed that **children always expressed joy and excitement when they were involved in physical activity play**. It is very much possible that these sessions would have also been long in duration and linked to high engagement but often the play episodes had to be stopped due to the space constraints as it would create disturbance in surrounding classes due to noise. Hinckson and Curtis (2013) conducted a systematic review of measures of physical activity in children with ID highlighting the need for more, appropriately designed studies to be conducted within this population, as often the tools used for measuring physical activity are not checked for validity and reliability. Keeping these limitations in mind, their review showed that children and young people with ID were consistently less active than their non-ID peers. This pattern was confirmed in a recent study which showed that children with ID were less physically active than their age-matched typical peers, both during and after school hours, however the difference was relatively smaller in school (Einarsson, Jóhannsson, Daly, & Arngrímsson, 2016). It is important to note that a lot of earlier studies have focused more on after school activities where participation in physical activity is much higher for typical children, which could be explained as a result of lack of safe and accessible environment in the residential areas for children with ID (Einarsson et al., 2015). Inaccessible social and built environments have been accepted as one of the major barriers during the decision making process of caregivers around outdoor play in children with developmental disabilities, alongwith lack of caregiver's awareness of opportunities, child's skills and health, etc. (Sterman et al., 2016). This is however not a reflection of child's preference but more of a limitation in the environment to support physical activities of children with ID. A more relevant study in relation to our work comes from Woodmansee, Hahne, Imms, and Shields (2016) who further divided the physical recreation activities into 16 individual categories. They reported that despite of the overall results showing an agreement to lesser participation in outside-of-school physical recreation activities of children with ID than their typical peers, a different pattern emerges when looking specifically at play activities. Similar or even higher number of children with ID participated in 'playing games' and 'playing on equipment' categories when compared to typical peers. Another study addressing the context of play showed that play preference of children with and without developmental delays aged 3 to 7 years (chronological age) was quite high for both parental gross-motor play and rough-and-tumble play as compared to other play and recreational activities, however this opinion was entirely based on parental reporting (Case-Smith & Kuhaneck, 2008). **It is interesting to see that within the available literature on physical activity in relation to disability population, there are very few scattered studies that mention physical activities in a play context. Our study clearly establishes the positive effect of movement and physical activity on joyfulness and engagement during play episodes in children with ID, using a rigorous analysis of direct observation of children's play episodes.** This is an attempt to strengthen the agenda to focus on the positive aspects of participation in our population and emphasizes on the need of more studies that segregate the physical activity domains and study them in relation to their context. Boddy, Downs, Knowles, and Fairclough (2015) has also expressed the need for more studies in physical activity research which use systematic observational techniques that take the context into account, further acknowledging that children with ID needs to be given more attention as the focus in academia has been more on children with Autism Spectrum Disorders(ASD).

It is also important to note that physical activity research has been limited when it comes to application of this domain in practice and design, with focus on technological interventions. While working with typical population, the focus has generally been on exergames (Best, 2011; Sun & Gao, 2016) which integrate physical activity in video games context. These studies have reported lesser distraction and higher situational interest, as compared to playing the same game without exercise. Situational interest plays a significant role in motivating children and is reflected in attracting a learners' attention, involving them in the process, and providing instant, positive feelings about the activity (Hidi & Harackiewicz, 2000). This could be even more significant considering that the added physical activity are often not intrinsically related to the content or the process of the game, thus adding contextually relevant movement could be even more effective. Lloyd (2016) expresses this need of conducting more research to identify the most effective avenues to promote physical activity in individuals with disabilities. Apart from exergames, tangible interactions and digitally augmented physical spaces are some of the emerging domains which have used the benefits of movement and physical activity alongwith the dimension of interactivity, to engage children (Marco, Cerezo, & Baldassarri, 2013; Price & Rogers, 2004). However, it should be noted that adding movement and physical activity does not necessarily require sophisticated infrastructural support and caregivers can figure out useful strategies in existing play artefacts/activities to include movement e.g. use of action songs. **By looking at the preference for physical activity play in our population, it could be inferred that frugal and simple design interventions in play artefact and activities could be equally effective and heavily technological applications may not be needed to design affordances for physical activity and movement that lead to playfulness. This opens up new possibilities in the design and application space which have not been addressed in existing literature. This potential for application of adding affordance for physical activity was operationalized into the generative playfulness dimension of movement**.

Another interesting observation that can be made from literature review is that there is a much stronger discourse in research on physical activity focusing on its developmental effects on typical and special children (Boddy et al., 2014; Howie & Pate, 2012; Pesce et al., 2013; Rasberry et al., 2011; Tomporowski, Lambourne, & Okumura, 2011). However, generally more emphasis has been given on the quantitative parameters of physical activity than the qualitative characteristics in studies of exercise and cognition (Pesce, 2012). **While such research studies address an important concern focusing on using physical activities to positively impact child's self-regulation and developmentally appropriate behaviours, we are highlighting a complementary approach to the discourse of physical activity where a designer utilizes movement and physical activity play to elicit fun and engagement in children, as they engage in well-planned activities**. This discourse of approaching physical activity based research as a source to elicit playful opportunities in children, typical or special, has hardly been seen in literature, baring the few studies discussed earlier in this section. A recent study looked at physical activity participation and motor skill proficiency in typical kindergarten children, identifying the difference based on gender of the child (Temple, Crane, Brown, Williams, & Bell, 2016). There is a need to further explore how movement and physical activity interventions and designs would affect engagement as a function of child's age and gender. More research studies are required especially those which look relation between the user characteristics and the design characteristics related to movement as an affordance in toys and activities.

5.7.5 Constructive play and children showcasing outcome

Constructive play **emerged to be among the most engaging play types, after pretend play in the present study**. This finding confirms the preference for constructive play in preschool children with ID as seen in another study by Malone (2009) in the school free-play context. Our study showed that **children were able to engage in meaningful constructive play** i.e. there was a purpose to children's construction and children would associate meaning to their final product. Furthermore, **a number of children were seen showing attachment to the construction they had made**, by either requesting the facilitator to preserve their constructed artefact (e.g. shapes made using blocks) or looking for feedback and appreciation from facilitator by showcasing their construction from time to time. As pointed by Cohen and Uhry (2011), the ability to construct and symbolically represent an imaginary or real world object is developed by age of 4 years in typical children. However, our literature review did not show any earlier studies which looked into the development of constructive play and how meaning is assigned to their construction, in children with intellectual disabilities. Thus, **our thesis addresses this theoretical gap by identifying that meaningful constructive play emerges at the same mental age in children with intellectual disability**, but it is difficult to analyse their representations on being inspired from real or imaginary world due to communication difficulties. This could be much more relevant in the context of special schools as **constructive play could become a useful tool for catharsis and emotional expression for these children, who generally lack such opportunities**.

There has been a strong pattern related to facilitator's interaction as already discussed in an earlier sub-section, stating that almost all the children were seen seeking interaction with facilitator during play in a number of occasions. When looking further into the nature of these interactions, we found that there was a common qualitative characteristic, that **most children tried to catch facilitator's attention generally to show progress and state of play with respect to all play types but more often in target-oriented play** like challenge based play. As the facilitator gave attention to child's activity, **it was often accompanied by appreciation from the facilitator**. Thus, having an audience to their play episode without direct interference contributed to sustaining child's interest. The idea of praising these children is not new. Praise and positive attention as behavioural principles are considered as a part of Positive Behavioural Support (PBS) framework used to support individual with intellectual disability in achieving educational outcomes (Ruef, Poston, & Humphrey, 2004). This shows that children would cherish opportunities to display the progress and state of their play, especially during challenge based and constructive play, both of which were a target oriented activity. **This preference for showcasing the state and outcome of play activity could be used in design application and was operationalized into the generative playfulness dimension called 'showcase outcome'**. As defined in the earlier section, showcase outcome as a dimension refers to the addition of affordances in the design of toy and activities that will allow the child to have choice of exhibiting the outcome of play or the progress in play to another person, or to preserve the showcased outcome for future, as a sign of achievement. Such display or showcase of outcome needs to be associated with appreciation, built in design or from an external agent. This kind of appreciation would generally classify as 'external reward' defined by Cameron and Pierce (2002), as "external rewards are those that come from outside the person and are usually arranged by other people".

External rewards has been a topic of interest scholars in the field of psychology and education over the years, especially with the rising popularity of gamification which uses external rewards like badges, leader-boards, etc. as common motivational strategies to display achievement. However there have been contrasting opinions about the actual effect of using external rewards in gamification and educational applications, and the studies seem to have a number of limitations (Filsecker & Hickey, 2014). Firstly, most of the research has been conducted in laboratory conditions rather than in ecologically valid settings. Secondly, rewards have not been given during the performance but based on test performed later. Thirdly, many studies acknowledge the role of gamification (including rewards) in fostering engagement, they do not operationalize the concept of engagement properly. Thus, **our work addresses all these existing gaps in literature by looking at the idea of rewards in an ecologically valid setting of school play space, presenting the reward during the activity and thus making it a part of the activity, and clearly operationalizing the concept of playfulness and engagement when addressing the effect of rewards on it**. Our study reports a positive effect of external reward in the form of appreciation which contradicts some of the literature for typical children (Abramovich, Schunn, & Higashi, 2013; Vansteenkiste, Niemiec, & Soenens, 2010). Ryan and Deci (2000) have been among the prime opponents of using rewards as motivators, based on their popular self-determination theory, arguing that external rewards may lead to undermining of intrinsic motivation resulting in individual's loss of interest in the activity, by shifting the focus to acquiring incentives which are externally located. A recent literature review of studies based on rewards looked at the neuroscience perspective stating that while social and educational psychology has contrasting opinions on effect rewards may have on motivation and performance, but neuroscientists seem to have a much more clear support for importance of rewards as primary motivators of behaviour and key components in the control of actions, decisions, goal-directed behavior, and learning (Hidi, 2016).

(Gooch, Vasalou, Benton, and Khaled (2016) elaborate on the importance of context for gamification (generally using rewards strategy) based on whether the activity is voluntary or forced upon, explaining how gamification could have a positive effect in first situation, but opposite in the second. Indeed, our study looks at appreciation and reward strategy in a voluntary play situation showing a positive effect. However, **we are further proposing the idea of volition to be applied at not only the initial engagement with the activity but also in the reward contingency**. This would imply that while the outcome (end goal) of the play activity could be selected by child himself or defined by external rules, as in the case of constructive play and challenge-based play respectively, **ideally it should be the child's intention and choice to showcase the outcome for appreciation, instead of appreciation being a fixed condition of the design**. Gooch et al. (2016) gives an example of allowing the child to determine the badges themselves and making the rewards dynamic, focusing less on comparison but more on recognizing competencies. We believe that the existing work has hardly accounted for this perspective on external rewards as a function of child's volition and it should be tested out in future studies by varying the context and different reward contingencies.

Literature corresponding to children with intellectual disability (ID) is relatively limited. One of the study looked into the use of reinforcement strategies like use of token rewards and found it to be quite useful especially for children with ID (Matson & Boisjoli, 2009). There is a clear difference of opinion concerning the effect of praising children as a social reinforcer, however special educators seem to have a consensus on using praise as a positive social reinforcer and using it as a common strategy for children with special needs (Bayat, 2011). However, the discourse of using praise in special education seems to be centred on emphasizing its effect on reducing inappropriate behaviors and increasing specific cognitive or motor skills. Our study on the other hand, focuses specifically on how showcasing outcome and following it up with recognition and praise would affect the engagement of child in the activity. **Considering that play as a context has not been explored much yet, there is definitely scope of future work with this population**. From the practitioner's perspective, it should be useful to think of strategies and design attributes which allow children with choice to showcase their performance at any stage of play and receive feedback, either through the design of toy or another agent which is part of the designed play activity. Thus, adding the showcase outcome dimension should add to the child's motivation and lead to higher playfulness.

5.7.6 Using star-diagram visualization model for designing

Having discussed the emergence and definition of each of the generative playfulness dimension, an attempt was made to utilize these dimensions as design guiding principles which could help the toy designers and activity planners in the idea generation process. Aligning with the perspective of a design activist, the aim was to contribute to design practice and a visualization model has been theorized which presents a systematic framework for using these dimensions to design, evaluate and/or redesign play artefact and activities across different play types and contexts for children with ID.

A number of alternative visualizations were explored with focus on the model being able to consider context especially in re-design situations and be dynamic in nature. The model should be able to assist in development of multiple useful solutions instead of one single idea. The final visualization is a star-shaped model which has been termed as 'generative playfulness dashboard', as shown in figure 5.22.

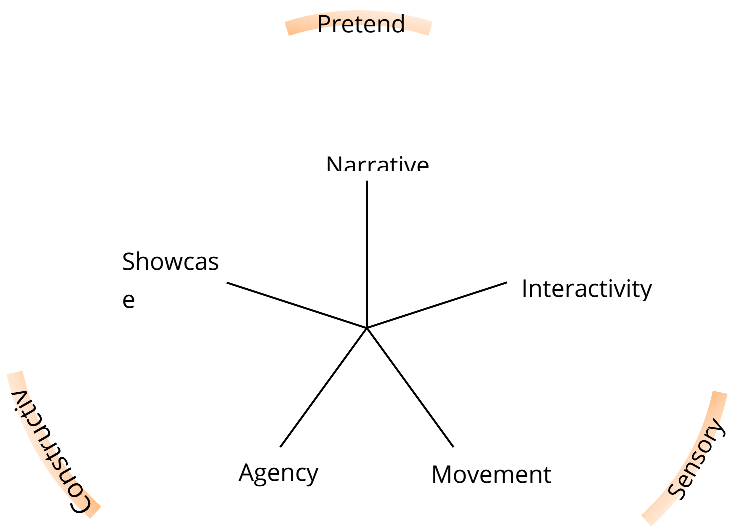


Figure 5.22. Star diagram visualization model to be used for designing in different play contexts

The dashboard model is described in more detail as a part of recommendations to design practitioners in Chapter 7. However, the model remains speculative since the effectiveness of the model as an idea generation tool could not be tested in the scope of this thesis, but nevertheless it could be useful in practice.

As discussed in the literature review chapter, the field of video game design has seen several significant advances including taxonomies of game elements, symbolic representation and grammar (Koster, 2005), game design patterns to add engagement and fun (Björk et al., 2003; Falstein, 2002; Kreimeier, 2002). However, these studies do not correspond with our work as the information is primarily applicable to video games often used by adults. They deal with complicated features of video games including complex narrative arcs, maintaining multiple economies and dynamic gameplay. Moreover, these studies are game-centric i.e. they focus on game as an artefact and interaction between its features. On the other hand, our work identifies dimensions and proposes a visualization model that looks into the overall domain of play (including unstructured non-game activities) for preschool children, and focus is on the interaction and its affective role on the player. This discourse thus becomes a novel contribution in the field of research on play and design, and a significant direction for future enquiry, discussed for its scope as future work in the conclusion chapter.

5.8 Assessment of emerging theory: Note on validity and generalizability

The theory and resultant dimensions emerged from an exploratory, interventional study using analysis based on a Glaserian Grounded Theory methodology. Following sub-sections elaborate on steps taken to ensure internal validity and the extent of generalizability (external validity) of the emerging theory.

5.8.1 Addressing validity threats

Based on the research design, possible validity threats to the emerging theory were addressed at different stages, discussed as follows.

<u>Participant's selection</u>:

The study was conducted in a single-facility ensuring that ecological factors of the facility did not act as confounding variables in affecting the results. However, children were selected from multiple classrooms based on the criteria of having mild to moderate ID and mental age between 3 to 6 years. While there were more children in moderate range than mild ID (avg IQ = 46.7), the results did not show any correlation with the IQ and hence it can be safely assumed that results are applicable to the whole range. The population was also skewed in terms of gender with 5 boys and 2 girls among the analysed participants. The possibility of gender-specific toys existed mostly in pretend play toys. Since only two of the toys from each play type could be included in the study, selection of standard, familiar toys accounting for parental interview data ensured that children interacted with toys that they were comfortable with. e.g. while both girls were presented with kitchen set and doll as pretend play toys having played with them earlier, boys were generally presented with miniature cars, doctor set, etc. Most of the toys in other play types were seen to be gender-neutral. Further-more, the possibility of gender-bias was consciously explored during analysis and found non-significant.

<u>Selection of toys</u>:

The toys were selected with the main aim to ensure that children had sufficient variety in terms of possible age-appropriate play experiences so that resulting play preferences were not skewed. This was achieved by using a play classification by Kudrowitz and Wallace (2010) which is specifically designed from toy design perspective, is applicable to any toy or play and has distinguishable categories. The initial list of toys was composed in collaboration with experts including an Occupation Therapist, psychologist and special educator so that standard, age-appropriate and commonly used toys were represented. This would lead to certain patterns in material properties like most toys were made of plastic and were multi-colored, representing the general standards. Similarly, there were more sensory toys that engaged through auditory channel than other sensations. The list was however restricted to toys which were meant for solitary, sitting play activity aligning with the scope of the study.

Following this, the list was presented to the parents to inquire about the level of child's familiarity with toys. Based on a pilot study, unfamiliar toys (never or rarely played) were removed from the final selection since it was found difficult to introduce toy-play and enable a free play context without assistance, which would have added new variables related to child's abilities. Also, all toys which were used in study were recently bought to maintain same level of novelty in terms of appearance, which could have otherwise biased child's choice. Lastly, the developed theory was abstracted into design characteristics rather than focusing on play preferences between individual toys, reducing its dependence on individual toys.

Context and procedure:

Several important procedural decisions including toy presentation and session duration were guided by a pilot study. Introducing two toys from each category at the same time ensured that child could choose within and between play types, while avoiding the possibility of serial order bias. Pilot study had earlier shown that the child didn't engage with all toys, hence it was seen important to offer some element of choice within toys from a specific play type. However, more than two toys from a play type would have led to 12 or more toys at a time which seemed overwhelming. The duration of a play session was decided to be one hour, which was the maximum time allowed by the school authority. The pilot study showed that one hour was sufficient time for observing engagement when a total of eight toys were presented to the child. Also, the duration aligned with the standard period duration of 45-60 mins, as children were already accustomed to it in school. Furthermore, play sessions were conducted at different times of the day, equally divided into pre and post-lunch sessions, ensuring that specific time did not play a role in observed behaviour.

Toy presentation in the form of positioning the toys along a circular arc in a randomized manner ensured that there was no positional bias which could have affected the observed play preferences. The presence of an active facilitator was interventional and not naturalistic since such one-on-one correspondence is not possible apart from Occupational Therapy sessions. However, research protocols ensured that data was collected in both absence and presence of facilitator, allowing the possibility to formally study the facilitator's role. As a result, facilitator's interaction became one of the main categories of analysis and was accounted within the emerging theory.

Data analysis:

The analysis process involved subjective interpretation of video data in the form of codes and memos within the Glaserian grounded theory framework. Inter-rater reliability is the commonly used instrument when dealing with subjectivity and possible ambiguity where a set of trained raters code or rate the raw data and degree of agreement is used to resolve ambiguity, if any. However, inter-rater reliability does not add much in case of grounded theory since coding is only the first phase of analysis, and it is followed by series of steps involving selective coding and interpretation of codes into patterns and categories. Also, memos which played a very important role during the analysis using Glaserian Grounded Theory approach are not taken into account while checking for inter-rater reliability. Hence unlike other research methodologies, validity in Glaserian version of grounded theory is seen through the criteria of 'fit' and 'relevance', discussed as follows.

Degree of fit refers to how closely concepts fit with the examples they are representing. By Adhering to the Glaserian grounded theory approach, we ensured that emerging theory's conceptual codes and categories were derived from empirical data rather than a preconceived selection of codes and categories from the literature (Glaser & Strauss, 1967). The researcher intentionally didn't access related literature till the later stages of analysis when the theory had been substantially formed. The constant comparison method used in comparing slices of data and concepts through the process helped in establishing confidence in the fitness of the emerging categories as they were validated by new data and inconsistencies were resolved. Patterns were further strengthened by looking consciously for negative cases and refining its properties. The initial assumptions and background of the researcher was clearly stated at the start and during the analysis, researcher articulated his own theoretical sensitivity at different stages by excessive use of memos, thus checking the possible personal bias and adding objectivity to the theory. Thus, this aspect was taken care by carefully following the principles of Glaserian Grounded Theory methodology.

Relevance makes the research important, and evokes 'grab' and attention, because it deals with the main concerns of the participants involved from their perspective (Glaser, 1998, p18). If less important theories and ideas are forced into the analysis over core problems and processes then relevance of the theory will suffer. While it is not possible to go to the exact user and take feedback on the emerged theory since most of the children had verbal and comprehension difficulty, feedback was taken from experts and professionals working in the domain of special needs and having significant experience. This included practicing psychologist, Occupational Therapists, and special educators. The procedure involved explaining experts about the generative playfulness dimensions briefly and handing a sheet with operational definitions of each dimension. Experts were then asked to look at a set of video clips taken from existing data and comment if the definition was able to capture the relevant design characteristic. The experts were also asked to comment if they found the dimensions to be true and useful in contributing to playfulness of a toy or an activity, based on their experience. Some minor adjustments were made in the definition (already included in the dimensions discussed earlier), and all the experts gave a positive opinion on the relevance of the dimension, based on their experience.

5.8.2 Generalizability of the emerging theory

Generalizability of the emerging theory in the Glaserian grounded theory framework is seen through the lens of 'workability' and 'modifiability'. Grounded theory does not aim for full scholarly coverage based on the literature. Instead it aims for theoretical coverage, that is, 'only those ideas that work and the more parsimonious the better' (Glaser, 1978, p11). Thus, false insights get rejected in the process and working insights get supported culminating into categories. The workability of a grounded theory depends on sampling by paying attention to diversity and including deviant cases and different situations. While the present study had a limitation in terms of sampling where sampling was not driven by on-going analysis but nevertheless, each participant was analysed one-by-one with focus on negative cases for emerging concepts. Furthermore, the workability of selected dimensions was further validated in the following phase through an interventional study using quantitative research framework, as discussed in chapter 6. Another significant factor to consider was modifiability which refers to possibility of altering or recasting the theory to accommodate new data instead of discarding the theory. In the present study, the constant comparison method of analysis is adopted to ensure the emergent theory is modifiable. Infact, as discussed in a previous section, a number of concepts were modified over the course of analysis to better represent the data. Furthermore, the overall theoretical framework for the proposed dimensions is presented as modifiable such that the dimensions would be refined by operationalization in different contexts and newer dimensions could be identified by looking at different category of toys, in terms of material and technology.

While the analysis procedure addressed the issues of generalizability using grounded theory principles, the design of the empirical study itself was constrained in a number of ways including the studied population, used toys and context to fit within the limited scope of doctoral thesis However, the claims and associated theory should be generalizable in a larger context, discussed as follows.

Population:

The interventional study was performed at a special school facility situated in a sub-urban part of Mumbai, a metropolitan city. A beneficial aspect of such location was that children came from varied financial backgrounds, covering the whole spectrum, as school also allowed rebates for children with low family income. In that sense, the findings are applicable across the spectrum. However, all the children were representative of an urban sample. Since our study did not use sophisticated and technology oriented toys, the preferences are more likely to be transferable to rural children and their toys.

The present study specifically looked at preschool children with mild to moderate ID including some children with Down’s Syndrome (DS). While the participants were selected to ensure that there were no other impairments for maintaining uniformity in a small sample, generally children with ID are associated with comorbidities. In that context, the findings of this study should be applicable to children with sensory and physical impairments along with ID like Cerebral Palsy (CP), given that the other impairments are not severe. However, not all the playfulness design principles may be equally suitable. e.g. movement as a design principles would be difficult to implement and may not even be preferred by children with CP, while other principles may work effectively. Similarly, children with sensory impairments may require certain mediums of implementations for design principles to be effective. Thus, by taking implementation considerations, the findings should be transferable to these populations. However, these findings are not applicable to children with significant cognitive limitations and behavioural issues e.g. children with severe and profound ID or children with Autism would require an independent study, due to significant differences in their play behaviour and abilities, which would affect their preferences. Lastly, most of the findings could be equally effective for typical children when matched on mental age, and is an interesting area of further exploration, in the direction of developing universal design principles.

Toys:

The interventional study involved bringing a new set of toys from different play types, ensuring sufficient variety in play interactions. While these toys had different levels of familiarity, children were aware of how to play with the toys, having interacted enough before the study. Toys which were rarely or never played were not included in the study to avoid the learning curve with a new toy and the need of facilitation which would contradict the free play context. While unfamiliar toys were not studied in this study, it is expected that findings will be applicable to unfamiliar toys since play preferences wouldn’t vary significantly beyond the toy introduction stage. Moreover, a number of useful facilitation strategies emerged over the course of the analysis which could be used to introduce unfamiliar toys to these children.

It is also expected that the findings from the present study would be applicable to toys with variation in material, color or size considering that the design principles have been defined as independent of their mode of implementation. Besides, the emergence of concepts was not based on a single toy or play interaction, but preferences which were seen in different situations, varying in context and associated toys. Nevertheless, the material properties of medium of implementation are significant in relation to ease of implementing some of the design principles e.g. in case of electronic toys, the implementation of dimensions like interactivity and agency could be more sophisticated when compared to basic wooden toys.

Context:

The present study was conducted in an indoor, interventional space within the special school. Play for children with special needs is often restricted due to accessibility to public play spaces with home and schools being two major contexts where play can manifest. The findings of this study should be applicable to the home context considering that within the special school, a free-play context was studied and possible intervening factors like presence of school teachers and other supervising agents was checked. It is still possible that child would be more expressive at home, strengthening the social connection dimension of playfulness reflected as a part of his stable personality. Nevertheless, it wouldn’t change his play preferences and hence the design principles and related theory would be applicable at home. The findings should also be generalizable to outdoor play context although some design principles or guidelines could be more intuitive to implement e.g. movement would be an effective design principle due to the reduced space and noise constraints.

While the selection of toys was limited to support solitary play, often children were seen inviting the facilitator to join as a play partner. As a result, situations varied from solitary play to parallel play and even cooperative play in some occasions. It is expected that the present findings would be applicable to social play context, given that designer accommodates the dynamics of involving multiple players while implementing the principles. e.g. the dimensions of interactivity or showcase outcome can involve the peers as a part of the designed play activity using a toy.

6. Workability of selected generative playfulness dimensions

6.1 Introduction

This chapter reports a controlled design-intervention based study implementing selected generative playfulness dimensions, individually and in combination, into redesign concepts of a toy belonging to a different play type. The effects of integrating the generative playfulness dimensions on the playfulness of children with special needs are reported primarily based on quantitative, statistical analysis supplemented by qualitative insights.

As discussed earlier in chapter 5, the proposed model advocates using these dimensions across different play types irrespective of the source of their origin. Thus ‘translation’ of dimensions across play types becomes a significant factor in operationalizing the proposed model of generative playfulness dimensions. Even though, the theoretical development of these dimensions tried to ensure that they were decontextualized and were more a general property of play artefact or activity, further validation of workability of these dimensions across a different play type would strengthen the theoretical model. In a more constructive sense, the design-intervention study also aimed to elaborate on the operationalization of selected generative dimensions into playful toy design concepts across different contexts, commenting on which individual toy features were more efficient.

6.1.1 Selection of generative playfulness dimension for testing workability

While the model for generative playfulness proposes a total of six dimensions, it was not possible to compare the effect of all of the dimensions leading to a huge number of their possible combinations making them unfeasible to test, as discussed in research methodology chapter. Thus, it was decided to select three of six dimensions for testing their workability by using them for ideation in the process of redesigning an existing toy, and test out the effect of these dimensions individually and in different possible combinations on the playfulness of the toy. Each of these combinations was represented as a stimulus condition to be tested. The dimensions included – narrative, interactivity (assistance) and agency/control of player. Each of the dimensions is described below explaining the reasons for selecting these three dimensions for testing.

Narrative: Narrative as a dimension is based on one of the most strongly grounded insights from the earlier exploratory study, showing the preference for pretend play over other play types by children. Narratives were generally constructed by children themselves (child becoming the story-teller), sometimes even from play artefacts which were not introduced for pretend play and facilitator was often invited to be a part of pretend play.

The design intervention study gave the opportunity **to see if narratives would continue to have an effect on engagement in play activity when they were explicitly presented to the child and embedded into the on-going play activity**. This dissociation of narrative from story-telling (child narrating the story) element allowed us to explore the inter-play between narratives and play interactions with non-pretend play artefacts like challenge based, constructive or sensory toys. While increasing number of research studies have substantiated that a strong narrative line leads to more immersive and engaging gameplay (Bringsjord, 2001; Schneider, Lang, Shin, & Bradley, 2004) and motivate players (McQuiggan, Rowe, Lee, & Lester, 2008), critics see narratives as a distraction to the player from allowing them to critically process game content (Green, Brock, & Kaufman, 2004). Indeed, transportation is a term which has been accepted in research referring to the situation when player is fully focused on the events of the narrative which might be beneficial to engagement in pretend play based activities however, transportation might start competing with the play affordance of non-pretend play based artefacts like challenge toys and thus lead player off the intended play actions. It was worth checking **if transportation could have an effect on observed engagement**. Thus, narrative as a dimension presented opportunity for possible non-intuitive outcomes leading to its selection.

Interactivity: Interactivity as a generative playfulness dimension emerged from multiple theoretical insights based on significance of facilitator's interaction during play and his strategies from the earlier grounded theory study. This included children's need to interact with the facilitator during play as they often sought feedback on their state of play from facilitator. Children were also seen playing with challenge-based toys that did not give appropriate feedback when they made mistakes and thus led to ambiguity and frustration. Interestingly, children’s engagement depended upon active facilitation to ensure that they didn’t make more than 2-3 mistakes at each step, or the child would leave the toy. Interactivity as a design characteristic can offer a solution to this issue.

The design intervention study gave the opportunity to see the **workability of interactivity as a dimension by replacing the role of facilitator as a responsive and interactive agent by the design of toy itself**. Baek (2009) acknowledged the role of sensory stimuli in digital games in attracting players to the gameplay. A number of studies have looked into distinct aspects of feedback design, e.g. Xie, Antle, and Motamedi (2008) looked at different interface styles for jigsaw puzzle like physical (traditional), graphical (screen based) and tangible (interactive pieces on table-top) and how it affected the engagement and enjoyment of the play activity. From the perspective of operationalizing interactivity as a generative playfulness dimension, it was worth exploring **how and at what places integrating feedback would be helpful** in adding to playfulness without disrupting the on-going non-sensory play activity.

Agency: The last of the three selected dimension was ‘agency/control of player’. While the design of earlier exploratory study ensured that children could exhibit free play (non-guidance from an external agent) among the different play types, either pretend play or constructive play emerged as the most playful of the play types for every child, while the least playful was seen to be challenge based play. In fact, some of the children were seen deriving non-intended play possibilities like pretend or constructive play from challenge based toys. The most intuitive explanation to this difference across play type was the level of agency or control that child could enjoy in pretend play episodes and constructive play where he sat his own rules, as opposed to challenge-based play where the toy often had embedded rules and structure to the play process. One of the pilot studies also showed that in special schools, unstructured-free play activities were found to be more playful than structured play activities (Johry & Poovaiah, 2014).

Challenge-based play becomes much more relevant in the context of our users in special schools as their play artefacts are often seen as developmental aids which generally fall in the category of challenge-based and outcome based play (Johry & Poovaiah, 2014). It is worth noting that it is not be possible to completely eliminate rules from challenge-based play since it is an outcome/target oriented play. The following design intervention study explored **if the player's agency would still have a significant effect on playfulness when it was varied on a scale** in challenge-based play, instead of merely looking at its presence. Besides, there is some contradictory evidence on effect of structure and autonomy, with Gilmore et al. (2015) proposing that when presented with optimal challenge, a lower structured activity could have led to decrease in engagement. Mills, Beecher, Dale, Cole, and Jenkins (2014) refer to studies which propose that adding structure would contribute to development of children with disabilities. It was worth checking **if adding structure to play for children with ID could have a positive effect** on comprehending the activity and thus on observed engagement during the play activity, or will agency/autonomy of player lead to higher playfulness as expected. Lastly, agency as a dimension gave an opportunity to test for its effect when it was decreased from the baseline toy stimulus, unlike other dimensions which were tested for their effect on being added.

6.2 Research design

The main aspects of research design for the design intervention study comprising of phase 3 of the thesis are summarized in this section, having been discussed in detail in the chapter 3 on methodology explaining the rationale behind selection and identification of the various aspects of research design. This chapter throws light on how the intervention was conducted, while the why aspect has been discussed in chapter 3.

A **within-subject or repeated measures design** was selected in the present study to test the five different stimuli conditions, based on possible combinations of the three generative playfulness dimensions. The dependent variable was observed 'playfulness' of the child, operationalized as a combination of engagement (duration and frequency of repetition of play with stimulus) and joyfulness (frequency of expressing joy seen through facial expressions). The independent controlled variable was each of the stimuli conditions representing a unique combination of generative playfulness dimensions.

6.2.1 Subjects and facility

Subjects (N=14) included 8 girls and 6 boys with mild to moderate intellectual disability having mental age between 3 to 6 years at the time of the initiation of study, which also restricted the chronological (physical) age from 6 to 10 years approximately. They belonged to different classrooms at the special school facility in Mumbai city and all were Indian in ethnicity living in local neighbourhood. Table 6.1 represents the demographic data of the subjects including the Chronological Age (CA), Intelligence quotient (IQ), Mental Age (MA), % disability, etiology of disability, and family income of each subject, as taken from the annually updated school records.

Name1[3]	**Sex**	**CA (years)**	**IQ**	**MA (years)**	**% disability**	**Etiology/ conditions**	**Family income (lacs)**
Keh	F	6y9m	68	4y7m	-	Delayed speech, mild CP	0.25L
Nid	F	6y11m	61	4y3m	50%	-	2.5 – 3L
Sam	F	7y1m	61-66	4y6m	45-47%	-	6L
Shl	M	7y1m	50-55	3y9m	55-60%	Down Syndrome	12L
Yat	M	6y1m	61	3y9m	49%	Down Syndrome	4L
Kau	F	6y	60-65	3y9m	45-50%	Down Syndrome	-
RiyD	F	8y6m	60	5y1m	50%	-	2L
Spa	M	8y10m	60	5y4m	50%	-	4.6L
Sid	F	10y6m	54	5y8m	56%	-	18L
Poo	M	9y10m	62	6y	50%	-	2.4L
Bha	M	8y10m	57	5y3m	53%	-	2.4L
RiyK	F	8y1m	50	4y1m	50%	language barrier	4.8L
Sho	M	9y3m	57	5y3m	53%	Delayed speech	2.5L
Pal	F	7y9m	40	3y1m	-	mild CP	1L

*Table 6.1.*Demographic data of the subjects obtained from school records and assessments.

6.2.2 Selection of toy for redesigning into intervention stimuli

As discussed in chapter 3, a challenge-based toy with a fairly known baseline effect was needed to be selected for redesign, since being able to enhance the playfulness of challenge-based toy which was earlier found to be less playful, would also show higher impact of the effect of using dimensions. Shape matching board/bucket toy (refer figure 6.1) was selected as it was among the least playful toys needing high cognitive decision making and a convergent play progression. Moreover, it had a single learning concept of shape cognition involved ensuring that there were not too many extra variables involved due to the learning aspect in the toy. Shape recognition is also an age-appropriate learning concept for preschool mathematics standards (Resnick, Verdine, Golinkoff, & Hirsh-Pasek, 2016).

[3] Name and identifiable details of the subjects have been purposely omitted throughout the study

Figure 6.1. Shape sorting board/bucket selected for redesign in the design brief

6.2.3 Materials/ Stimuli for each condition

A total of five stimuli conditions were selected for the intervention, considering the unique possible combinations of the three dimensions, and excluding the conditions which were non-feasible and redundant (refer chapter 3 for details). Each of these dimensions was implemented in their most common and practically feasible medium i.e. narrative through visual, interactivity and agency (removal) through auditory medium. The five stimuli conditions selected for interventions are as follows.

Condition 1: Agency
Condition 2: Agency + Interactivity
Condition 3: Agency + Narrative
Condition 4: Agency + Narrative + Interactivity
Condition 5: Narrative + Interactivity

After determining the stimuli conditions, the next step involved designing the material/stimuli corresponding to each of the conditions. A number of concepts were generated involving the brainstorming process with emphasis on use of interesting narratives which could be comprehended by the children and were related to their daily lives, so that they could relate with the storyline. This was usually followed by designing the signal, action fidelity and narrative response which would suit the corresponding narratives. A total of six concepts were finalized, as shown in figure 6.2.

Figure 6.2. A group of toy concepts designed using the selected generative playfulness dimensions to be used in validation study.

Figure 6.2 (a), (b) and (c) can be grouped as a sub-category where the child assumes a character in the unfolding narrative and thus exhibits role play. Both concepts (a) and (b) are based on a narrative of having pet animals where the child plays the role of their owner and is asked to take care of these animals by feeding them food. The mouths are in different shapes while the corresponding blocks become the food. The difference between (a) and (b) is more in terms of visual style, with (a) focusing more on realistic effect while (b) being more child-like having the overall shape resembling that of the shape to be inserted e.g. dog resembles a square and cow resembles a circle. Figure 6.2 (c) is based on a narrative that a group of fictional funny characters have got lost in the city and they need to return to their home. The child plays the role of guide and helps the characters in reaching their homes back by matching the holes in each home with the corresponding character. Figure 6.2 (d), (e) and (f) can be grouped as the second sub-category where player has a God’s eye view. He plays a passive role in the unfolding narrative and becomes an audience, using his action for triggering different dialogues which are a part of the narrative. Figure 6.2(d) is based on a narrative that a group of children are playing in a park and this leads to a narrative which unfolds as the child matches each ride with the correct block. Figure 6.2 (e) is based on a narrative that children are going for a picnic on a Sunday and the scene depicts their journey. Each object in the form of holes unfolds a part of the story when being matched. Figure 6.2

(f) is based on a narrative that objects lying on the table become alive and talk to each other. Every time the child places the correct block in the hole, a part of the story is narrated through feedback.

Pilot testing session: Out of the six final concepts described in the earlier sub-section, one concept from each of the groups was selected for further development based upon the ease of comprehension and relatability with the narrative as discussed with school staff. These were concept (b) i.e. ‘feeding pet animals’ concept and (d) i.e. ‘children in playground’ concept as shown in figures above. The development involved the physical toy design, design of interactivity including the signal trigger, action fidelity and narrative feedback, visual graphics, etc. corresponding to the stimuli conditions. The developed concepts were tested with a child named ‘Kar’ in a pilot study and it was found that concept (b) based on a narrative of feeding pet animals showed better comprehension of signal triggers and interactive feedback. Child was also able to relate to narrative. This was also one of the concepts where child himself had a role play element of being an owner and care-taker of pet animals. Thus final study employed the use of concept (b) as material/stimuli for each condition.

After choosing ‘feeding pet animals narrative’ concept for final intervention, it was important to differentiate the conditions among each other to minimize the element of repetition or boredom, when exposed sequentially in a repeated measure research design. While the basic play process was kept constant to allow comparison, the graphics and visual appearance of each condition was varied as shown in figure 6.3.

(a)

(b)

(c)

(d)

(e)

Figure 6.3. Stimulus design for the five conditions: (a) Condition 1: Agency, (b) Condition 2: Agency + Interactivity, (c) Condition 3: Agency + Narrative, (d) Condition 4: Agency + Narrative + Interactivity, (e) Condition 5: Narrative + Interactivity

6.2.4 Feedback design for each stimuli condition

Apart from the visual design of each condition, three of the five conditions also needed an element of auditory feedback for interactivity or signal trigger. The feedback could not be integrated into the toy itself due to resource and time constraints, and was played by the researcher from a distance by using a Bluetooth speaker placed inside the toy box, ensuring that children did not suspect the source. Thus, **Wizard of Oz** technique was employed for trigger and feedback playback. Feedback design needed in required conditions is described below.

Condition 2: This condition constituted of agency and interactivity but no narrative. Hence, action fidelity feedback given for child's attempt was presented as plain "yes" and "no", recorded in a clear female voice. A success event which involved insertion of a block successfully was presented as clapping sound for 2 seconds, considering that the most obvious representation of success without the use of dialogue would be clapping.

Condition 4: This condition constituted of agency, interactivity and narrative. Hence, action fidelity feedback given for child's attempt was narrative-laden and dialogue based, presented in Hindi and Marathi language, depending upon the child. A correct attempt would be responded as "Haan, ye mera khana hai (yes, this is my food)" and incorrect attempt would be responded as "Nahi, nahi.. ye mera khana nahi hai (no,no.. this is not my food)". A success attempt in this condition would be responded as clapping sound, followed by "Thank you, mera pet bhar gaya (thank you, my stomach is full)". Also, it is worth noting that all animals had a unique differentiable voice, resembling the personality of the animal.

Condition 5: This condition constituted of interactivity and narrative, but no agency. While action-fidelity feedback and success feedback remained the same as condition 4 with narrative dialogues involved, signal triggers were further introduced to determine the sequence of block selection, and reduce the agency. The signal trigger consciously included the name of each animal as well as their calling sounds for easier recognition. E.g. for cow, signal trigger was presented as "Moooo.. mai tumhari gaay hun, please mujhe khana do (Mooo.. I am your cow, please feed me food)". Similarly, "rawrrr", "miyaaaun" and "bho-bho" were used as calling sounds played before dialogue for tiger, cat and dog respectively. Again, all animals had a unique differentiable voice, resembling the personality of the animal.

6.2.5 Research hypothesis

The objective of the present study was to validate and operationalize the translation of selected generative playfulness dimensions in challenge-based play, which would require broadly two main hypotheses to be tested, as briefly described below.

a) **Stimulus condition on net addition of one or more generative playfulness dimensions will lead to higher playfulness than the parent condition.** Following relations needed to be satisfied for this hypothesis to be true:

Playfulness (condition 1) < playfulness of all other conditions (i.e. 2, 3, 4 and 5), and
Playfulness (condition 4) > playfulness of all other conditions (i.e. 1, 2, 3 and 5)

where Condition 1: Agency, Condition 2: Agency + Interactivity, Condition 3: Agency + Narrative, Condition 4: Agency + Narrative + Interactivity, Condition 5: Narrative + Interactivity.

Playfulness comprised of engagement (duration and number of times child chose to play again with toy), and joyfulness (no. of times child showed facial expression of joy). No comparison is made between playfulness of condition 2, 3 and 5 since each of the condition is made up of combination of two of the selected generative playfulness dimensions.

b) **Stimulus condition on net deletion of one or more generative playfulness dimensions will lead to lesser playfulness than the parent condition.** Following relation needed to be satisfied for this hypothesis to be true:

Playfulness (condition 5) < Playfulness (condition 4)

While the above relation is already been taken into account in hypothesis 1 in the reverse direction, it is worth mentioning separately since this was the only instance where a dimension was reduced from the base redesigned toy to further evaluate the effect of presence as well as absence of generative dimensions.

6.2.6 Data collection procedure

As discussed in chapter 3 earlier, blocking technique was used to divide the stimuli conditions for randomization, ensuring that conditions with higher number of added generative playfulness dimensions came later in sequence, as follows.

Block 1: Condition 1 (Base toy - only agency)
Block 2: Condition 2 and 3 (One dimension added to base toy)
Block 3: Condition 4 and 5 (Two dimensions added to base toy)

These blocks were presented in a serial order starting from block 1 to 3, however within each block, conditions were randomized. This led to four possible sequences: condition 1-2-3-4-5, condition 1-3-2-4-5, condition 1-2-3-5-4 and condition 1-3-2-5-4.

Children were randomly assigned to these sequences ensuring that these sequences were equally utilized. A gap of **one week** was given before exposure to the next condition for each child, thus data collection for all five condition took around 5 weeks for each child. Apart from the research design, all environmental factors were kept constant including the play space (Occupational Therapy room) and facilitator (school occupational therapist). The configuration of the interventional play space (OT room) is shown in figure 6.5.

*Figure 6.4.*Front view of child playing in condition 1 with facilitator sitting around on the mattress

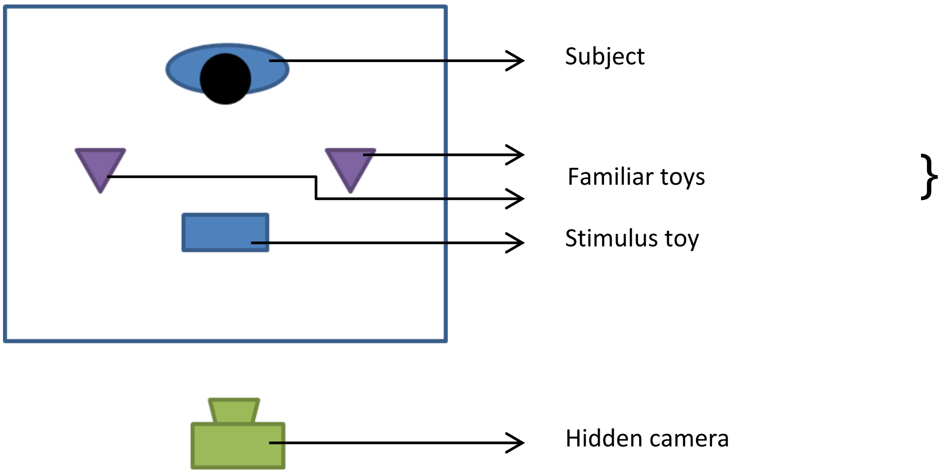


*Figure 6.5.*Top view showing the arrangement of stimulus and other toys in the play space

The OTs were given multiple training sessions of the standard intervention protocols by simulating the process with children who were not the part of main study, till they felt comfortable and didn't make errors in facilitation. The present study used the **system of least prompts** (Neitzel & Wolery, 2009a) and **constant time delay** (Neitzel & Wolery, 2009b) techniques for facilitation, which also align with the facilitation insights developed in our study. The protocols used for conducting sessions are described below.

1. Subject was brought to the OT room ensuring that he was in normal mood and asked to jump on trampoline for a minute (a regular protocol for OT sessions at the school). After this, subject was asked to sit on a soft mattress, at a location where a set of three toys were kept along a circular arc in front of him, as the facilitator sat next to him (refer figure 6.4). These toys consisted of the intervention stimulus (at centre) and two other familiar toys which were

generally liked by the subject during OT sessions (as shown in figure 6.4 and 6.5). A hidden camera was placed in front of the subject to capture his actions and expressions.

2. Researcher was also present in the room but sat at a corner not directly facing the subject. He played the role of a silent observer to ensure that all protocols were followed properly and to play auditory trigger and feedback in required conditions, using Wizard of Oz technique.

3. The session began by facilitator introducing the subject to the three toys, with an initial bias towards the intervention stimulus by saying “Would you like to play with this new toy?” This was done to ensure that child started with the stimulus and played at least once.

4. During the session, controlled assistance was given to the subject in 3 steps from least to most prompts i.e. indirect verbal to direct verbal & gestural to modelling trigger as described:

(a) Based on a constant time delay of 15 sec., if the subject was stuck with a shape for more than 15 seconds, facilitator gave an indirect trigger which implied telling the subject if he was attempting the correct hole or not with respect to the block being held, and to try another hole in case it was wrong.
(b) If the subject was still stuck for next 15 seconds, facilitator gave a direct trigger which implied pointing verbally and gesturally towards the correct hole with respect to the held block. If the child was already attempting the correct hole but unable to insert due to orientation issues, the facilitator would model the insertion task without dropping the block and ask child to try it out himself.
(c) If the subject still did not succeed in inserting the block for next 15 seconds, facilitator would finally hold subject’s hand and physically model the insertion task, dropping the block.

It was important to ensure that timely assistance was given to the children as they could have got frustrated and completely withdrew from later conditions. Children’s withdrawal from a toy on consecutive mistakes was found as an insight in the earlier exploratory study using Grounded Theory. Controlled assistance ensured that activity did not go out of control and also there was no bias in terms of assistance that children got and thus no unwanted variable was introduced in the study.

5. At the end of one trial (which consisted of putting all four shapes), facilitator waited for 5 seconds. If the subject approached the toy again, trying to open and play, facilitator would assist him in taking the blocks out and restarting. In case, there was no such approach from

the subject, facilitator would ask “Would you want to play with this toy or that toy?” pointing at all the three toys, one by one. For some subjects who didn’t show a clear decision making, several such prompts were given asking the subjects to choose. After the choice, facilitator would assist in resetting the tested toy stimulus if chosen.

6. In case, when the child chose one of the familiar toys, and not the intervention stimulus, the recording was stopped and the facilitator let the child play with the selected toy. This ended the intervention session. In case, the child continued to play with the intervention stimulus, an upper limit of 10 trials i.e. child playing 10 times with the intervention stimulus was set for a session due to time constraints at the school.

7. Conditions which involved interactive feedback (condition 2, 4 and 5) and signal trigger (condition 5) were modelled by the facilitator at the start of the session once, explaining what was meant by each of the feedback, to ensure that child was able to comprehend it. In condition 3, which involved narrative but no feedback, facilitator described the scene and backstory involving pet animals and subject being their caretaker, before the session started.

The data collection process had to be divided into phases due to constraints at the school however the gap between two conditions was kept to a minimum of one week. A total of 69 videos were collected (5 videos for 14 children) excluding the video data of one session which was lost due to equipment failure. A comprehensive analysis of the collected video data as well as the diary notes of the researcher was performed as shown in the next section.

6.2.7 Data analysis procedure

Video data from each session was coded to describe the events along with time stamp using Atlas Ti software. The events were the basic unit of analysis which consisted of individual video segments corresponding to an attempt by the subject for insertion of a shape, corresponding to a specific level of assistive trigger needed and the outcome. A number of terms had to be defined in the course of the analysis to process and operationalize the data e.g. ‘facilitator compensation time (FCT)’ was the compensation factor added to normalize the error by facilitator when assistive triggers were not given at pre-defined 15s gaps. The operational definitions of some of these terms relevant to analysis like ‘total engagement time’, ‘total effort time’, ‘trial’, ‘fail attempt’, etc. are defined in Annexure E, along with their respective codes, for reference.

The primary measured variables for analysis were:

a) Total engagement time (E_T) – duration in minutes

b) Total number of trials/ times toy repeated (N) – frequency

c) Total number of times child gets distracted in play (d) – frequency

d) Total number of instances of joyfulness (J) – frequency

e) Total effort time (Ef) – duration in minutes

f) Total number of triggers needed

In the course of the analysis, several sources of errors were identified, as briefly mentioned below along with the associated codes.

1) **Problem in holding the blocks** – A number of children had fine motor coordination issues and they found difficulty in inserting a block in hole because they were not able to hold the block horizontally. It was later realized that a pinching grip could have been given to each block but modifications were not made since some data was already collected. The issue with holding was found consistent among most children and thus treated as a fixed variable for the sake of analysis [code: orientation problem – 3D].

2) **Difficulty in feedback comprehension** – While the pilot study showed that subject was able to comprehend the signal triggers as well as interactive feedback, in the main study, children showed variable comprehension ability of the feedback. This introduced a new variable in the play process across conditions, however since it was an inherent property of the studied user, the researcher could not have eliminated it. Instead, the ability was assessed and acknowledged in the process of analysis [code: Action fidelity feedback doesn't affect, child not able to identify animal sound].

3) **Blocks going in incorrect hole** – The researcher made attempts during the design of the intervention stimuli to eliminate the possibility of a block going incorrectly in a different shaped hole, however due to the 3rd dimension of height, it was possible to orient and insert some shapes in specific incorrect holes. Although controlled assistive triggers checked the frequency of these instances, still few cases were seen where child inserted the block in incorrect hole. Such instances were still treated as success attempt as the insertion happened, and the focus was on effort and engagement time. A high frequency of such instances would skew (reduce) the total effort time. The analysis acknowledged such cases. [code: error - block goes in wrong hole].

4) **Assistive trigger protocol error** – The facilitator sometimes made a mistake by giving an assistive trigger, too early or too late. Such cases were normalized by adding a compensation factor called FCT (described above).

In summary, a total of 70 codes with varying frequencies were used on the collected video data. Majorly, these codes looked into – a) emotional response of subjects, b) interaction of subjects and facilitator and types of assistance offered, c) types of errors during study, d) subject's comprehension abilities, etc. along with codes for associated shapes and their positions on the board for each event. This allowed analysing the data from multiple perspectives. A list of all the codes used in analysis is attached in Annexure F.

The differences in the observed values of dependent variables were tested statistically, using parametric tests like ANOVA and paired sample t-tests. These results were further substantiated using non-parametric tests including the Friedman test and post hoc analysis with Wilcoxon signed-rank tests however the graphs are presented based on the parametric statistics due to their suitability to represent. The statistical analysis techniques are discussed in chapter 3 in more detail.

Qualitative analysis: While the analysis was primarily quantitative in nature, the patterns seen in behaviour often raised a question if the children showing same behaviour had anything in common in terms of user characteristics. Apart from the demographic data of subjects, an attempt was made to classify the users into categories based upon their behavioural responses in different situations. Some of these classifications were useful later when understanding patterns in engagement, joyfulness, effort time, etc. Few classification examples are shown below, while a comprehensive list of all classifications is attached in annexure I.

a) Based on signals triggers given in condition 5:

- i) Rules themselves not comprehended
- ii) Signals not comprehended in multiple occasions
- iii) Signals comprehended but voice not identified
- iv) Signals comprehended and voice identified

b) Based on Shape perception ability (fail attempts, orientation problem, incorrect insertion error)

- i) High ability (0 out of 3 above-mentioned issues found)

ii) Medium ability (1 out of 3 above-mentioned issues found)

iii) Poor ability (2 out of 3 above-mentioned issues found)

(iv)Very poor ability (all of the above-mentioned issues found)

c) Based on child's level of patience

i) Waits for signal & success feedback

ii) Waits for only success feedback

iii) Doesn't wait for any feedback

Apart from the classifications based on observed behavioural patterns, results were also compared to the user characteristics identified from their demographic data.

6.3 Results

While the field data was collected for 14 subjects, after the analysis, three subjects were found unfit and had to be excluded from the results as they did not truly represent the sample population. Two of these subjects showed unique pattern behaviour in choice making affecting the measured variables. This included 'Sam' who never repeated play with any toy and always switched toys after one turn. She was tested with her favourite toys (outside of the design intervention study) and displayed the same pattern, further confirmed by the occupational therapist that was used to working with her. The other subject showing pattern behaviour in choice making was 'Spa'. He would switch the toy whenever he was explicitly asked to choose as a part of protocols. The 3rd subject to be excluded was 'RiyK' because she had a language barrier having come from Southern India and didn't understand any of the local languages which included Hindi, English and Marathi. It was necessary to remove them from the results to avoid skewing of results, due to non-typical behaviour. Hence, the results are discussed based on **analysis of remaining 11 subjects**. A number of interesting findings emerged from the analysis with regards to the tested hypothesis which also shaped recommendations for design practice. This section is divided into analysis of each of the significant measured variable, finally summarizing the overall results with respect to the research hypotheses.

6.3.1 Engagement duration (E_T)

The pooled mean of engagement duration (E_T) for all subjects across the conditions showed a normal distribution based on the Skewness and Kurtosis values (refer Annexure G). Analysis of variance (ANOVA) showed a main effect of conditions on engagement duration, $F (4, 40) = 11.082$, $p<0.001$, $\eta_p^2 = .526$. Post-hoc analysis was done using Paired t-tests ($\alpha=0.05$) to further identify the conditions which were significantly different from each other. Figure 6.6 shows the distribution of the pooled means (with standard error) of engagement duration across the five conditions, highlighting the differences which were statistically non-significant. The exact probability values are reported in Annexure G for reference in the form of a table.

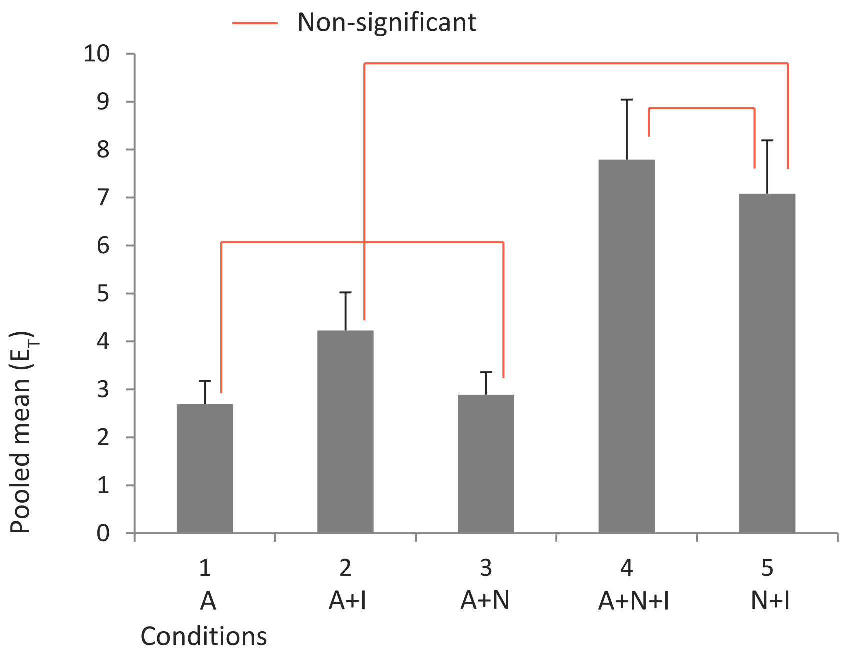


Figure 6.6. Distribution of pooled means and standard error (error bars) of engagement duration across conditions highlighting statistically non-significant differences.

Group data for engagement frequency was also tested using non-parametric tests. There was a statistically significant difference in engagement frequency depending on the stimuli condition, $\chi^2(4) = 27.872$, $p < 0.001$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a significance level set at $p < 0.05$. This led to a replication of results seen in parametric tests as shown in figure 6.6 earlier (for detailed non-parametric statistics, refer to tables in Annexure H). Significant difference was found between engagement duration of most of the conditions, **except between condition 1 & 3, condition 2 & 5, and condition 4 & 5**. The results did not seem to match our assumptions of condition 1 being significantly lesser and condition 4 being significantly higher than the remaining conditions. Condition 3 hardly showed an increase from condition 1 even though it had the dimension of narrative being added, while condition 5 showed engagement duration comparable to condition 4 even though it had one of the dimension of agency reduced. The analysis further included looking at the distribution of engagement duration across conditions individually for the subjects. A pattern seemed to appear reconfirming the distribution seen for the means of their engagement duration, as shown in figure 6.7.

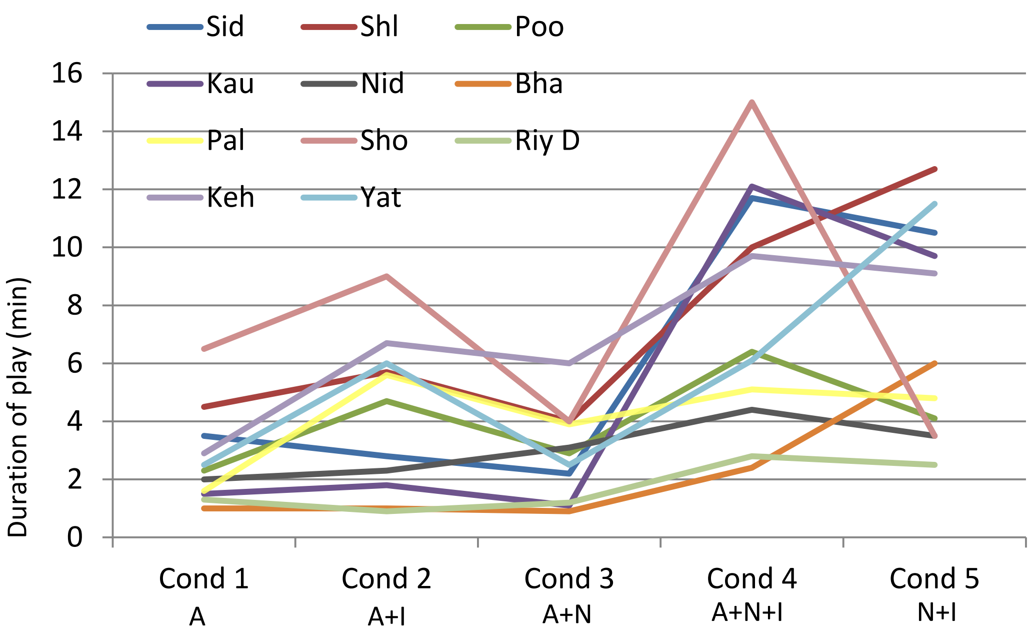


Figure 6.7. Line chart of individual distribution of engagement duration for 11 subjects across 5 conditions

Based on the earlier graphs, condition 2, 4 and 5 seemed to lead to significantly higher engagement than condition 1 and 3 for most subjects.

Relooking at the research design, a **possible source of error was identified when comparing condition 5** with other conditions. Since condition 5 involved introducing signal triggers to reduce the agency, there was an additional time which was spent by the subjects in comprehending and identifying the voice of animal characters giving signal triggers, which varied on their ability. This time was added up in the calculation of total engagement time, thus skewing the observed values of condition 5 higher than the expected value. Furthermore, engagement duration had another confounding variable of performance which could have increased or decreased the total engagement time, irrespective of how interested a subject was in the toy. To check this effect, and to further validate the observed pattern in engagement, the researcher looked at the other engagement parameter of frequency, which implied measuring the number of times subjects chose to repeat intervention stimulus in a condition, described below.

6.3.2 Engagement frequency (N)

At the end of each trial (which consisted of putting all four shapes), child was asked to choose between the available toys to play with. His interest to continue playing with the interventional stimulus toy was seen as a sign of (re)engagement in the play activity, measured as the engagement frequency (N). The distribution of pooled means of engagement frequency was found to be non-normal due to high Skewness and Kurtosis statistics. Looking at the individual distribution of subjects for engagement frequency (refer figure 6.7), one of the subject named 'Shl' seemed to be an outlier showing high engagement in general for intervention stimuli irrespective of the condition. On removing 'Shl' data, an acceptable, near normal distribution was seen for pooled means of engagement frequency, based on Skewness and Kurtosis statistics, apart from condition 3 with Kurtosis of -2.277 (SE=1.334). These statistics values are tabulated in annexure G for reference. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi2(9) = 34$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.47$). Analysis of variance (using Greenhouse-Geisser correction) showed a main effect of conditions on engagement frequency, $F\ (1.9, 16.9) = 7.565$, $p=0.005$, $\eta_p^2 = .457$. Post-hoc analysis using Paired t-tests identified the conditions which were significantly different from each other. Figure 6.8 shows the distribution of the pooled means (with standard error) of engagement frequency across the five conditions, highlighting the differences which were statistically non-significant. The exact probability values are reported in Annexure G for reference in the form of a table.

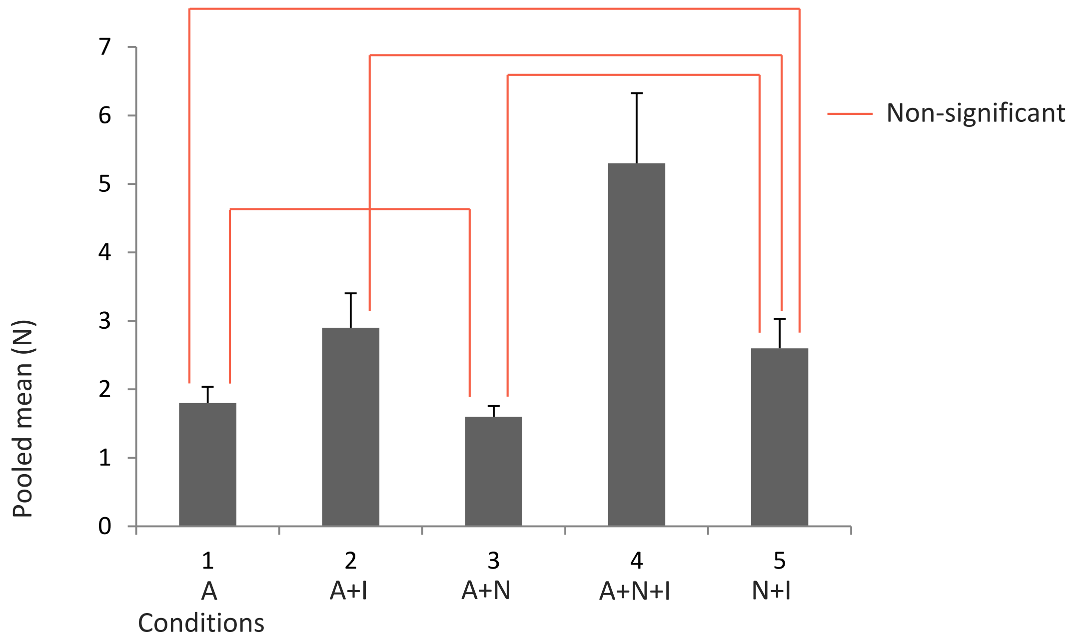


Figure 6.8. Distribution of pooled means and standard error (error bars) of engagement frequency across conditions highlighting statistically non-significant differences.

Replicating the earlier process, non-parametric tests were used on group data for engagement frequency to verify the results. There was a statistically significant difference in engagement frequency depending on the stimuli condition, $\chi^2(4) = 26.989$, $p < 0.001$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a significance level set at $p < 0.05$ and non-parametric tests identified exactly the same groups found in parametric tests as shown in figure 6.8 (for detailed non-parametric statistics, refer to tables in Annexure H).

Significant difference (α=0.05) was found between (re)engagement frequency of most of the conditions, except between condition 1 & 3, 1 & 5, 2 & 5, and 3 & 5. Thus **condition 4 showed significantly higher engagement than all other conditions, and condition 1 showed significantly lesser engagement than condition 2 and 4.**

The skewed engagement values of engagement duration seen in condition 5 were normalized by considering frequency, leading to a significant decrease in engagement frequency from condition 4, as expected. Still, the non-obvious finding was that condition 3 which addition of generative playfulness dimension of narrative failed to enhance engagement in play activity, although narrative seemed to contribute significantly in condition 4 in combination with the dimensions of interactivity and agency, to enhance the engagement. Thus, it cannot be said that narrative as a generative playfulness dimension was ineffective, as probably the **mode of**

implementation of narrative also had a role to play, differing in condition 3, 4 and 5. While medium was visual and static using images (apart from the initial story briefing) in condition 3, narrative involved both visual as well as auditory medium to communicate the sequence of narrative events in condition 4 and 5.

Also, while qualitatively engagement in condition 5 seems to be more than condition 1 as expected, the difference was not statistically significant. The next step involved checking the distribution of engagement frequency across the conditions individually for the 11 subjects to further understand the possible causes for observed patterns in group data, as shown in figure 6.9 below.

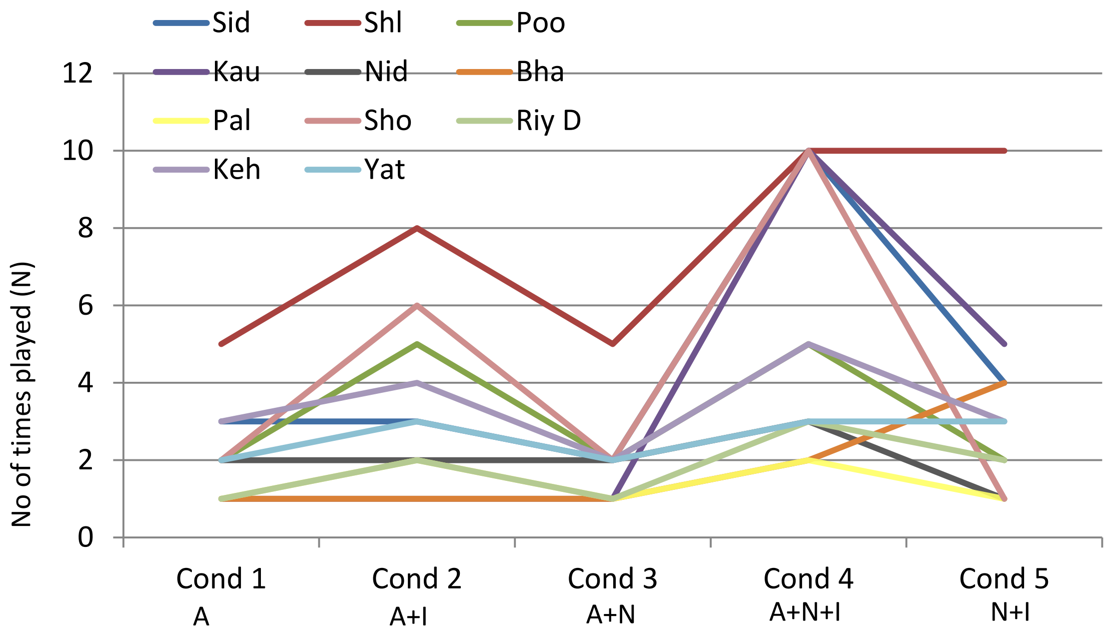


Figure 6.9. Line chart of individual distribution of engagement frequency of 11 subjects across 5 conditions

Individual data for subjects followed the pattern seen for group data with condition 4 emerging to be highest in terms of engagement frequency for most children, while condition 2, 4 and 5 led to higher engagement than condition 1 and 3. However, the distribution of engagement frequency seen in condition 5 showed a large amount of variability between subjects. While condition 5 showed a statistically significant reduction in engagement frequency with respect to condition 4, it was not significantly higher than condition 1 as expected, which could be explained by the large variability between subjects seen within condition 5, leading to reduction of the overall mean of engagement frequency in condition 5.

Qualitative analysis was used to supplement and argue out the patterns as well as the exceptions seen in the quantitative results above.

Substantiating with qualitative insights based on user characteristics: While conditions with interactivity (condition 2, 4 and 5) were largely seen to be more engaging than non-interactive conditions (condition 1 and 3), there were some exceptions to this pattern. e.g. 'Sho' and 'Nid' showed lesser engagement in condition 5 than condition 1. This exception could be explained by relooking at the classification of overall behavioural characteristics of the user (refer Annexure I). 'Sho' and 'Nid' having shown low engagement frequency in condition 5, both had poor comprehension ability for signal feedback and rules. On the other hand, children with good comprehension ability like 'Shl', 'Bha' showed high engagement frequency in condition 5, and were among the exceptional cases who did not show a decline in engagement as compared to condition 4, even though there was a statistically significant reduction for the overall sample. This explained the large variance within condition 5 across the subjects as the observed engagement frequency was found to be closely related to subject's ability to comprehend and identify the signal feedback.

Another exception in relation to a pattern showing conditions with interactivity to be more engaging than non-interactive conditions was for 'Kau', 'Nid' and 'Bha' who did not show increase in engagement from condition 1 to 2. All of them showed a common behavioural characteristic of having low-initial interest in the intervention stimulus i.e. these subjects did not seem interested about the experimental stimulus in condition 1, and were all non-expressive. It is possible that due to their prior experience, these children took more time in accepting the intervention stimuli in the next condition. These results and incongruences are further argued and elaborated using literature in the discussion chapter.

Lastly, the low engagement seen for condition 3 which involved addition of generative playfulness dimension of narrative along with agency was unexpected. As mentioned above, the medium of implementation of narrative was mainly visual in nature, which was static. When looking at the behavioural characteristics of subjects, an interesting relation emerged where children who had poor language comprehension, needed for action fidelity feedback and signal triggers, also showed no interaction with narrative and characters for any of the narrative conditions (condition 3, 4 or 5). On the other hand, children who had good language comprehension also showed interaction with narrative. Thus, involving into narrative seemed to be related on interactivity and associated auditory feedback.

6.3.3 *Joyfulness rate (J/no. of trials)*

Apart from engagement, joyfulness was also used as a parameter to assess the effect on playfulness, calculated by the frequency of child expressing joy (J) through smiling and laughing while playing with the intervention stimulus divided by the number of trials in a condition. It is important to note that rate is a better indicator of joyfulness than the frequency since it normalizes the effect of differences in duration of playing in each condition.

Based on the data, it became clear that not all children were expressive and **only 7 out of 14 subjects expressed joyfulness more than once for a condition/s**. Thus, it did not make sense to check the effect of statistics on the group data across conditions due to the small number of subjects. This also implied that joyfulness cannot be used as a universal parameter for measuring playfulness. However, it was worth checking the pattern for the expressive children and if it substantiated the engagement pattern or contradicted it. The distribution of joyfulness rate across the conditions was checked individually for the 11 subjects as shown in figure 6.10. One of the child named 'Shl' had a missing data point in condition 4 since the video recording got corrupted hence his joyfulness frequency has been approximated based on diary notes of the researcher, who was present in the play space.

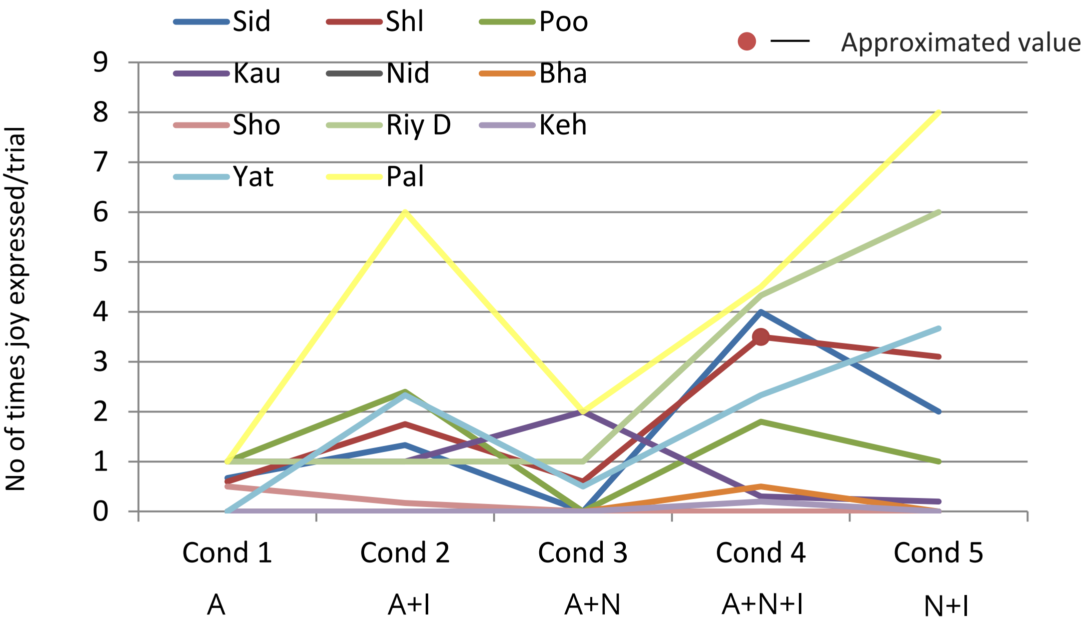


Figure 6.10. Line chart of individual distribution of joyfulness rate of 11 subjects across 5 conditions

While statistical analysis could not be performed on the group data, the distribution of joyfulness rate for the individual subjects showed that qualitatively there was a clear pattern of **condition with interactivity (i.e. conditions 2,4 and 5) being higher than non-interactive conditions (i.e. conditions 1 and 3) for 6 out of 7 children**. This result is in agreement with the pattern seen in engagement, however the difference is that **condition 4 did not emerge as being significantly more joyful** than condition 2 and 5, as seen in engagement pattern. Thus, the generative playfulness dimension of interactivity (which was present in condition 2, 4 and 5) seems to be strongly related to the expression of joy, more than any other dimension.

The analysis also looked at the frequency distribution of joyfulness instances within a condition i.e. how the frequency of joyfulness expression varied from initial trials (when the child started playing) to later trials (when the child was about to end session). An illustration of this analysis is shown for one of the subject named 'Shl' in figure 6.11 below, with each bar representing one of the condition. As mentioned earlier, video data was missing for the specific session in condition 4 due to which condition 4 data could not be plotted.

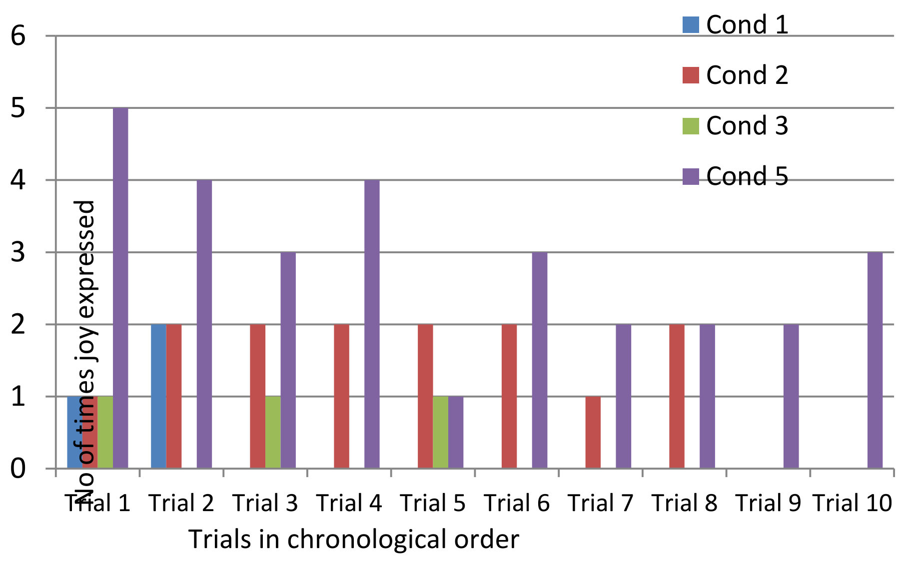


Figure 6.11. Bar diagram showing frequency of joyfulness for 'Shl' within each condition across trials

Based on figure 6.11, joyfulness does not vary significantly as each of the conditions progress. A similar pattern was seen for all the expressive children, thus showing that joy was expressed evenly within a condition and thus **enjoyment was sustained over the entire duration**.

Since joyfulness was seen mainly related to interactive feedback, it was worth exploring if there was a specific event which led to more joyfulness expression than others. It was seen that **interactive feedback at success was found to lead to more joyfulness than**

intermediate locations. This made sense since success as an event accompanies the achievement of a sub-goal.

Substantiating with qualitative insights based on user characteristics: As seen in figure 6.10 above, seven out of fourteen subjects were found to be non-expressive. Interestingly, all seven of these subjects had multiple behavioural characteristics which were common like they all showed low initial interest in the toy, minimal or no interaction with the narrative and its characters in condition 3,4 or 5 and they all generally had a passive, follower attitude towards facilitator, not making clear choices in the decision making protocol. These set of common behavioural characteristics seem to **reflect the context-independent, 'social connection' construct of playfulness definition**, showing that joyfulness expression is a stable, personality trait of the subject. The construct of social connection has been identified in the literature and previous exploratory study using Grounded Theory analysis, and elaborated further in the discussion chapter.

6.3.4 Rate of effort time

While the main dependent variables used to assess playfulness were engagement and joyfulness, effort time was also calculated primarily to observe the significance of practice effect which could have occurred due to repeated measure design used for the study. Also, it was worth investigating performance of the subjects across the conditions as a function of effort time. To normalize the effect of varying engagement frequency, the analysis was focussed on total effort time per trial (or rate of effort time) i.e. the total time taken once the subject started insertion attempt till the time the block was inserted or left, for all such attempts for a condition divided by total number of trials for that condition. The distribution of pooled means of total effort time/trial for the subjects was within the permissible values of Skewness and slightly high for Kurtosis in the range 2-3, thus treated as normal distribution (tabulated in annexure G). Mauchly's test indicated that the assumption of sphericity was satisfied ($\chi2(9) = 12.6$, $p > .1$). Analysis of variance showed a main effect of conditions on effort time/trial, $F(4, 36) = 6.328$, $p=0.001$, $\eta_p^2 = .413$. Paired t-tests were used to further identify the conditions which were significantly different ($\alpha=0.05$) from each other. Figure 6.12 shows the distribution of the pooled means (with standard error) of rate of effort time across the five conditions, highlighting the differences which were statistically non-significant. The exact probability values are reported in Annexure G for reference in the form of a table.

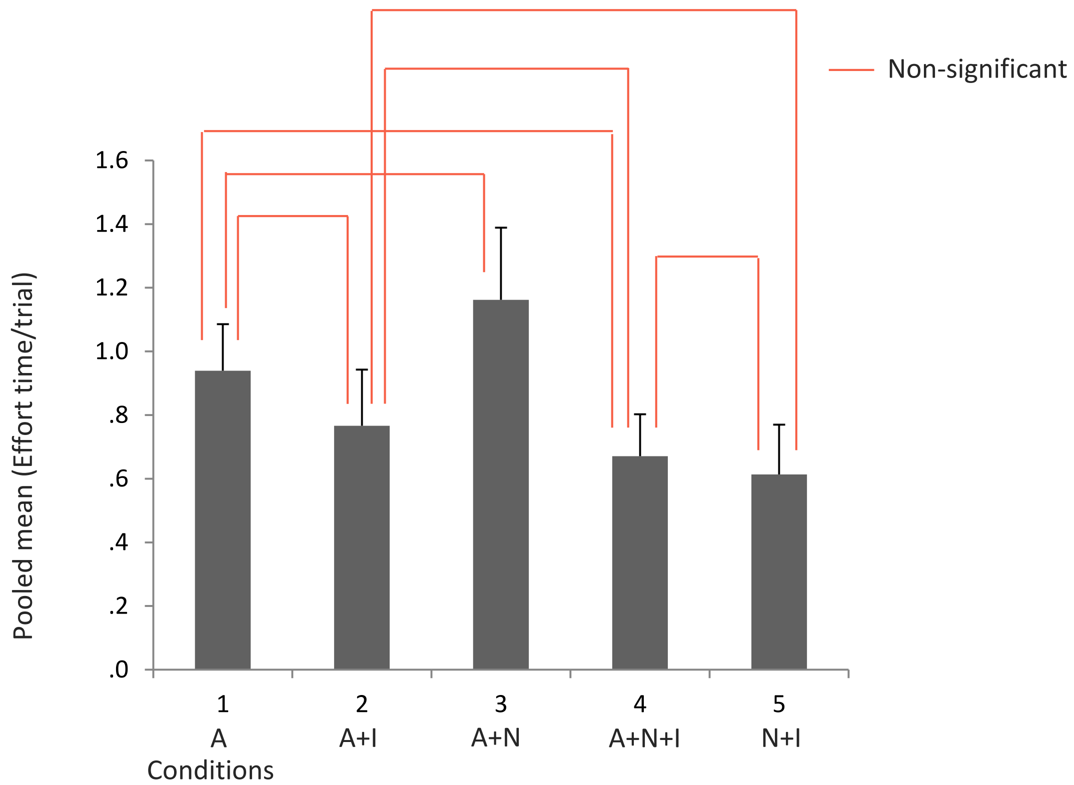


Figure 6.12. Distribution of pooled means and standard error (error bars) of rate of effort time across conditions highlighting statistically non-significant differences.

Non-parametric tests were used on group data for rate of effort time to verify the results. There was a statistically significant difference in effort time/trial values depending on the stimuli condition, $\chi^2(4) = 13.374$, $p = 0.01$. Post hoc analysis with Wilcoxon signed-rank tests was conducted with a significance level set at $p < 0.05$ and non-parametric tests replicated the results as seen in parametric tests (for detailed non-parametric statistics, refer to tables in Annexure H).

Total effort time per trial was significantly more in condition 3 as compared to all the conditions with interactivity (i.e. condition 2, 4 and 5). Also, total effort time for condition 1 was significantly more than condition 5. The results did not show any strong pattern. Qualitatively looking at the graph, non-interactive conditions (condition 1 and 3) needed higher effort time thus interactivity could have had a positive effect on performance of the subjects, leading to decrease in total effort time. A very similar distribution was seen for numbers of assistive triggers which were needed per trial across the five conditions, validating the pattern seen for effort time. The analysis further looked into individual distribution of rate of effort time for subjects across the five conditions, as shown in figure 6.13.

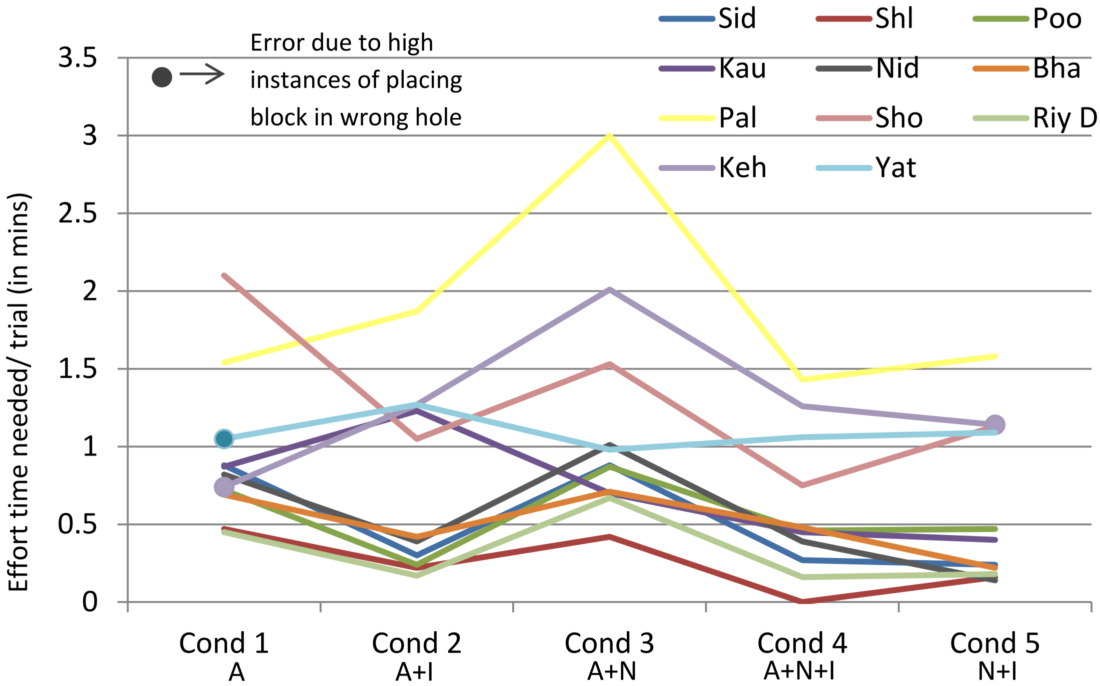


Figure 6.13. Line chart of total effort time taken per trial (rate) for 11 subjects across 5 conditions

As pointed out using dots in figure 6.13, there were 3 sessions for which the total effort time could have been inaccurate since they involved high frequency of errors caused by blocks going into wrong hole, thus effectively reducing the effort needed. Ignoring these data points, for most subjects condition 3 seemed to be the highest in terms of total effort time taken per trial, followed by condition 1 and 5. Interestingly, this **pattern seemed opposite to the pattern for engagement** where condition 1 and 3 were least in engagement, followed by condition 5. Qualitative analysis was used to supplement and argue out the observed patterns as well as the exceptions seen in the quantitative results above.

Substantiating with qualitative insights based on user characteristics: There were few exceptions in the observed pattern in figure 6.13. Excluding the cases of ‘Yat’ and ‘Keh’ who showed erroneous reading due to high instances of placing block in wrong hole, only ‘Pal’ and ‘Kau’ didn’t seem to follow the pattern. It was found that their reading was based on 1 trial in conditions which showed exception. This could have easily skewed the plot and thus it is not reliable.

For all other children, a pattern was seen with non-interactive conditions needing higher effort time. It made sense to look into the role of interactive feedback on subject's performance in order to understand this pattern. The effect of interactive feedback would depend upon the ability of children to comprehend action fidelity feedback since it would have made it easier for children to match shapes. However it was found that 5 out of 9 children who showed the above pattern of effort time being related to interactivity often had problems in comprehending action fidelity feedback. Thus, comprehension of interactive feedback does not seem to have any direct effect on the performance of subjects. The other possibility is that probably conditions with interactivity lead to higher engagement and higher engagement would lead to increase in performance. Thus, it was decided to test the correlation between (re)engagement frequency and total effort time/trial for all the conditions combined. Correlation coefficient Pearson's $r(55) = -.34$, $p=0.01$, showed that there was a weak correlation between the engagement and effort time. Thus, while qualitatively we could see an inverse relation between engagement and performance of subjects, it could not be statistically established.

6.3.5 Learning effect (habituation and practice effect)

Habituation effect is defined as the reduced responsiveness to stimulus on repeated exposure[4], and in the context of our study on playfulness, habituation effect could have led to boredom for later conditions. A number of steps were taken to check habituation effect including varying the visual design of the intervention stimuli for each condition (refer section 5.2). Also, a minimum of one week gap was kept between exposures of two conditions. However, there could still have been some habituation effect, so a graph was plotted for engagement frequency (N) in the order of presentation of a condition i.e. from 1st exposure to last exposure (i.e. 5th exposure need not be condition 5 but could also be condition 4, depending upon a subject's sequence) as shown in figure 6.14. The purpose of this graph to see if there is a continuous increase or decrease trend as the child was exposed to conditions.

[4] http://pip.ucalgary.ca/psyc-312/repeated-measures/within-subjects-designs/Special-Considerations.html

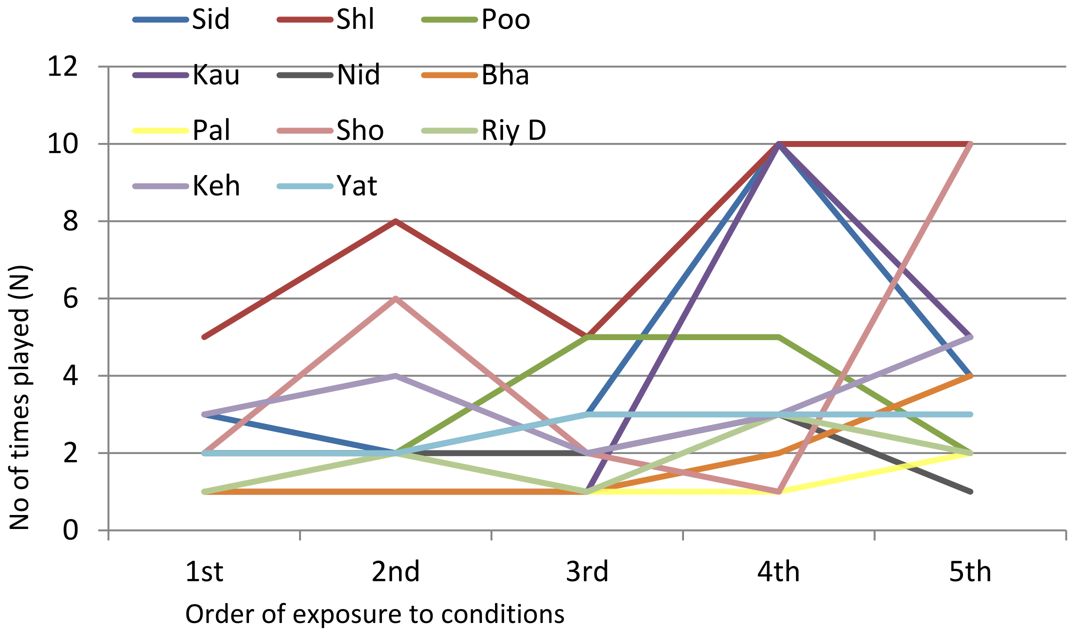


*Figure 6.14. E*ngagement frequency (N) of subjects varied across the sequence of exposure to conditions

None of the 11 subjects showed any sign of decrease in engagement due to a possible habituation effect. In fact, later exposures seemed to have relatively higher engagement frequency than earlier exposures. Thus, the habituation effect was safely assumed to be non-significant.

The next step involved checking the possibility of practice effect which is defined as improvement in performance in a task on repeated exposure[2], and in the context of our study, it would have two interpretations - reduction in effort time for later conditions (practice effect primarily on motor coordination) and reduction in instances of fail attempts and errors due to perception (practice effect primarily on visual perception). Again, a minimum gap of one week between exposure to two conditions helped in checking these practice effects. Firstly, we looked at the extent of practice effect on motor coordination by plotting a graph for total effort time/trial in the order of presentation of a condition i.e. from 1st exposure to last exposure and looking for continuous trends as shown in figure 6.15.

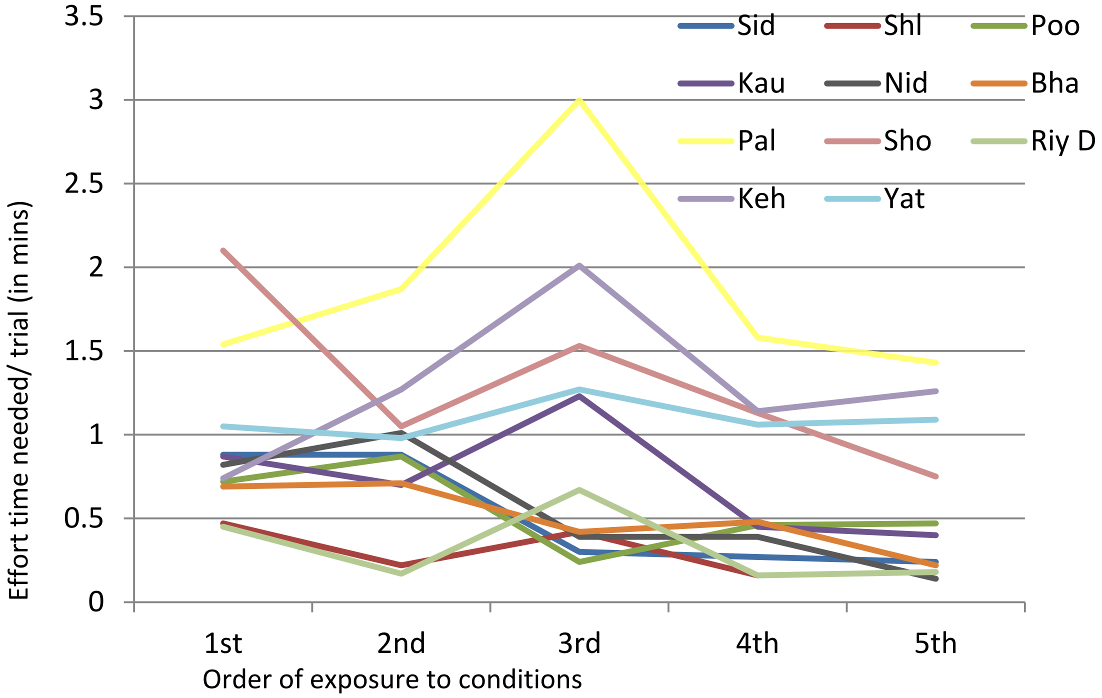


Figure 6.15. Total effort time/trial of subjects varied across the sequence of exposure to conditions

Qualitatively, there appear to be two set of subjects, one who clearly did not show any practice effect in motor coordination (due to non-decreasing plot lines), and others who had a relatively flat line curve, generally in decreasing order. The latter included ‘Nid’, ‘Poo’, ‘Sid’ and ‘Bha’. Also, there could have been some dampening in effort time value as there aren’t many peaks in later exposures.

Since we could not find a standard clinically significant difference which could be used to differentiate the values between two exposures, our inference is based on approximation. Now even if we assume that above-mentioned four subjects showed a significant decrease in total effort time/trial and showed practice effect, it is still a small proportion out of 11 subjects. Furthermore, as discussed in the analysis sub-section of effort time, only a weak correlation was seen between the performance and engagement of subjects. Also, the direction of correlation seemed to be engagement affecting the effort time and not the vice-versa. Hence, while the practice effect can’t be completely eliminated, it is safe to say that the **small practice effect would not have made any significant difference** to our inferences about playfulness (engagement and joyfulness) between conditions.

It was also worth checking if there was any practice effect in motor coordination within a condition i.e. later trials taking less effort time than earlier trials. This was analysed for all subjects however only one subject named 'Poo' has been reported to illustrate the analysis process as shown in figure 6.16, with each bar representing one of the condition.

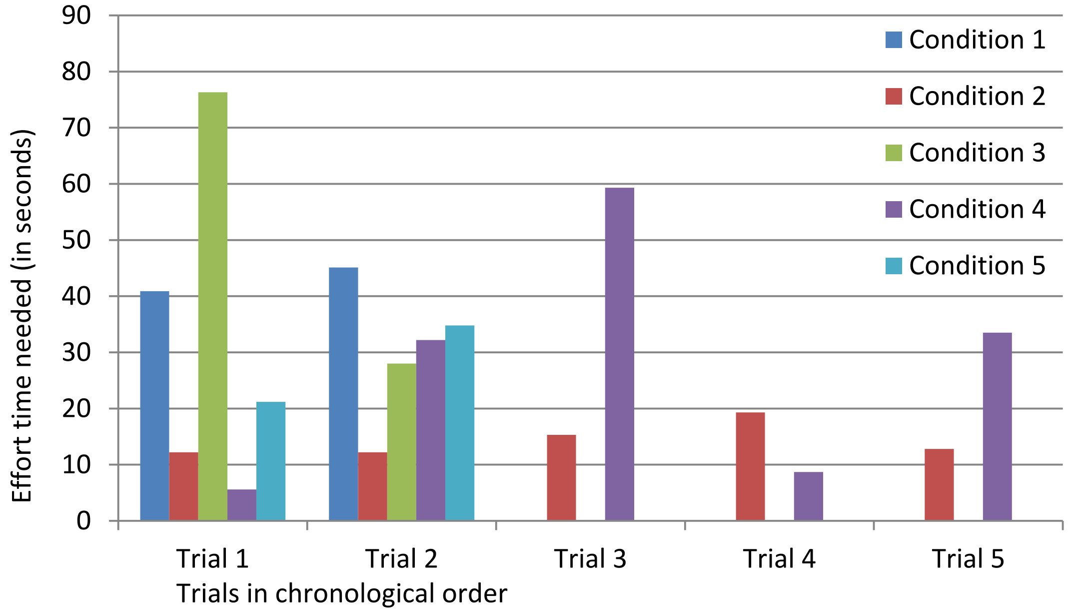


Figure 6.16. Bar diagram showing effort time needed in each trial for 'Poo' within each condition

Based on figure 6.16, effort time does not show any specific pattern and doesn't decrease as the trials progress within each condition. Other subjects also showed similar distribution with no presence of learning effect in motor coordination within a condition.

As mentioned earlier, the second possibility of practice effect was in relation to subject's visual perception, implying that the difficulties in visual perception will reduce for conditions which come later chronologically as compared to earlier ones. There were primarily two distinct actions in the play process which could result from difficulty in visual perception. These are – a) fail attempts due to child trying a block in incorrect hole, b) misplaced success attempts where child inserts a block in incorrect hole due to erroneous stimulus design. We looked at the extent of practice effect on visual perception by plotting a graph for visual perception errors/ trial in the chronological order of presentation of conditions i.e. from 1st exposure to last exposure, where visual perception errors are calculated by adding the instances of fail attempts and misplaced success attempts (refer figure 6.17).

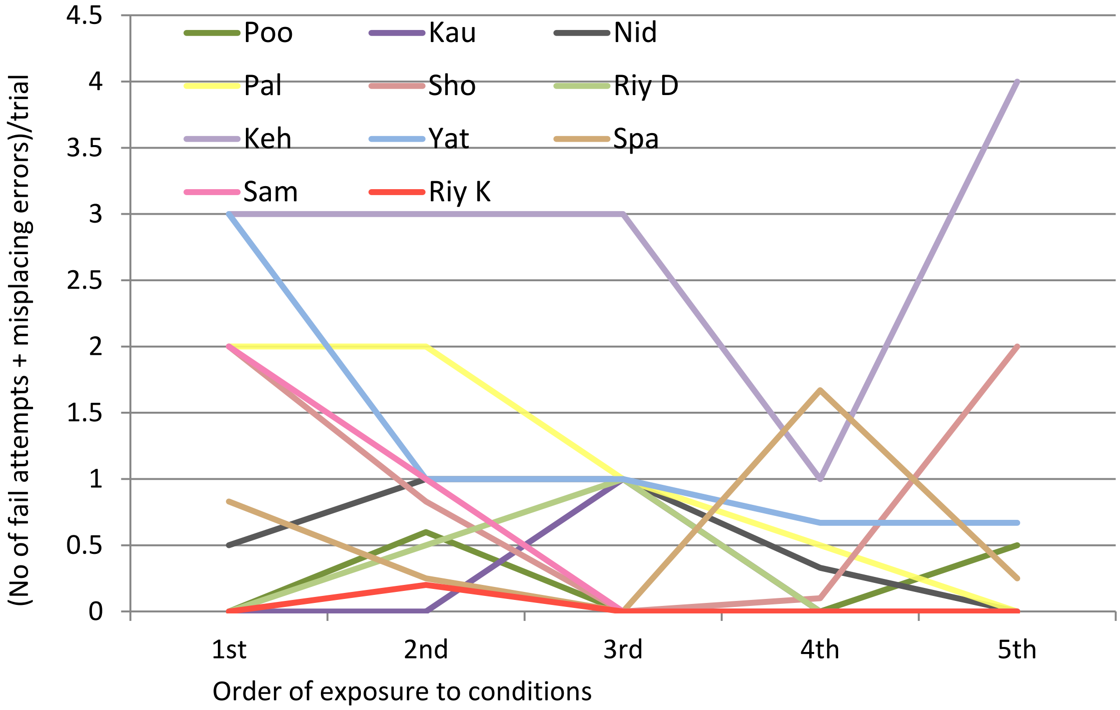


Figure 6.17. Visual perception errors/trial of subjects varied across the sequence of exposure to conditions

Qualitatively, only four subjects seemed to show a decline in visual perception errors/trial for later conditions starting from condition 2, namely 'Nid', 'Pal', 'Sam' and 'Yat'. Generally, there was no pattern seen based on visual perception errors, thus it can be safely assumed that there was no significant learning effect in relation to visual perception.

6.3.6 Role of shape and position of blocks, design of stimulus

A number of interesting relationships emerged in the course of the analysis, which were not directly linked with the focus on hypothesis testing, but nevertheless useful and worth reporting. Also, there were certain parameters which were checked to ensure that external variables didn't affect the observed patterns. Some of the relevant findings are briefly discussed below.

1) Effort time was measured for each individual attempt and shape codes were also associated with the attempts which allowed us to compare the effort needed for different shapes. A common pattern emerged where maximum effort in motor coordination was needed for triangle and trapezium for all subjects. In fact, **when arranged in decreasing order based on effort needed, shapes were as follows: triangle, trapezium, square, circle**. Since, almost all subjects showed the same pattern, it was worth trying to understand the cause of this pattern. It seems that

because a 3rd dimension of height was also involved, which often led to orientation and insertion problems, blocks with shapes having acute angles became more difficult to insert, as the tendency to get stuck would be more. These results also substantiate the pattern seen in other studies with triangle and trapezium being seen as shapes difficult to distinguish for preschool children (Clements, Swaminathan, Anne, & Hannibal, 1999; Verdine, Lucca, Golinkoff, Hirsh-Pasek, & Newcombe, 2016).

2) Since the coding phase included adding codes for shape and position for every attempt, it was possible to check if shapes had any specific effect in the sequence of play. Looking at the order in which shapes were chosen for insertion one by one, 8 out of 14 subjects (including the 3 subjects who were excluded from the main analysis) showed a sequential pattern where circle was seen to be the 1st choice for 6 out of 8 children in some or most conditions. Also, Triangle or trapezium was seen to be the last choice for 6 out of 8 children. Considering that triangle and trapezium were found to be most difficult shapes in terms of motor coordination, while circle was found to be the easiest as identified in an earlier finding, it seems that **subjects would choose shapes based on the ease of matching and inserting them**. Hence, it could be hypothesized that children tried to avoid (in this case, delay) high challenge situations. The sequence adopted by subjects in the 1st trial of initial conditions was further noted to identify if they were able to visually perceive the difficulty or was it that they learned about the difficulty while playing and adapted this sequential pattern. It was found that 3 of the 6 children used the same sequence from the 1st attempt while other three later adapted it, hence the sequential pattern could probably be due to a mix of visual perception and experience based learning.

3) One of the possible errors in the interpretation of above findings could have been with respect to the design of intervention stimuli for different condition. The analysis involved checking if any of the animal graphics (condition 3, 4 or 5) stood out from the rest. No instances were found where subjects showed more or less affinity for a specific graphic except 'Keh' who seemed fixated upon tiger and looked at it closely whenever the feedback was played in condition 4. Also, two subjects, Kau' & 'Sho', could have shown affinity in following a specific sequence in inserting shapes (feeding animals), i.e. cow, cat, dog, tiger and dog, cow, cat/tiger respectively. Furthermore, no animal graphic substantially stood out in terms of visual perceptual errors for condition 3, 4 and 5. Lastly, no animal voice substantially stood out in terms of its recognisability shown by children, except 'Bha' (cow)and 'Yat' (dog) who were

able to recognize one of the animal's voice significantly better. Thus **research design was found to be robust and no errors were found in the design of stimulus** which could have led to bias towards a specific shape, and thus affect play.

4) The addition or reduction of generative playfulness dimensions in the intervention stimulus could also have led to variation in the cognitive ability or processing needed for playing in the different conditions. It was important to check if the difference in the cognitive ability needed to play was significant. Table 6.2 shows the level of cognitive ability needed to play in respective conditions.

Condition	Level of cognitive ability needed
Condition 1, 3	Identification of shapes, matching
Condition 2, 4	Identification of shapes OR comprehension of action fidelity feedback, matching
Condition 5	Comprehension of signal triggers, identification of shapes OR comprehension of action fidelity feedback, matching

Table 6.2. Cognitive ability needed to complete the tasks while playing in each of the 5 conditions

Condition 5 needed maximum amount of cognitive ability due to the extra task of comprehending signal triggers. This was followed by condition 2 and 4 which allowed multiple strategies to progress but it can't be conclusively said if it needed lesser cognitive ability as child could perform the task by either strategy. Also, the two strategies cannot be directly compared. Besides, the analysis showed that only some children were able to comprehend the action fidelity feedback and that also occasionally, hence condition 1, 2, 3 and 4 become comparable. Thus, it is safe to assume that the effect of variation in cognitive ability needed to play is minimal and should not affect our findings with respect to engagement and joyfulness.

6.4 Summary of results

The present study aimed at implementing selected generative dimensions, individually and in combination, into redesign concepts of a toy belonging to challenge-based play type, observing its effects on the playfulness of children with special needs. It was an attempt to further operationalize the translation of selected dimensions into a different play type. This led to two main hypotheses, as discussed below in relation to observed results:

a) ***Stimulus condition on net addition of one or more generative playfulness dimensions will lead to higher playfulness than the parent condition.*** Following relations needed to be satisfied for this hypothesis to be true: Playfulness of condition 1 < playfulness of all other conditions (i.e. 2, 3, 4 and 5), and Playfulness of condition 4 > playfulness of all other conditions (i.e. 1, 2, 3 and 5)

b) ***Stimulus condition on net deletion of one or more generative playfulness dimensions will lead to lesser playfulness than the parent condition.*** There was only one condition where playfulness dimension was removed, to observe the effects. Following relation needed to be satisfied for this hypothesis to be true: Playfulness of condition 5 < Playfulness of condition 4

Playfulness was assessed based on the combination of engagement (duration and number of times child chose to play again with toy), and joyfulness (no. of times child showed facial expression of joy). However, joyfulness was found to be expressed only by some of the subjects. Hence **joyfulness could not be used as an independent measure, but as a supplementary measure** for further substantiating the pattern seen in engagement duration and frequency.

Results showed that, engagement in condition 4 was significantly higher ($p<0.05$) than all other conditions, including condition 5, but joyfulness was significantly higher than condition 1 and 3, and comparable with condition 2 and 5. Thus **overall playfulness was significantly higher in condition 4 than all other conditions validating hypothesis b) and part of hypothesis a)**.

However, **engagement in condition 1 was significantly lesser ($p<0.05$) than only condition 2 and 4, while comparable with condition 3 and 5**. Joyfulness in condition 1 was significantly lesser than condition 2, 4 and 5. Thus **hypothesis a) could not be completely validated** because of two main contradictions. Firstly, playfulness did not increase in condition after generative playfulness dimension of narrative was added to agency, however narrative dimension in combination with the interactivity dimension led to highest playfulness (condition 4). It was inferred that narrative was sustained primarily through interactive auditory feedback and visuals by themselves failed in engaging child with narrative. The second contradiction was seen when playfulness did not increase significantly for condition 5 (only joyfulness showed a clear increase). Engagement in condition 5 although higher than condition 1, also had most variance out of all conditions. This variability primarily led to non-significance in increase, as it was based upon subject's comprehension ability of signal triggers which were introduced to reduce agency. Whenever children showed poor comprehension, the engagement decreased significantly, and increased on good comprehension. Thus, probably the **mode of implementation of adding narrative and reducing agency led to failure of some aspects of the hypothesis**. This, however helped in generating useful design recommendations to operationalize the use of these dimensions in design practice, detailed in discussion section.

In terms of generative playfulness dimensions, interactivity was found to be one of the most effective dimensions, as playfulness in interactive conditions was significantly more than non-interactive conditions (condition 1 and 3). Narrative enhanced the playfulness when combined with interactivity but failed in isolation due to the choice of medium and implementation limitations. Agency when reduced showed a significant decrease in engagement as expected, however in comparison to condition 1, engagement was not significantly higher due to the high variance of condition 5, caused by the role of feedback comprehension ability of subjects. Again, a better implementation should have resolved this issue. We specifically checked for the presence of habituation and practice effects due to the repeated measures design that had been employed, and found that there were no significant effects, as well as, the design of stimulus and other aspects of research design were found to be robust, leading to reliable findings. Some of these findings are significant both for theory of design research and design practice, as elaborated in the following discussion section.

6.5 Discussion

The discussion will focus on the significant theoretical contributions from the present study, in relation to existing research knowledge in the domain of applying the selected dimensions and also highlight individual toy design features which played a significant role in operationalizing the dimensions in a real-life context of play in special school.

6.6.1 Narrative

Narrative has been a well-studied concept in multiple fields with a dedicated branch of knowledge known as narratology, dealing with its structure and functions. Some of this interest could be attributed to recognition of narratives for contributing to engagement in most emerging mediums and application areas. e.g. studies suggest that use of compelling narratives can enhance the engagement and replayability of the video games (Adams, 2001;

Bringsjord, 2001). Schneider, Lang, Shin, and Bradley (2004) found that introducing a narrative in a first person shooter video game (challenge based) enhanced the sense of presence and physiological arousal in players, as compared to non-narrative game play. Recently, Lu et al. (2016) looked into the effect of narratives in active video games for 8 to 11 years aged typical children. They reported that by a simple introduction of a small narrative cut-scene, children's physical activity increased significantly. However, there has been a counter-argument in video game studies which emphasizes on player interaction being the essence of video gameplay, and warns that interaction shouldn't be overshadowed by storytelling aspect (Ke, 2016). Nonetheless, narrative has stayed at the heart of design in a lot of present day video games. Narratives has also been employed in communicating social messages and prevention strategies to youth and found success in engaging and persuading them as seen in a number of recent studies (Gamberini et al., 2016; Miller-Day & Hecht, 2013). Another application of narratives in new media could be seen in instructional design where narrative is used as a strategy for problem-based and project-based learning, acknowledged in recent studies reviewing game based learning (Abdul Jabbar & Felicia, 2015; Ke, 2016). McQuiggan et al. (2008) looked at the effect of narrative based learning environment on 8th grade typical school children and found that while learning gains weren't sufficient, narrative-centred learning led to increase in motivational factors including self-efficacy, presence, interest, and perception of control. Ke and Abras (2013) report a similar result for 7th grade children with special learning needs stating that narrative contributed in reinforcing concentration of the children while playing with digital games to learn mathematics. Despite the observed positive effects, the use of narrative for learning or other serious purpose could also act as a distraction to the player from allowing them to critically process game content. This situation when player is fully focused on the events of the narrative has been termed as 'transportation' (Green et al., 2004) or 'presence' (Rowe, McQuiggan, & Lester, 2007). While the concept of presence is beneficial to engagement in pretend play activities, it might start competing with the play affordance of non-pretend play based artefacts like challenge based toys and thus lead the player off the intended play actions, a concern also raised by McQuiggan et al. (2008) while testing a narrative based learning game with 8th graders. Addressing this concern, the validation study (i.e. study 3) looked into the operationalization of the narrative dimension in a challenge-based toy context and observed its effect on playfulness. While there were possibilities of non-intuitive outcome, this exploration is also important because most of the earlier studies in the domain of narrative application, as discussed above, have focused on older children and adults.

Mccarthy, Tiu, and Li (2014) acknowledged the presence of narrative had a positive effect on engagement in a digital game to learn mathematics for preschool typical children. Clearly, **there is much lesser research literature for effect of narrative on engagement for preschool typical and special children's play in non-pretend play context**, as a lot of focus has been on using technological interventions to mediate story-telling and pretend play. Before we discuss the results from the validation study, it is important to reiterate that narrative in our context is being collaboratively constructed between player and the artefact. The artefact communicates the appropriate cues or prompts for action, and the player is expected to behave cooperatively in the construction of the narrative through his actions.

The narrative dimension was implemented in three of the five overall conditions, including condition 3 (narrative & agency), condition 4 (narrative, agency & interactivity) and condition 5 (narrative & interactivity), varying in mode of implementation depending upon the condition. Surprisingly, narrative dimension did not always show a clear positive correlation with playfulness, unlike other dimensions. **As a counter-intuitive finding, narrative dimension was found to significantly enhance playfulness in combination with interactivity dimension (i.e. condition 4 and 5) but failed to have any effect in absence of interactivity dimension (i.e. condition 3), when compared to non-narrative conditions.** It could be argued that higher engagement seen in condition 4 and 5 is primarily due to interactivity dimension and narrative is irrelevant, however within conditions having interactivity dimension (i.e. condition 2, 4 and 5), significantly higher engagement was seen for condition 4 over condition 2 where condition 4 included narrative dimension, while condition 2 didn't (this point is discussed in more detail in the next sub-section on interactivity). This shows that narrative dimension did play a role in enhancing engagement but failed to have any effect in the absence of interactivity. It was an unexpected result considering the earlier literature which seems to have a consensus that narrative leads to enhancement of engagement. However, since there are no previous instances in literature where an application context similar to our study has been checked, it made sense to look into the way narrative had been implemented in the respective conditions in our study. Also, to understand this deviation, we relooked at the definition of narrative in relation to its medium of implementation. One of the most useful explanation emerged from Wolf (2003) who reconceptualising narrative in applying it to visual arts. Instead of focusing on the absence and presence of narrative, Wolf explained narrative as being multi-factorial and gradable in nature. Inspired from theory given by Prince (1982), Wolf uses the term 'narrativity' which consists of plurality of factors or ‘narratemes’, not all of which should be present in order to render a text a narrative. Using this flexible framework allows us to discuss narrative or rather narrativity in our toy with respect to other mediums, and its corresponding effect on engagement. Prince defines narrative as ‘the representation of atleast two real or fictive events or situations in a time sequence, neither of which presupposes or entails the other’. Furthermore, several other factors needed for enhancing the narrativity are: requirement of ‘anthropomorphic beings’, ‘existence of conflicts’, having a ‘well-defined and interacting beginning, middle and ending’, and a narrative world which is coherent and intelligent (Prince, 1982, 1996). Padilla-Zea et al. (2014) further narrows down the characteristics of a good story in the context of games emphasizing on dividing the narrative into goals and sub-goals, and affording actions which allow players to achieve the goals to reap rewards. Our toy in study 3 does have a number of these elements described above, including a narrative world with anthropomorphic beings (represented in the form of animals in the park), fictive events in time sequence (animals being hungry and then fed) and division into goals and actions following the narrative. However, the other elements seem to be lacking or absent e.g. the existence of conflict. Conflict emerges as an outcome of a good narrative arc which follows the typical sequence: setup, complication, development, resolution, and denouement (Thompson, 1999). These phases need to be discreet and distinguishable leading to conflict, tension and climax (Bizzocchi, 2007). This type of narrative arc seems to be weak in our toy stimulus as the individual stages are not clearly divided. Furthermore, the denouement or ending is not explicit in the narrative of our toy, as there is no significant change in state when all the animals have been fed in the narrative. This characteristic of having a meaningful and clear ending, termed as teology, has been claimed to be one of the most crucial criterion for narrative representationality (Wolf, 2003). It seems likely that both of these factors i.e. conflict and an explicit ending, could have been responsible for the difference in observed playfulness between narrative condition 3 (no interactivity) and conditions 4,5 (with interactivity). The addition of an interactive feedback based on the child’s action gives voice to the element of conflict and tension, emerging from animals’s dialogues remarking on the need to be fed and whether the child’s actions are being helpful. The acknowledgement after being fed through dialogues in conditions with interactivity, again contributes to the representation of an ending, although both of these factors still remain weak in comparison to the narrative arc as usually seen in other media like films, story-books and video games. In condition 3, in the absence of character dialogues, it was assumed that after the initial briefing by facilitator to setup the story, narrative arc would be sustained by the children themselves through their actions and with the aid of story world and characters depicted through still visuals. However, it cannot be denied that without the dialogues (interactive feedback), the narrativity seemed to reduce, and children did not invest cognitively in the narrative .Thus, we can conclude that **when integrating narrative in challenge based play activity, explicit communication of sequence of events is needed in the design to sustain engagement, and plainly relying on visuals and child's ability to progress the narrative not be sufficient**. Interactive feedback was found useful as it helped in advancing the narrative arc and communicating the ending. This insight was further substantiated by looking at the user characteristics of our subjects in study 3, in relation to observed playfulness. An interesting relationship emerged showing that **some children who had poor language comprehension leading to difficulty in comprehending signal triggers and interactive feedback also showed negligible response to narrative and the associated characters in terms of empathizing or interacting, although they were all initially briefed about narrative storyline.** This confirms that it was primarily through auditory, interactive feedback that children were invested into narrative, and visuals by themselves were unable to sustain child's interest in the story. However, this insight also presents a new challenge for future to further analyse the semantic and syntactic nature of the narrative information, and design it to be easier to comprehend for preschool children with ID having varying level of language limitations. The toy stimulus design used in our study embedded the learning element of shape identification indirectly in the process of feeding multi-shape blocks to animals, instead of directly informing the children on information of shapes through narrative content. **It seems that such information heavy narrative strategies would be even more difficult for preschool children with ID to comprehend, and thus an indirect approach using the actions to embody learning, as in our case, would be a better choice.** However, we report this insight with caution, since the focus of our study has not been on learning outcome, and this is more of an after-thought. Hirsh-Pasek et al. (2015) while giving suggestions on designing learning based applications for children mentions the need of integrating such actions into the game's narrative, or context, as attempted in our study.

Apart from the reasons discussed above, the mode of implementing narrative into the study conditions could have also contributed to the difference seen in playfulness between the conditions as visuals (condition 3) is a static medium, while interactive auditory feedback (condition 4 & 5) was abrupt, dynamic and transient. This could have enhanced instances of joyfulness expression, and led to higher playfulness.

It is important to note that above findings and argument on the need for explicit communication of narrative dialogues is limited to one specific implementation of the narrative in the context of challenge-based toy. **This finding needs to be further explored as a function of how strong the narrative arc is, how it is presented and its effect on engagement.** This is because there is a trade-off between having a stronger narrative arc and the control of player in the non-pretend play context like ours as having a strong narrative arc could also lead to diversion into a pretend play activity. None of the conditions in our study showed children deviating from the rules and structure of challenge-based play activity and indulging into pretend play, which could be attributed to not having a very detailed representation of narrative and not using a dynamic medium which could create the sense of transportation. Bizzocchi (2007) acknowledges this trade-off in the ongoing debate between narratologists and ludologists, suggesting that as opposed to the narrative arc, other narrative elements like character, storyworld, emotion, narrative interface, and micro-narrative could be more useful channels to explore in the context of games (challenge-based). His visualization of micro-narratives is similar to our representation of a small narrative being 'played out' by player. Rowe et al. (2011) showed through his study that narrative presence and learning can be achieved together by careful design considerations, however his subjects were 8th grade typical children, and the insights wouldn't be applicable to preschool children with special needs.

From a broader perspective, our findings showed that the effect of narrative, its structure and function, on engagement in an activity would vary based on the medium and context. One of the useful classification of narrative based on medium could be about how much narrative structure is designed externally and how much of it is actively created by the child, ranging from being completely structured e.g. film/animation, comics, or semi-structured e.g. wordless books, adventure video games, to completely unstructured e.g. pretend play toy sets. If we place our narrative conditions from study 3 on this scale, they would fall between completely structured to semi-structured considering that the child becomes an active role-player and controls the sequence of actions but the theme/content is not altered. Caracciolo (2015) distinguishes video games into two categories – being narrative focused as events are pre-structured and simply followed step-by-step, versus being gameplay focused where player has higher agency and can employ multiple strategies, each having its own experiential qualities. None of the two categories explain the class of toys represented in our study, as the toy couldn't be narrative focused since story has to be simple for children with ID to understand and follow which contradicts the notion of making narrative arc stronger and detailed. Information-rich and learning focused narrative would become too complicated, leading to children getting distracted. On the other hand, children with ID can't create and execute complex strategies and take multiple perspectives, as seen to be the base of gameplay focused category. Furthermore, if the designed toy or play activity does not employ digital medium, there are limitations in how much aesthetic and narrative detailing could be included. It seems clear that the research literature discussed earlier on applying narrative in other mediums like video games, story books, instruction design, etc. would not be directly applicable in our situation, with unique constraints and conditions. There are hardly any previous research studies that look into role of narrative in preschool toys. Recently, Baykal, Alaca, Yantaç, and Göksun (2016) used tangible, interactive toy based on tangrams to teach shapes to preschool children involving narrative as a condition, however their work seems to be focused on effect of narrative on learning, emphasizing on the word-to-object mapping capability of narrative. **Considering that our medium of implementation of narrative borrows properties from several known mediums but does not fit into any specific category, our operationalization of narrative dimension to observe its effect on playfulness, looks at an unexplored medium of narrative (i.e. using it in challenge based toys) and context (preschool children at special school), addressing this theoretical gap in research literature.** The need for reconceptualization of narratology that allows for transmedial applications of its findings has also been expressed in a number of studies (Herman, 2011; Wolf, 2011). Bateman (2016) adds that new accounts of multimodal discourse in narratology may serve as a powerful intermediate level of modelling that would connect abstract narrative concerns with concrete, and thereby model-able, features of narrative artefacts and performances.

6.5.2 Interactivity

Interactivity is the second generative playfulness dimension which was operationalized in the context of challenge based toy in the validation study. As defined in the last chapter, interactivity derives from the role and strategies of the facilitator as a responsive agent in play who was found to have a significant positive effect on the observed playfulness of children in the exploratory study in phase 2. It implies that the design of play activity/artefact should embed this role by giving instantaneous feedback on fidelity of the action (being a success or failure) as well as the state of play and its progression, in a responsive and contextual manner. A number of theories in the domain of play research have discussed about the characteristics of a good feedback e.g. social cognitive theory states that a good feedback should give a clear picture of how well a player is doing (Bandura, 1997), while self-determination theory suggests that feedback should empower the feeling of mastery (Rovniak, Hovell, Wojcik, Winett, & Martinez-Donate, 2005). One of the most prominent theories on engagement comes from Csikszentmihalyi (1990) who talks of the immersive state of flow which could be achieved with immediate feedback as a necessary component of the task. While there is a substantial support for the use of interactivity and feedback, empirical work that shows the effectiveness of interactivity in different applications related to children is still limited, as will be discussed later in this section. In the context of the validation study, interactivity was included in three of the conditions, namely: condition 2 (interactivity + agency), condition 4 (interactivity + narrative + agency) and condition 5 (interactivity + narrative). Due to this intrinsic difference between the conditions, the implementation of interactivity dimension also varied between the conditions. e.g. condition 2, without narrative, had a more abstract and plain feedback to action events, while condition 4 and 5 had a narrative-laden feedback. Agency dimension also led to differences in implementation of interactivity with an additional dialogue in the form of signal trigger being included in condition 5 to control the sequence of play and reduce player's agency. However, interactivity was limited by the scope of its implementation, as there was no change in the content of narrative based on the action of the child. A higher level of interactivity may even lead to adaptation of the gameplay and game world to the skill level of the child by measuring his ongoing performance, as demonstrated in a recent study (Ioannidi, Zidianakis, Antona, & Stephanidis, 2016). Weber, Behr, and DeMartino (2014) presented a framework and a scientific scale to measure interactivity in video games, stating that it needs to be treated as scalable, which is an interesting domain for future studies in operationalization of interactivity as a dimension. Acknowledging the limited scope of implementation of interactivity dimension, results from the validation study are discussed below.

The findings showed that **toy stimuli which were designed by including interactivity dimension lead to significantly higher playfulness than non-interactive stimuli** i.e. playfulness of condition 2, 4 and 5 was higher than condition 1 and 3 (except condition 5 which didn't show a significant increase, due to effect of removing the agency dimension, as explained in next sub-section on agency dimension). Interactivity was introduced by use of auditory stimulus at action events which constituted of attempts made by the children to insert a block, ensuring instantaneous feedback on fidelity of the action and progress, also furthering the narrative, wherever applied. However, the design implementation could not completely replace the role of a responsive facilitator as seen in study 2, because some of the children failed to comprehend and/or respond to the action fidelity feedback (stating the correctness of their attempt). Hence, facilitator played a complementary role by following a system of least prompts and constant time delay techniques (explained in the previous section on research design), ensuring that child got the guidance without getting frustrated from repeated failures. It is advised that design practitioners should experiment with other sensory channels like visual and tactile cues and use multi-modal sensory approaches to implement interactivity more effectively, further embedding the role of responsive facilitation within design.

Interactivity emerged as one of the most effective dimension to enhance playfulness, as was expected from the strongly grounded insights from study 2, showing the significance of having a responsive agent in play. As discussed earlier, interactivity and feedback have been recognized as a significant component of multiple popular theories on motivation and engagement (Bandura, 1997; Csikszentmihalyi, 1990; Rovniak et al., 2005). Moreover, many researchers have proposed or advised inclusion of interactive and immediate feedback corresponding to action events in different applications like video games (Desurvire, Caplan, & Toth, 2004; Lazzaro, 2004), education games or game-based learning (Dondlinger, 2007; Ibrahim & Jaafar, 2009), etc. Yet, it could be noticed that **most of the theoretical work or studies proposing the use of interactivity are not based on empirical data, and doesn't correspond to specific age-groups**. Furthermore, within the empirical work, **there is a very strong discourse in the domain of education technology which looks at the effect of interactivity on learning or development, not commenting on its relationship with playfulness** (Hsiao & Chen, 2016; D. a. Lieberman, Bates, & So, 2009). This rising popularity of interactive media and how it is affecting the learning and development can be seen by a number of recent review studies, explaining the positive as well as negative effects of interactivity in learning based applications (Ke, 2016; Troseth, Russo, & Strouse, 2016). Clearly, our work differs from the studies addressed in these recent reviews as we are specifically looking at the relationship of interactivity and playfulness in children.

Within the domain of play and children, there is some support from researchers and practitioners for the significance of interactivity. While Simpson and Lynch (2003) suggest making toys responsive in nature for children with special needs, Hinske et al. (2008) lists immediate feedback to player's action as one of the guidelines for designing augmented toy environments for typical children. However, these suggestions are again based on the experience of researchers in designing toys for children, and not an outcome of empirical work. While not exactly interactive through the use of technology, cause-and-effect toys are among the most basic examples of using interactivity in the design of toys, as action is followed by change in state of the toy. Studies on such toys became one of the few threads supporting interactivity through empirical research, as seen in Niccols, Atkinson, and Pepler (2003) and Hauser-Cram (1996) who found that cause-and-effect toys elicited more persistence than puzzles tasks for toddlers (18 months and 43 months average mental age, respectively) with Down's Syndrome and Intellectual disability, stating immediate feedback as the cause of higher motivation in cause-and-effect toys. Another term for interactive toys used in literature is reactive toys, defined as 'those toys which, when acted upon, temporarily sustain motion and/or produce auditory, visual, or tactile feedback' (Bambara, Spiegel-mcgill, Shores, & Fox, 1984). Studies with children with profound and severe MR children have experimentally shown that reactive toys led to higher engagement in the play activity (Bambara et al., 1984; Murphy, Carr, & Callias, 1986) than their non-reactive versions but these results do not directly apply to our context since the reactive/ non-reactive versions were made for toys meant for sensory and pretend play, and the play activity was not structured or target-oriented, unlike ours. It was interesting to see that there aren't many follow-up studies in this direction, an exception being the recent work on 'intelligent toys' by Hu et al. (2016). Working with typical preschool children in China, Hu et al. (2016) designed a voice-interactive doll called *BabyTalk* which embeds interactivity at sensory, behaviour and emotion level, showing promising results in engaging the children. These examples are closer to new-age robots designed to interact with children, but the focus remains on facilitating social interaction and pretend play activities. Considering the research landscape in relation to interactivity as discussed above, **our finding on operationalization of interactivity dimension leading to higher playfulness extends the usefulness of interactivity in the relatively unexplored context of challenge-based play activity by engaging preschool children with ID.** Infact, we came across only one recent study which looks into interactivity in challenge-based play activity for preschool children through an interactive table-top application with tangible objects, showing that children were interested in the toy more than the non-interactive traditional version while engaging in a color sorting activity (Kubicki, Wolff, Lepreux, & Kolski, 2015). Such state-of-the-art interactive technologies like interactive tables and surfaces, robots, tangibles, etc. are increasingly attracting attention in research, promising to provide both engagement and learning as pointed out by Nacher, Garcia-Sanjuan, and Jaen (2016) in a review study, but it is worth noting that their focus is not on traditional categories of toy/play. Our study gave an example on how interactivity could be added to toys without the use of sophisticated technological interventions. Indeed, this role can entirely be played by a facilitator for the children in special schools, as seen in the exploratory study in phase 2. It is also worth noting that operationalization of interactivity dimension did not affect the structure of challenge-based play by diverting it into sensory play. When using technology into ordinary toys as seen in the recent work, it is important that augmentation should not divert children making them focus on the added features only, neglecting the traditional play (Hinske et al., 2008). **One of the reasons for the successful translation of interactivity into challenge-based play could be that success feedback was different and more rewarding than intermediate feedback, which kept child motivated to complete the goals of challenge-based play**.

Another interesting result related to operationalization of interactivity dimension showed that engagement in condition 4 (having narrative-laden feedback) was significantly higher than engagement in condition 2 (having plain, abstract feedback), implying that **context-related meaningful feedback leads to higher playfulness than context independent, more abstract feedback**. This insight aligns with our earlier explanation on how the interactive feedback played a significant role in communicating the narrative (check narrative sub-section). Assuming the same flexible framework of narrativity being gradable, it could be easily argued that narrative-laden feedback, as used in condition 4, is more effective in voicing the element of conflict and tension (animals stating they need to be fed and remarking on child’s actions being helpful or not), as well as communicating an ending (animals acknowledging being satisfied and thanking), in comparison to condition 2 which communicates the fidelity of action performed by child and the ending but doesn’t connect it with the story. Indeed the engagement of condition 2 being lesser than condition 4 but higher than condition 1 and 3 could be explained by considering that condition 2 becomes intermediate on a scale of communication effectiveness between condition 4 having narrative-laden, richer feedback and condition 1 and 3 having no interactive feedback. Apart from this argument, there does not seem to be much precedence in literature studies that focus on quality and nature of auditory interactive feedback and its effects on children's engagement. However, Rolandelli, Wright, Huston, and Eakins (1991) showed a similar pattern when studying children's auditory and visual processing of television programming as a function of narrative. He found that children in the narrated condition displayed greater visual attention that non-narrated condition which used abstract music. Another study showed that children's cognitive engagement in TV viewing depended upon the local comprehension of associated language through audio (Lorch & Castle, 1997). Although the context of our study was very different where children were presented with static images of characters (requiring not too much of visual comprehension but narrative comprehension) and children were active participants i.e. doers and not viewers, it is still possible that presence of locally comprehended associated interactive feedback positively impacted the attention of the child in the task when the feedback was more meaningful and narrative-based, thus leading to highest engagement in condition 4. Contrasting to relatively much higher number of research studies in visual representation and its semantics, there is a dearth of studies that look into the quality or representation of sound and tactile channels. Droumeva, de Castell, and Wakkary (2007) while studying soundscapes (multiple sound based environments) for embodied learning, acknowledges that most of sonic interfaces have been limited by giving the auditory information through single-sound, confirmatory feedback displays, missing the potential of being more immersive and realistic. Thus, our study advocates further exploration of interactivity through different sensory channels including visual, auditory, tactile and proprioceptive by studying their qualitative properties as a function of playfulness.

Our study used auditory feedback channel to implement interactivity, and restrict agency. Consistent to the finding from study 2, **joyfulness was almost always found to be related to interactive, auditory feedback supporting the existing literature**. Auditory feedback has been found to improve engagement and enjoyment in the context of virtual environments (Larsson, Västfjäll, Kleiner, Vastfjall, & Kleiner, 2001; Rohrmann & Bishop, 2002). (Grimshaw, 2008) focused specifically on the effect of sound stimuli in video games and showed that its presence had a positive effect on subjective feeling of immersion, however sound in the above studies has been implemented more as a background track. It is worth noting that auditory feedback in our context is associated to action events and is transient, and not a background soundtrack which is present continuously. Thus, our study comments at a different aspect of auditory feedback in relation to specific action events or hooks. Between the different action events, the present study found that interactivity at success led to maximum instances of joyfulness as compared to intermediate locations. It would be interesting to further explore the relationship between action events in different play types and its relation to joyfulness.

6.5.3 Agency

Player's agency/autonomy is the third and final generative playfulness dimension operationalized in validation study (study 3) in the context of challenge based toy. Reiterating the earlier definition, player's agency/autonomy as a dimension proposes that player needs to be allowed to have more freedom to manipulate a toy and drive play as he intends, being less bounded by any external guidance or intrinsic rules or conditions embedded in the design of play artefact. The significance of autonomy has been acknowledged as one of the three psychological needs to achieve self-motivation in the popular self-determination theory by Ryan and Deci (2000), further stating that providing choice and opportunities for self-direction enhance intrinsic motivation in an activity. Hidi and Renninger (2006) in their four-phase model of interest development in learning activity further expanded this view by proposing a reciprocal relation between developing interests and the factors of autonomy, competence and social-relatedness, both affecting each other dynamically. This view has been corroborated in the theory of game studies where Sweetser and Wyeth (2005) identified control as one of the main elements of player enjoyment in games. A lot of empirical work also supports these theoretical constructs as discussed later.

Since challenge-based play implied that activity would be outcome/target oriented, rules or constraints could not be completely eliminated and hence absolute agency of player in the form of free play could not achieved, but conceptualizing agency dimension on a scale, allowed us to increase or decrease its magnitude by varying the rules and constraints. While the other two dimensions were studied for the effect of their addition (inclusion), it was consciously decided to check the effect of agency dimension when it is reduced from the toy, hypothesizing that a similar counter-effect would be seen in the form of reduced playfulness. The reduction of agency dimension in the present study was achieved by reducing agency/autonomy of the player in deciding the order of inserting the blocks (or feeding the animals) by pre-setting a specific random sequence which child would have to 'follow' based on the received auditory signal triggers in condition 5. This added more structure into the play activity, taking away some part of player's autonomy and making it a play activity constraint. The effects of controlled reduction of agency dimension in the validation study are discussed below.

As hypothesized, **reduction of agency dimension from condition 4 showed a significant decrease in engagement**, however joyfulness was not affected as much. In the course of our studies, joyfulness has always been found associated to action events leading to auditory feedback. These events were in-fact increased in condition 5 (considering the signal trigger as an auditory stimulus event). Thus, even though agency dimension was reduced, it did not have the same negative effect on joyfulness since the action events with auditory feedback did not decrease. However, with a significant effect on engagement, overall playfulness was also decreased from condition 4 to 5. This result was however not completely intuitive considering that reduction of agency in the toy stimulus involved introduction of signal triggers. There was a possibility of increased arousal in condition 5 which could have led to engagement due to the inviting, auditory signals. The arousal induced by sound may be an important factor in the initiation and maintenance of game playing behaviour (Wolfson & Case, 2000). Besides, as cited earlier, Gilmore et al. (2015) while studying preschool children with intellectual disability had predicted that lower levels of structure in activities may actually lead to decrease in engagement for these children. However, our study showed that agency dimension did have a significant positive effect on engagement and its reduction in condition 5 significantly reduced the engagement.

Child's agency or autonomy is not a completely new concept as it has been recognized to contribute to engagement in a number of theories (Hidi & Renninger, 2006; Ryan & Deci, 2000) as well as empirical studies in different contexts e.g. instructional virtual environments (Karimi & Lim, 2010; Roussou, 2004), non-interactive reading task (Mills et al., 2014), electronic video games (Padilla-Zea et al., 2014), etc. Cordova and Lepper (1996) specifically looked at the effect of giving choices over non-instructional components of a serious game (e.g., character icons and names) to 4^{th} & 5^{th} grade typical children and reported that the learner group who was given choices showed more interest and engagement, which also translated into a better performance. Studies in the domain of children with special needs also acknowledge the significance of agency or autonomy needed to develop self-determination skills and school participation (Almqvist, 2006; Eriksson, Welander, & Granlund, 2007; Wehmeyer, Sands, Doll, & Palmer, 1997) and mention the difficulties to achieve it for disabled children due to factors like overprotection from the caregivers, learned helplessness, low self-esteem, etc. (Honig, 1983; Sparks, 2013). Palmer et al. (2012) advocates that caregivers must provide children with special needs with opportunities to experience control and choice making at school and home environment through facilitation and environmental adjustments. However, disability literature which is often dominated by ASD also presents a counter-argument stating that free play may be problematic for the subset of children with ASD and a greater degree of adult intervention during child-directed activities might be needed to ensure that they engage more appropriately with their environment (Kemp, Kishida, Carter, & Sweller, 2013). This could have led to this perception that structure is needed for special children in general, as also seen in the pilot study during the observation of activities at the studied school group (Johry & Poovaiah, 2014). There was indeed a need to check the effect of autonomy in our context and with preschool children with ID. Furthermore, empirical studies which have studied the effect of autonomy/agency on engagement related factors are also few. Waldman-Levi and Erez (2015) stated that mastery motivation was increased in children with developmental disabilities (physical age: 2 to 4 years) by enhancing their autonomy through changes in physical environment, however these were mostly architectural interventions. Kemp et al. (2013) found that adult-directed activities were less engaging for children with disabilities as compared to unstructured free-play and meal-routine activities. However, both of these empirical studies could not directly inform our work considering that they had subjects in different age-group, and multiple etiologies including ASD, CP, etc. and were performed with a different objective and context. We did not find any existing study on agency/autonomy for children with ID that looked at challenge-based play activity. Thus our **finding on operationalization of agency dimension extends its usefulness in the unexplored application context of challenge-based toys for preschool children with ID.** Furthermore, **our study also addresses the research gap in the lack of empirical studies on effect of autonomy/agency by using a rigorous, empirical methodology.**

Another point worth noting in the results from the validation study was that while condition 5 showed a significant decrease in engagement in comparison to condition 4, the difference was not significant in comparison to condition 1, considering that condition 5 had a net addition of playfulness generative dimension (Condition 5: Narrative + Interactivity, Condition 1: Agency). This result refuted one of the tested hypotheses of the validation study on addition of playfulness dimensions. Based on qualitative insights focusing on children's behavioural characteristics, it was found that engagement in condition 5 was directly correlated to the ability of children to comprehend and identify the signal trigger (i.e. identifying which character was asking for food based on their voice). This correlation led to a large variance in the observed engagement in condition 5, which would have reduced the overall effect of addition of other dimensions. This correlation and its effect on reducing the overall engagement in condition 5 with respect to condition 1 again points to significance of agency dimension when focusing at the level of autonomy and control over the play activity. Children who could not comprehend and identify the signal triggers needed much higher amount of assistive triggers from facilitator, hence external guidance and involvement in the play activity increased significantly reducing agency. It is important to note that we have highlighted the significance of active facilitation in a number of occasions in our discussion showing a positive effect of responsive facilitation but in condition 5, facilitator intervened at the start of the activity, not giving the child the opportunity to commit errors and then responding to them as discussed in the interactivity section. Moreover, the idea of controlling sequence is more of an adult expectation and could have seemed unnecessary to the child, unlike assistive triggers which were given when child needed them. Thus, facilitator's interventions in correcting the sequence when children failed to comprehend the signal triggers were intrusive and unwanted from child's perspective. This would have led to reduction in the children's agency and his internal control in the overall play activity and led to dis-engagement. Based on this finding, it could be claimed that **adding constraints in order to create structured play should not lead to the need for external guidance which is fixed and leading in nature, disrupting the play**. It is important to identify 'when' and 'how' constraints need to be added, if at all, such that they are not intrusive and disrupt the engagement of children. The effect of intrusive involvement of adults in children's activity has shown similar effect on engagement in a number of other contexts. e.g. Calvert (2005) studied the effect of adult control on young children's attention to computer content presented as a story. They claimed that children were less interested and less attentive in the story when an adult controlled the situation, suggesting that user control plays an important role in engagement of children. Wooldridge and Shapka (2012) while studying mother-child interaction during play with electronic toys found that autonomy of child (average age = 19 months) was decreased as mothers tried to prevent exploration by giving verbally intrusive directives. We also felt that the external interventions in the form of informing children about the sequence in condition 5 (due to failure of children to comprehend signal triggers) led to decrease in their autonomy and thus affected engagement negatively. This effect can be explained through control-value theory of achievement emotions by Pekrun (2006), stating that the subjective control (i.e. belief that persistence in learning activity will lead to success) is lost because there is constant error leading to recurring external guidance affecting action and outcome, which would lead to negative emotions like boredom and thus disengagement. Our study supports this relationship between adult involvement and child's engagement in the context of challenge-based play for preschool children.

While it was initially not intended to rely on facilitator to reduce agency, it was the way this reduction was implemented which led to unexpected results, thus it is a limitation in our study. The research design and the play space constraints did not allow other possibilities but if at all curbing agency is necessary in the designed tasks, other mediums of implementation could be tried e.g. use of light or tactile feedback which are easier to identify, and do not become a barrier in the process of challenge-based play.

Lastly, while use of contextual, narrative-laden feedback has been recommended in the last section, it is important to ensure that it shouldn't become a barrier in play. In fact, the present study did attempt to check the complexity of the signal trigger. Based on a pilot study, the names of each of the animal characters were removed from the final feedback design, as it did not serve any new purpose and only added more information to be processed for the child during comprehension. Besides, it was found that some children did not wait for signal triggers, showing poor focus and shorter attention span in general. Having long signal triggers would have further added to dis-engagement from the play activity. It is recommended that **feedback added at initial or intermediate stages of play should not be too complex or too long especially at a stage which could become a barrier in progression**. This insight needs to be expanded through further enquiries by understanding the level of comprehension and attention span for children with special needs as a function of semantic properties of feedback, presenting an interesting scope for future studies.

Traditionally, the special education in developing nations has often involved use of a lot of guidance in the play activity, also reported in our pilot study in their naturalistic, observational study in an Indian special school (Johry & Poovaiah, 2014). It becomes even more relevant to emphasize the need of giving more control to the children at special school both at the level of controlling the play activity and choice of play, as well as, controlling the gameplay and its progression with an on-going play activity, as seen through the operationalization of agency dimension in validation study.

6.6 Validity and generalizability of the findings

The main objective of the validation study (phase 3) was to establish the workability of some of the grounded theory findings from phase 2. This led to selection of a quantitative research framework so that any remaining possibility of researcher's bias and subjectivity from the qualitative analysis could be eliminated. Following steps were taken to ensure internal validity and the extent of generalizability (external validity) of the emerging theory.

<u>Participant's selection</u>:

The validation study was conducted at the same facility used for exploratory, interventional study in phase 2, however participants differed as new children were included and some of the earlier children no longer fitted in the criteria of mild to moderate ID having mental age between 3 to 6 years. The validation study had more children in mild range than moderate ID with an average IQ = 57.75, as well as nearly equal representation in terms of gender, thus complementing the population involved in the earlier exploratory study. These participants broadly covered all the sections of society in terms of family income, representing the population at large.

<u>Stimulus (toy) used</u>:

Within the repeated measures research design, each child was subjected to five different toy stimuli, each representing a unique combination of the selected dimensions. Most of the properties of the toy stimuli were kept constant including its material, shape and size and hence, did not affect the validity of the findings. However, graphic elements like background color, patterns and design of characters (applicable to conditions with narrative) were changed between the conditions to maintain an element of novelty. However, these changes were brought within the same visual style e.g. background was always composed of bright colors, and design of characters was colourful and cartoonish drawn with black outlines. This was done to maintain consistence in graphical style and ensure that it did not affect children's preferences.

The base toy used for redesigning was selected specifically to represent a type of challenge-based toy with known low base-line in terms of engagement. This category of challenge-based toys comprising of a convergent play process and use of high-cognitive ability was also representative of most of the common learning aids used by these children at school e.g. jigsaw puzzle, shape and size sorting, etc. The mode of implementation of selected generative playfulness dimensions was based on how they were commonly used in existing toys e.g. narrative was primarily implemented using visuals, while interactivity and reducing agency was implemented through auditory medium. It is possible that changing the medium of implementing the dimensions would have affected the resulting playfulness, and has been acknowledged in the findings culminating in synthesis of operational properties of the dimensions. Lastly, to address the possibility of variable levels of familiarity between the toy stimuli for different conditions, facilitator modelled the toy play before the start of the recorded sessions, explaining the narrative or meaning of feedback, wherever applicable. Thus, unfamiliar elements did not become a validity threat in affecting the observed results.

In terms of generalizability, the present study showed that the grounded theory findings are transferable to a new context, and it is possible to enhance playfulness of toys through different combinations of dimensions, when implemented using certain operational properties. While the toy stimuli were not completely unfamiliar in terms of the underlying process of matching shapes, variable amount of unfamiliar elements were included across the conditions, showing the applicability of the theory to unfamiliar toys. The content of narrative should be generalizable although it is suggested that relatable content to be used while implementing the dimensions like narrative and interactivity otherwise the comprehensibility may become a confounding variable, possibly affecting the playfulness of the toy. Our study identified the 'feeding pet animals' narrative for its relatibility using the pilot study.

<u>Context and procedure</u>:

To account for validity threat due to intermediate events, all five sessions corresponding to the experimental conditions were recorded in successive weeks for each child; hence the overall duration of data collection for each child lasted for about a month. The validity threat due to maturation should not be significant since children's play preferences wouldn't change in a month period. In couple of cases, when children were not coming regularly to school due to health issues, the data collection was delayed until they resumed the school and were fit. Facilitator ensured that child was in good mood whenever he was brought for a play session.

To eliminate the other confounding variables due to context, most of the factors remained constant across the conditions including play space, facilitator (familiar Occupational Therapist) and other research protocols. Controlled facilitation was used based on system of least prompts and constant time delay technique, kept consistent across the conditions to avoid any extraneous variable. Facilitation was found necessary because children were seen to become permanently disengaged with challenge-based toys on repeated failure, which could have impacted the later conditions. Hence in absence of facilitation, design needs to ensure that children are presented with a challenge which is achievable and comprehensible. The positive effect of the dimensions on playfulness would be dependent on child being able to play with the toy.

The use of repeated-measures design ensured that individual differences between the children did not become confounding variables, thus reducing the need for larger number of participants for validity. Furthermore, several steps were taken to eliminate the practice and habituation effects which included randomizing the conditions with use of blocking procedure. Also, one week gap was given between data collection for any two conditions, and the graphical interface (packaging) was changed for each condition. This ensured that results would be valid irrespective of the order of exposure to toy stimuli from different conditions.

Data analysis:

The use of quantitative research methodology aimed at establishing stronger validity and reliability of the insights from the earlier, exploratory study. Parametric statistical tests were used with necessary corrections made on violation of normality and sphericity of data. These results were revalidated using substitutable non-parametric statistical tests enhancing validity within a small sample size. Furthermore, qualitative insights were used to supplement the findings from quantitative analysis, and better explain the observed patterns and exceptions. Lastly, all possible errors during analysis were acknowledged and accommodated e,g. errors made by facilitator in giving assistive trigger at the correct time were compensated during the analysis by a time compensation factor. These steps checked the possible validity threats in the analysis phase of the validation study.

7. Conclusion & contributions

7.1 Introduction

This chapter begins with a summary of the research findings and the process which was followed over the course of the thesis, explaining how the primary research questions were answered through the studies which were conducted. Research contributions are mentioned next, divided into – theory, practice and methodology. This is followed by a section highlighting the significance of this research and certain salient features of our work. Following the significance section, next section is specifically meant for design practitioners and facilitators, giving actionable recommendations based on the overall findings. Lastly, an evaluation of the study limitations and scope for future research directions is discussed. The chapter ends with concluding remarks on the overall thesis.

7.2 Summary of research: Revisiting the primary research questions

This research study focused on how playfulness is manifested for preschool children having mild to moderate intellectual disability in the mental age group of 3 to 6 years through interactions with designed play artefacts and activities, in the context of facilitated free play at special schools. Due to dearth of earlier research studies in the studied context and population, a sequential exploratory mixed methods research design framework was used, divided into three studies, each reported as a chapter in the thesis.

Within a wide variety of identified insights and relevant factors related to play, the research questions acted as an anchor in keeping the overall body of knowledge coherent, while other useful findings not directly linked to these questions were also noted. Being a doctoral thesis in design, a design centric perspective was prominent even in the primary research questions where our position was that of a design activist, in an attempt to inform practice through our research. The three primary research questions are answered below based on the prominent findings from the study, along with the process which was followed.

a. Do design characteristics of play artefacts/activities affect observed playfulness of children with ID, and how?

Before exploring the relationship between design characteristics of play artefacts/activities and observed playfulness, it was decided to first revaluate the underlying assumption for conducting this design research which involved checking if there was a need to enhance playfulness in the play activities at special schools. Hence, one of the preliminary study was conducted to understand the present state of play and the worldview of staff in a special school setting in India, using qualitative methodology based on ethnography observation techniques and semi-structured interviews. **The findings validated the need for design research intervention to understand and facilitate playfulness, as generally there was a lack of playful activities and the school staff had contradictory opinions about facilitating playful activities**. The lack of playfulness could be understood at two levels – a) limited availability of toys and b) design features of toys. It seemed logical to first address the toy availability concern leading to the second study which used an exploratory interventional framework, exposing the children to variety of existing toys (familiar but absent at school) belonging to four play types and allowing a comprehensive space of play interaction possibilities to study. The variety in play interactions became a rich source for studying the effect of design characteristics of play artefacts/activities on observed playfulness of children with ID. Reflecting on the patterns of play behaviour and play preferences through observation of facilitated, free play episodes, the first primary research question was answered as it was found that **design characteristics of play artefacts/activities had a significant correlation with observed playfulness** during the play episodes. e.g. pretend play clearly emerged as the most playful and most explored play type, and children derived narrative affordances from non-pretend play toys. Thus, the element of 'narrative' could be seen linked to the episodes with higher observed playfulness. Similarly, children creating affordances for physical activity play and showing a correlation between joyfulness expression and movement led to the identification of 'movement' as a design characteristic linked to playfulness. Using the rigorous constant-comparison technique in the grounded theory analysis, well-grounded design insights were identified which were further analysed for their generalizability. This led to **identification of a set of generalizable relationships between playfulness and design characteristics of play artefact, useful across play types and contexts**, which have been referred as generative playfulness dimensions. This would imply that these dimensions could be used as guiding principles by the design practitioners to generate (enhance) playfulness of a toy, learning aid or activity. These dimensions are – narrative, interactivity, agency of player, player's movement, and showcasing outcome.

b. Do the identified design characteristics predictably enhance the playfulness when implemented as design guiding principles for artefacts/activities belonging to different contexts, and how?

Having identified the design characteristics of play artefacts/activities in 2nd study, theorized into generative playfulness dimensions, its applicability as design guiding principles was checked in 3rd study by operationalizing them in the design of a non-playful, challenge-based toy. Within the constraints and scope of present thesis, only three of the dimensions were operationalized having possibilities of non-intuitive outcome, namely: narrative, interactivity and agency of player. The dimensions were added, individually and in combination, to the design of the toy. It was found that **all the three dimensions could be operationalized successfully as design guiding principles resulting in increased playfulness whenever a dimension was added**. While the combination of dimensions showed better affinity between certain dimensions (primarily due to nature of implementation), **a net addition of dimension always led to statistically significant increase in playfulness, while net deletion led to decrease in playfulness**. Challenge play by itself was seen to be least playful across all the studies, however through successful operationalization of generative playfulness dimensions, the activity became more playful and children were seen to acknowledge and appreciate the outcome or success related to challenge based play. Although, the effectiveness of these dimensions as design guiding principles was validated in the context of challenge-based play, it is very likely that the dimensions will be equally effective when applied across other play types, unless stated as a constraint of a dimension. The operationalization of these dimensions also led to some useful insights for design practice.

c. **How can the level of engagement and enjoyment be compared between play activities having different contexts, to check the effectiveness of environmental interventions?**

While not a primary objective of the study, this was a significant research question. The construct of playfulness was identified in theory which could account for engagement and enjoyment aspects in a play activity. However, it was needed to redefine the theoretical construct of playfulness such that it could be used as a context-dependent parameter to assess difference between different ecological settings or factors. The theoretical development of the construct of playfulness as an assessment happened parallel to the studies, informing the analysis and evolving in the process. The final theoretical construct of playfulness was based on **a contemporary definition of playfulness by Sanderson (2010), theorized as multi-dimensional, with engagement duration and frequency emerging as primary parameters and instances of observed joyfulness emerging as supplementary parameter for assessment, which in combination could be used in comparing playfulness** between play activities in a free play context**.**

Apart from the primary research questions, the present thesis also proposed **a visualization model for designers and activity planners which further adds control to each of the generative playfulness dimension, allowing it to be varied on a scale, referred as generative playfulness dashboard.** This tool could be very useful for predictably controlling the design features of toys and play activities to enhance playfulnless. However the validity and reliability of this model could not be tested due to the limited scope of present work. Having noticed the significance of facilitator in the context of special schools where children were not allowed solitary play in most situations, presence of facilitator was indeed found to be positively correlated with child's playfulness in the play activity and a set of useful facilitation strategies were identified translated into actionable guidelines, discussed later along with recommendations for design practice. The present study also contributed in the theory of research methodology when working with users having communication difficulty, and findings are presented in a later section.

7.3 Research contribution

This section presents the significant research contribution of the thesis towards theory, practice and research methodology, based on the direction of enquiry guided by the primary research questions. This is followed by a sub-section on triangulation of some of these findings across the two phases using available literature, further strengthening their validity.

a. Development of generative playfulness dimensions: The present work reports development of five generative playfulness dimensions which are a set of well-grounded play preference patterns for preschool children with ID in a free play context, reframed into design principles that are generalizable across different play types and contexts. These dimensions include: interactivity, player's agency, showcase outcome, player's movement and narrative. Following table (table 7.1) describes these dimensions briefly along with some of the novel theoretical contributions which were associated with the development of the dimensions.

As discussed in literature review, there were very few preceding research studies which could connect the theories of experiential and affective aspects of play including engagement and enjoyment to the design features of play artefacts and activities in the context of free play for preschool children with ID. Thus, **our study plays a bridging role to connect research in social science and design literature by using a bottom-up, data driven approach to identify generalizable design characteristics of artefacts/activities which lead to playfulness for preschool children with ID**. Moreover, the present study also **addresses the research gap in rigorous, empirical studies contextualizing the emergence of playfulness in real life play situations in a special school of a developing nation like India.** The role of socio-cultural factors was found to be important in multiple occasions during discussion of findings, and it would have been difficult to generate same patterns based on few studies in the studied domain from Western literature.

Dimension	Description	Research gap addressed in related theory
Interactivity	Making toy/activity responsive to player's actions by giving instantaneous feedback on fidelity of the action (being a success or failure) as well as the state of play and its progression	Strategy of letting child commit mistakes and then acting as a responsive agent has not been reported for preschool children with ID, contrasting the commonly used pre-emptive guidance approach. No previous work seems to operationalize persistence in play by focusing on the threshold for errors or failures.
Player's Agency	Reducing the intrinsic rules or conditions embedded in the design of play artefact as well as any leading external guidance, and allowing the player to have more freedom to manipulate a toy and drive play as he intends	Challenge-based play being not engaging for preschool children is extended to children with ID through an empirical study. Competitive play seems to decrease with increasing age and is contradictory to literature on typical children and unreported in literature for preschool ID children
Showcasing outcome	Designing affordances in toys and activities that will allow the child to exhibit the outcome of play or the progress in play at his will (while playing with constructive or challenge-based toy) to another person, or to preserve the showcased outcome for future, as a sign of achievement.	Applying child's volition in the reward contingency as a significant contributor to positive effect of external rewards has not been reported for typical and special children. Meaningful constructive play has not been reported for preschool children with ID.
Player's Movement	Designing play affordances in toys and activities that involve gross motor skills and moderate to heavy exuberant physical activity including locomotion.	Discourse of physical activity as an elicitor of fun and engagement has rarely been reported for special children. Application aspect of physical activity in play has not been addressed apart from technological interventions.
Narrative	Usage of relatable story-telling and/or role-play, externally introduced through design to complement the events and process associated to playing with a specific toy.	Based on pretend play as the most playful play type, no earlier study seems to have identified preferences for play types in free play context for preschool children with ID using an observation based rigorous methodology, and Indian context is also unreported

Table 7.1. Brief description of the generative playfulness dimensions

b. Validation of selected dimensions across challenge-based play context: The present work validated the effectiveness of three of the generative playfulness dimensions when used as guiding principles in the design of play artefact, using an experimental, quantitative methodology framework. Challenge-based play was commonly seen in school activities and was also seen as least playful among play types. **Our study addresses the existing research gap of operationalizing narrative, interactivity and player's agency as design guiding principles in the unexplored application context of challenge-based toys for preschool children with ID.** While the present study was limited in operationalizing the dimensions in challenge-based play, the objective was to demonstrate that it is possible to use these dimensions as guiding principles irrespective of the play type. Moreover, **the present work also established that it is possible to combine these dimensions and obtain significant positive effect on playfulness**, however treating each of the dimension as guiding principle should result in a vast space of design implementation possibilities, stimulated by designer's creativity. In that sense, each would be advisable to combine two to three dimensions at a time and explore the possibilities of designs.

c. Identifying non-intuitive characteristics of play behaviour and context for effective operationalization of dimensions: Having identified a set of generalizable design characteristics, **the exploratory phase also showed a number of non-intuitive insights** on play behaviour and associated context for preschool children with ID which are significant for theory and practice of designing for play. Similarly, while implementing the selected dimensions as guiding principles, **several useful and novel insights on play preferences were identified during the operationalization, defining the properties of the dimensions.** While these insights are not broad enough to lead to generalizable design principles, they could be useful in effective operationalization of the principles and are presented as stand-alone contributions to the theory of play for children with ID. Some of the significant contributions at this level are briefly presented below.

- When playing with a non-responsive, challenge based toy in free play context at special schools, children with intellectual disability got disengaged or stopped '**persisting**' after 2-3 consecutive mistakes. This persistence threshold could differ when compared to typical peers and is a useful insight for designing feedback and assistive strategies in activities and artefacts involving challenge.

- Children with ID show varying levels of **repetition** in their pretend play (in terms of repeated actions and acts) which doesn't affect their playfulness over time, as seen in free play episodes in study 2. While providing variety in narrative experience is often an achievable goal in the modern game and instruction design, it seems that the element of repetition could be a desirable property for playful design using narrative, for these children.
- Interactivity as a guiding principle was more effective when implemented and integrated with narrative in a toy or play activity. Hence, **context-related meaningful feedback** was more playful than context independent, more abstract feedback.
- When integrating narrative in challenge based play activity (i.e. dissociated from story-telling as in pretend play), **explicit communication of sequence of events** was needed to be built in the design to sustain engagement. Children were not able to sustain engagement when plainly relying on visuals in a toy and using actions to progress the narrative integrated in the challenge-based activity.
- Children got disengaged with a challenge-based toy when adding constraints to create structure led to the need of an **external guidance which was fixed and leading** in nature. It is claimed that external guidance should always remain responsive and children should be allowed the space to explore before being assisted.
- A preliminary study showed that **competition** emerges at 4 years mental age and seems to decrease with increasing mental age, unlike typical children. While due to limited number of subjects, the findings are suggestive in nature, they could be further explored through design intervention. The paradigm of competitive play in a special school setting in Indian context hasn't been reported in any earlier study.
- Unreported in any earlier study, **existing state of play and worldview** of staff at a special school setting was studied for preschool children in Indian metropolitan context. Sensorimotor practice play was the most common form of play available in school, while symbolic/pretend play was negligibly present, thus existing infrastructure did not provide opportunities for all the developmentally appropriate forms of play. Children generally showed inclination of social play manifesting as associative play and some instances of parallel play. Play was seen as a

scaffolding tool for development and play for its own sake was mostly absent in special schools, as unstructured, free play was very limited. A number of activities which were purely challenge based e.g. jigsaw, shape sorting etc., were given as play based sessions. Special school teachers believed that play needs to be supervised in most of the situations for safety and participation.

d. Development of playfulness assessment for comparing play episodes: One of the significant contributions of the present study to research methodology domain is through operationalization of playfulness construct as an assessment tool which could be used in other research studies where playfulness needs to be compared as a function of environment or context.

Having compared a number of theoretical constructs and popular assessments of playfulness in the literature review e.g. Children's Playfulness Scale (CPS: Barnett, 1991), Test of Playfulness (ToP: Bundy, 2000), etc., playfulness was seen to be treated as a static personality trait, making it unsuitable for our purpose. While Project Joy Playfulness Scale (PJPS: Sanderson, 2010) was an exception treating playfulness as contextual, it did not align with the objective of the present research since it measured playfulness over a period of time (two weeks) and involved play with a group of toys. However, Sanderson's (2010) multi-dimensional construct of playfulness became instrumental for our work, having four dimensions - active engagement, internal control, joyfulness and social connection, which were individually analysed across the two main studies, collectively leading to playfulness assessment. Each of these dimensions are individually discussed, as follows:

- **Active engagement** was found to be the most useful and objectively definable dimension, **assessed by measuring the duration of play interaction with a particular toy as well as the number of times (frequency) a toy is selected for play interaction**. Also, in situations of free play with presence of multiple toys to choose and shift through, other qualitative factors could be taken into account when looking at engagement like – instances of bored behaviour (identified by facial and body gestures) and instances of focused behaviour.
- **Joyfulness** which addressed the emotional aspect of engagement **was assessed by identifying the instances where child expressed joy through smile and laughter**. It was found that expression of joy was generally associated with

presence of a peer or facilitator hence **joyfulness wouldn't be a reliable parameter in solitary play sessions**. The dependence of joyfulness on presence of others has not been discussed in earlier literature. Furthermore, **only some children in our population were expressive** and hence joyfulness cannot be used as a universal parameter to assess playfulness. However, **joyfulness could be helpful as a supplementary parameter** to substantiate (or refute) the effects seen in engagement across different contexts.

- **Social connection** was defined by Sanderson (2010) as 'child's cooperative interaction with others and the surrounding world'. In was assessed as **constituting of a set of measurable indicators, like ease of toy exploration, ease of communicating with facilitator, exploration of play space, and ease of expression through facial and body gestures**. All these behavioural indicators which composed social connection were **seen as stable personality traits** which depended on individual characteristics, independent of the context of play. Thus, social connection while useful for studies in psychology, are **not helpful in design intervention studies** when comparing the playfulness between different intervention stimuli and contexts.
- **Internal control** was referred as 'the child's sense of safety, balance, and competence that allows her to comfortably engage with the surrounding world'. In both studies, the research design ensured that **internal control was constant as child was allowed free play and choice** and thus didn't affect results. It is important to differentiate between the internal control which was given to children at the level of overall play activity defined by the research design protocols, with the internal control children had while playing with a toy or activity due to the intrinsic rules of that toy or activity. The latter was a controlled variable which was later attributed to the generative playfulness dimension of agency.

Thus, **effectively active engagement was the most useful dimension for assessment, while joyfulness was used to support the patterns** seen in active engagement. Internal control was kept constant by following appropriate research protocols and social connection was conceptualized with certain behavioural characteristics which were found to be static, personality traits of children. Assessing playfulness in other interventional studies could use these definitions and parameters for objectively studying playfulness differences.

7.3.1 Triangulation of findings and analysis across the studies

Having discussed the significant findings in the form of research contributions for all the phases, this section explains how some of these findings are connected across the studies, through triangulation. However, since the validation phase included only selective dimensions, comparison across the studies was possible only for narrative, interactivity and player's agency dimensions, as discussed in table 7.2 below. In general, all the three dimensions were seen to significantly enhance (or reduce when deducted) the playfulness of a challenge-based toy as expected, further substantiated with literature. There were some instances where literature is contradictory (in different context) or showed mixed opinions. Besides the idea of triangulation, some of the theoretical insights got further refined from exploratory to validation phase, based on operationalization. e.g. while narrative played a significant role in enhancing playfulness in both studies, when operationalized in a challenge-based play context, it became necessary to explicitly communicate the narrative events, either through feedback or facilitation. In that sense, this section provides a more comprehensive view of the findings at the level of the thesis.

S. No.	Exploratory study	Validation study	Literature
		Interactivity	
1	Children can't sustain failure and get disengaged when they make 2-3 consecutive mistakes in challenge based play	Controlled facilitation ensured that children did not experience sustained failure, resulting in no instance when child left the toy in middle of a trial. Also, children did not develop a permanent disinterest in later conditions by avoiding sustained failure.	Children with ID have shown lack of persistence due to attitude of learned helplessness (Bayat, 2011). Environmental factors associated with children with special needs like low parental warmth, support, family conflict, etc. have been found to affect their persistence (Smiley et al., 2016; Zhou et al., 2007)
2	Children often seek feedback on their state of play from facilitator. Also, higher engagement was related to facilitator's interaction in the activity	Conditions with interactive feedback on child's action were significantly higher in playfulness than non-interactive conditions	Pattern of seeking facilitator's attention has been found to be prevalent in children with Down's Syndrome (Feeley & Jones, 2006; Wilde et al., 2016). Empirical work is only on reactive or cause-and-effect toys which are not challenge-based (e.g. Murphy et al., 1986; Niccols et al., 2003; Hauser-Cram, 1996; Hu et al., 2016)
3	Auditory feedback was almost always associated with expression of joyfulness from children	Sound was almost always associated with joyfulness leading to significantly higher joyfulness in conditions with interactivity	Role of sensory stimuli including auditory channel has been acknowledged for enhancing immersion in video games, but it's used more as a background track (e.g. Baek, 2009; Grimshaw, 2008; Larsson et al., 2001)
		Narrative	
4	Pretend play (storytelling + narrative) emerged as the most playful & explored play type. Children derived most play affordance by using other toys as a part of narrative	Adding narrative led to increase in playfulness in challenge-based play only when narrative events were explicitly communicated through the design	Studies have shown significant effect of narrative on engagement in mediums like video games (Adams, 2001; Bringsjord, 2001, Lu et al., 2016), instructional design (Abdul Jabbar & Felicia, 2015; Ke, 2016)

5	Pretend play was repetitive but still among the most playful of all activities	Narrative was repeated over trials and still found to be engaging to the children in condition 4 and 5	Building repetitiveness intentionally has only been explored briefly with ASD children, for other children there is contradictory literature which advocates adding more variety and novelty in content (Dickey, 2005; O'Brien & Toms, 2008; Ryan & Deci, 2000)
		Agency	
6	Structured play (challenge-based) is least playful while unstructured play (pretend & constructive) is most playful, also seen in one of the pilot studies. Children seek agency as they use challenge-based toys for pretend and constructive play	Reducing agency led to significant decrease in engagement from condition 4 to 5	Mixed literature since theories and empirical work has supported the idea of increasing autonomy, but it has also been predicted that reducing structure in activity will lead to reduction in engagement for children with ID (Gilmore et al., 2015). Also, children with other disabilities like ASD may require more adult intervention (Kemp et al., 2013)
7	Facilitation effectively helped in engagement sustenance when it was responsive, while pre-emptive or leading guidance often led to decrease in engagement in challenge-based play	Pre-emptive and leading guidance to communicate signal trigger in condition 5 led to significant decrease in engagement, while responsive facilitation did not have any significant adverse effects	Play material needs to be autotelic signalling on the progress through actions (Carr, 2000). Young children's interest and attention decreased when adult controlled a story presented through computer (Calvert, 2005)
8	Purely challenge based play was found to be least playful. One of the pilot study showed competitive play (type of challenge play) decreased for children with ID when mental age was increased	Condition 1 which had least number of generative playfulness dimensions from other play types was the least playful	Market survey based study showed that purely challenge based toys were popular in children only after 8 years of age (Kudrowitz & Wallace, 2010), also substantiated in Piaget's developmental theory who introduces problem solving after 7 years of age (Ginsburg & Opper, 1988)

Table 7.2 Triangulation of findings from the two phases and existing literature

7.4 Significance of this research

There were a number of ways in which the present research is significant for both guiding theory and practice in the domain of play for preschool children with ID, discussed as follows.

7.4.1 Relevance to the domain of special needs

The first exploratory study led to familiarization with the social constraints at the facility including poor child-teacher ratio which affects facilitation in Indian context. This reemphasized that **design intervention could be a more effective strategy in addressing the lack of playfulness over sociological/ therapeutical interventions** which would require facilitation support. Moreover, the identification of generalizable playfulness dimensions and its operationalization as guiding principles can have a significant practical impact in the context of special schools. One of the pilot study in phase 1 showed that challenge-based play was commonly used as a developmental and learning medium in the special school, despite of it being least playful of all play types, as consistently established in all the studies. The generative playfulness dimensions can be used for **designing artefacts and activities which can combine the learning/developmental focus of such challenge-based activities while making them engaging and enjoyable** for the children.

While some of these dimensions have a decent amount of reference in the earlier literature from different fields, it is worth reiterating that there are very few data-driven, empirical studies which support the effectiveness of these dimensions for preschool children with special needs in play context. The present study also **steps away from the heavy developmental and learning focus** in the discourses involving preschool children with special needs. Our focus was on enhancing the engagement in the activities and interactions, with an assumption that engagement is a pre-requisite to encourage learning and development in children, a position also taken by Kemp et al. (2013) recently. While we did not specifically analyse the effect of learning in children, the validation study (study 3) seemed to indicate that higher engagement may have been responsible for better performance in children.

Lastly, our research showed that while there might be some difference in contextual factors in play for preschool children with ID e.g. lesser free play, much higher presence of facilitator, etc., the play behaviours would manifest in a similar manner as typical peers, and **preschool children with ID are capable of experiencing playfulness in different types of play activity** when they are consciously designed with focus on certain design characteristics. **It is important to bring out this positive account of these children's play**, when there are past studies in Indian context reporting that children with MR displayed more of 'no activity', passive observation play or exploratory play than creative and functional play (Khoshali & Venkatesan, 2007; Venkatesan, 2000).

7.4.2 Reflecting on playfulness from a design-centric perspective

The present study used a trans-disciplinary approach borrowing methodological frameworks and literature from social sciences while also consciously bringing in design perspective to analyse and frame the emerging insights. The design-centric perspective was important because it **allowed us to look at emerging insights from the point of view of their application in a specific context**, leading to ideas which might have not been explored earlier in research from other domains. e.g. persistence in children has generally been looked in terms of attention span or continuation of appropriate behaviour (e.g. Ekstein et al., 2011; Niccols et al., 2003). However, when studied in the context of challenge-based play, we identified that preschool children with ID get disengaged or stop 'persisting' after 2-3 consecutive mistakes. This could be explained based on the term *learned helplessness* to explain an attitude of lack of persistence in children with ID who have had unsuccessful and negative learning experiences early on (Bayat, 2011). However, the notion of looking at the threshold for errors/failure was not found in the earlier literature and could be more useful as a measure of persistence to guide design and application. Another example of the design-centric perspective could be seen in the conception of 'movement' dimension. While physical activity has been studied, generally as a function of development or as a technology oriented intervention, we have proposed that basic, frugal affordances in play activity and toy interaction will also lead to enhancement of playfulness. The widening of solution space can result in a lot of interesting activities using movement, which have not been applied or researched in earlier literature for their effect on engagement. The dimension of 'showcasing outcome' was developed based on a common behavioural pattern of children wanting to showcase their play progress and to preserve their outcome as they exhibited meaningful constructive play. These insights were directly translated from application perspective leading to the idea of adding volition (choice) not only the initial engagement with the activity but also in the reward contingency. While rewards have been a subject of extensive research investigation, there does not seem to be much literature which looks into giving choice to children to showcase outcome to seek appreciation, and appreciation (reward) seems to be a fixed condition in design. Hence, the design-centric perspective played an important role in interpretation of the findings and the application of behavioural patterns into design practice, giving a different point of view for looking at behavioural patterns.

7.4.3 Non-applicability of findings from other mediums

Studying challenge-based play activity using commonly available age-appropriate toys brought a sense of practicality in the emerging findings, as they were based on the individual and environmental constraints of a real life scenario for preschool children with ID at special schools. It is worth noticing that previous work has been more prominent in addressing aspects of engagement and enjoyment through other mediums like video games, instructional design, etc. However, the recommendations which are based on other mediums could not be directly applied in our context with its **unique technological and resource constraints and for our population with its limitations in cognitive and communication capabilities** e.g. Caracciolo (2015) talked about the dimension and effectiveness of the dimensions of 'narrative' and 'player's agency' through narrative-driven video games which used strong and information-heavy narrative arcs, and game-play focused video games which involves higher agency and multiple strategies. In both of these categories, based on our research, it could be safely assumed that preschool children with ID would have found it difficult to comprehend and engage in the artefacts. Thus, it was necessary to establish these guiding principles using age-appropriate toys and studying the behavioural response of children while playing with them.

7.4.4 Socio-cultural situatedness of the findings

The reported research was conducted in a metropolitan city of India, and all the three major studies had influence of socio-cultural factors, highlighting some **unique aspects of play which could be counter-intuitive as compared to the Western understanding**. One such finding was about competitive play whose intensity seemed to decrease with increase in the mental age of children with ID, contrary to the literature for typical children in Western context (Johry & Poovaiah, 2015). The tendency to avoid competition could have been due to negative self-concept as seen in special children (Pijl & Frostad, 2010), or other socio-cultural institutions like family structure, school environment, etc. which have been found to affect competition (e.g. Booth et al., 2012; Gneezy et al., 2009). In Indian context, this situation could be more aggravated considering that there is a shortage of professional care for such children (Gupta & Singhal, 2005) and mothers of children with ID in urban India have been linked with higher maternal stress than Western countries (John, 2012). All these factors may be contributing in the low self-esteem of the child which could have led to competition avoidance tendency.

As discussed in introduction section, Indian parenting stems from collectivist culture while Western countries generally follow an individualist culture. This would manifest in a more authoritative parenting in Indian context as compared to West (Rudy & Grusec, 2006). This was substantiated in the first exploratory study looking into world-view of special school staff on play, where most of the activities were guided and unstructured play was very limited. Our findings on agency dimension showed that pre-emptive guidance leads to disengagement of the child. However, in our context, the attitude of facilitator could be an influence of the cultural values, as well as the lack of time at their disposal as they generally attend multiple children at a time. Furthermore, as reported in the second interventional study, children showed a low error threshold of persisting 2-3 times in challenge-based play. It is possible that these children suffer from the attitude of learned helplessness due to inadequate facilitation and do not really get opportunities for learning through exploration which may be influencing their level of persistence.

Interestingly, comparing children on playfulness on individual factors in study 3 showed that family income of children was significantly correlated to engagement frequency (effect size = 0.64). The focus of the study was not on analysing the effect of socio-cultural factors in our population, and all these possibilities will need dedicated investigation. However, the situatedness of some of these findings highlights the significance on conducting such studies in lesser explored cultures like ours. It would be interesting to compare some of these results with other cultures in a cross-cultural paradigm.

7.5 Implication for research methodogy, design practice and facilitation

The contributions to theory as discussed in an earlier section are generally applicable to design practice also, as the primary objective of this research was to enable practitioners to use design characteristics in enhancing the playfulness of artefacts and activities. However, over the course of the study, there were a number of useful insights which were either not generalizable to be reported as a theoretical contribution, or were speculative in nature. Nevertheless, they have implications as useful actionable design practice insights, and are presented as follows. It is clarified that the purpose of this section is not to inform theoretical knowledge but it is specifically meant for researchers, design practitioners and facilitators, looking for actionable recommendations.

In that spirit, there are three sub-sections. First sub-section reports recommendations for researchers interested in conducting research with similar population and context. Second sub-section reports recommendations for design practitioners, comprising of actionable design recommendations based on empirical insights as well as an idea-generation tool to design, evaluate and/or redesign play artefact and activities based on the identified design principles in our thesis. Few of the actionable recommendations may seem repetitive as they are based on the operationalization insights from the third study but are restated in design-friendly language. Also, recommendations based on speculative insights are reported separately which emerge from the tacit knowledge and experience of the researcher, guided by suggestive findings from the study. The last sub-section reports the design recommendations for facilitators and activity planners, based on the empirical insights generated over the course of our research.

7.5.1 Research methods, design and technique based recommendations

The present thesis also involved the challenge of identifying research methods and design which would accommodate unique constraints posed by working with children having communication difficulties. Some of the insights on research design and methods in relation to preschool children with ID are presented below which could be replicated by other researchers working with a similar population and context.

- Spacing tested conditions in repeated measure experimental design with a gap of 1 week should be sufficient since no significant learning effect was seen in challenge-based play
- When testing the playfulness of a toy stimulus over a set of conditions, it was important to introduce timely, controlled assistance to sustain child’s interest in the toy over the conditions. As used in our study, constant time delay procedure (10-15s interval) and system of least prompts (3 levels of increasing order of support) could be an effective strategy to introduce assistive triggers such that children do not develop any negative feelings for the toy stimulus and are not completely disengaged with a toy, which could have affected the experiment.
- An isolated, distraction free space is ideal for conducting interventions since naturalistic settings could have a lot of visual and auditory noise, as well as presence of unwanted elements like classroom teachers as seen in the context of our special school facility. To account for the effects of non-naturalistic setting, conducting multiple (two to three) play rapport-building sessions with children should be sufficient to make children comfortable in interventional space and accept the facilitator without intruding their free play, as seen in the exploratory study.
- While studying play behaviour in a free play context and multiple stimuli (toys/games), movement analysis could be a useful tool as it gave significant insights about the selection pattern of children. When used within a Grounded theory analysis framework, the observed patterns were found to reflect the social connection dimension of playfulness.
- Including expert opinions in affinity mapping of the categories generated from Grounded Theory can be used to generate multiple perspectives in the formation of theory. This was used as a supplement to the actual category formation based on standard grounded theory iterative process.
- Play classification by Kudrowitz and Wallace (2010) was found to be suitable to categorize toys for preschool children, comprising of sensory, pretend/fantasy, construction and challenge-based toys, ensuring comprehensive coverage in play opportunities.

- Preference assessment can be adapted to measure engagement of children when subjected to multiple conditions, by giving children controlled choices at regular intervals (looking at re-engagement at fixed intervals)
- When presenting multiple stimuli (toys in our case) to children, a conical arrangement of stimulus in randomized order can be used to check for position bias as well as record the play interactions as children wouldn't generally face in other direction.
- In grounded theory analysis, the grounding of data is very important. Some useful techniques which help in easier recognition of the grounding of each concept are – linking relevant memos from the data by assigning them a unique number id, and color coding the relevant memos based on source children

7.5.2 Design practice based recommendations

<u>Generative playfulness dashboard tool</u>: A 2-D visualization model called generative playfulness dashboard has been proposed as a **speculative tool** for using the identified generative playfulness dimensions to design, evaluate and/or redesign play artefact and activities across different play types and contexts for children with ID, as shown in figure 7.1.

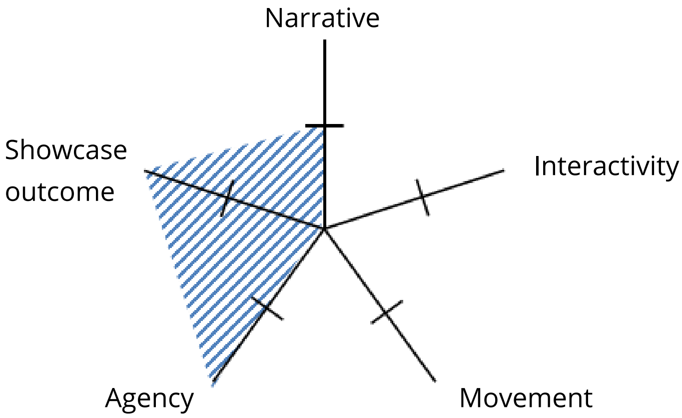


Figure 7.1. Representing a toy concept using dashboard tool

This model represents each of the generative playfulness dimensions as a branch of the star. This allows the designer to uniquely represent each of the concepts as the area covered by joining the dimensions which have been included in its ideation. Conversely, designer can start by selecting a combination of dimensions to generate ideas, where selected area then represents a possible solution space for concepts. An illustration of the process to be used in evaluation and redesigning of a toy concept using this tool is shown as follows.

*Need statement***:** To redesign ‘balancing monkeys’ toy (figure 5.23) by *Plan toys®* company for higher playfulness. This toy teaches the concept of balancing by allowing children to try different combinations of hanging monkeys on a tree.

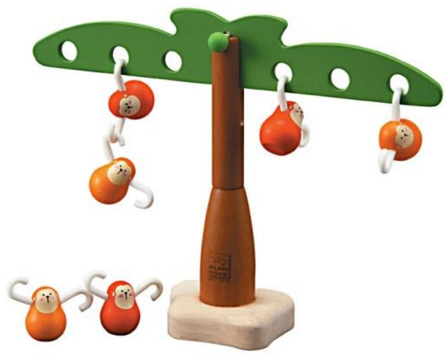


Figure 7.2. Balancing monkeys toy by plan toys® company

*Procedure for using the tool***:**

1. Evaluate the existing toy by approximating the presence of each of the generative playfulness dimension (as shown in blue shaded region in figure 7.3). The toy has a strong element of agency as player is free to explore different combinations of hanging the monkeys and there is no single path to reach the goal in most situations. Similarly, the game allows the possibility of showcasing the outcome and even storing it, being able to record the outcome visually. There is a narrative of monkeys playing on a tree, but the story-telling element could have been stronger, hence the lower scale is shown (figure 7.3).

2. Identify the generative playfulness dimensions to further add – In this case, it is decided to add movement and further strengthen narrative dimension, denoted by red shaded region in figure 7.3.

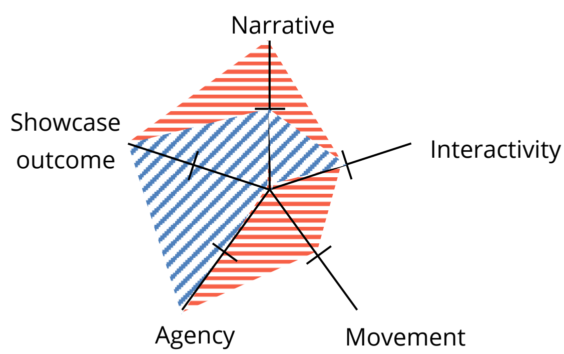


Figure 7.3. Representing an existing toy concept and new ideation space using dashboard tool

3. Think of different conceptual ideas corresponding to each of the selected dimensions and then arrange them in a morphological analysis based idea matrix to creatively explore the different possibilities in implementation, as shown in table 7.3. Different ideas for movement and narrative dimensions are represented as Mx & Nx.

Design space	Movement concept 1	Movement concept 2
Narrative concept 1	M1 – N1	M2 – N1
Narrative concept 2	M1 – N2	M2 – N2

Table 7.3. Morphological analysis based idea matrix of possible concepts

4. Select the concepts which seem to be feasible and effective. E.g. one possible combination could implement narrative dimension by including use of action song involving monkeys and counting. Movement dimension could be added to the toy play by making the shape of monkeys rounder and hooks smaller so that they roll around whenever they fall and thus child has to chase and pick them. This combination when added to the existing toy design could be more playful than the existing play.

As discussed in the procedure above, it is important to that conceptual ideas should be generated by treating individual dimensions as broad design directions in the process of ideation, instead of checklist items. The use of these dimensions as design guiding principles would be dependent upon the context of its application and constrained by the capabilities of the player, which gives a large solution space for exploration to the designer. Since the present thesis could not test or validate the effectiveness of this visualization model and process framework in generating playful concepts for artefacts and activities, we do not claim that concepts generated using the visualization model along with the identified dimensions will always add to playfulness. However, the validation study establishes the positive impact of selective dimensions on playfulness. Thus, it seems likely that the use of model should be able to assist in developing concepts which are playful.

<u>Actionable design practice recommendations (based on empirical insights)</u>: A set of actionable recommendations are presented below which emerged from empirical insights that aren't broad enough to qualify as design principles.

1. Sound is an effective medium for stimulus and feedback as it always leads to joyfulness, and thus adds to playfulness

2. In addition to integrating feedback in design, the ability to modulate feedback based on the intensity of physical action has been seen to enhance engagement, especially in sensory and challenge based play

3. Meaningful constructive play was found to be engaging, and should be encouraged as it can become a useful tool for catharsis. The meaningful construction activity could be stimulated through facilitation by giving some thematic/ concrete affordances in the construction set, and/or ideas to explore in play

4. Repetition of story and characters can be a desirable characteristic when adding narrative as a part of play activity, since children often involve in engaging pretend play acts and actions which are repetitive

5. Children always play in presence of facilitator (in special school) introducing an extra agent in play, thus design of activities or artefacts can have built affordances which involve facilitator meaningfully

6. When integrating interactive feedback, stimulus at success state should be made distinct and stronger than feedback at intermediate stages. This would contribute in keeping children motivated to reach activity target. Besides, feedback at the success stage often leads to joyfulness

7. Social play is more preferred than solitary play for these children, and design should build affordances for social interaction, whenever possible. Competition is generally avoided and may lead to anxiety, thus using more of associative and cooperative strategies in social play is recommended. For designers, competitive games should be revisualized to focus on cooperation

8. Design of play artefacts needs to acknowledge the difference in chronological (7-10 years) and mental (3-6 years) age which could lead to physical ergonomics issues like material handling, force application, etc. e.g. issues were seen like construction blocks and jigsaw puzzles being difficult to manipulate, toys broke easily like drum, doctor set

9. The standard group goals in activities need to be made flexible and customized and process should allow incremental outcomes to account for variation in the abilities of the children, as children balanced upon their level of disability and mental age still showed variability in their abilities

10. Feedback added at initial or intermediate stages of play should not be very long and information heavy, as some children with special needs have a short attention span (e.g. in case of narrative-based feedback, removal of names of characters if they do not fulfil a specific purpose)

11. Challenge as an element of play is not playful in itself, however children show appreciation for outcome if the process is interesting and engaging thus designing for challenge-based play could consider adding design characteristics which add to the playfulness value, like the generative playfulness dimensions

12. When adding constraints to create structured play, it should be ensured that no external guidance is needed which is leading in nature, and child is allowed the freedom to explore This could be done by ensuring that constraints are comprehensible, and/or developing pre-requisite skills in children so that constraints become comprehensible

13. Design of interactive feedback can benefit from adding context-related meaningful feedback as it is found to be more playful than context independent, more abstract feedback

14. Narrative communicated primarily through the use of visuals, does not engage child in play. When integrating a narrative into the play activity or artefact, using more of multi-modal interaction and dynamic feedback can lead to higher playfulness

15. Stand-alone sensory toys are not very helpful in leading to long engaging episodes for the studied age-group however sensory elements still succeed to attract and catch initial attention of the child which could be a useful characteristic in design

<u>Actionable design practice recommendations (based on speculative insights)</u>: A set of actionable recommendations are presented below which are based on speculative insights. These recommendations emerge from suggestive findings from the study and the tacit knowledge and experience of the researcher.

1. Most children naturally seem to attempt tasks in increasing order of difficulty when given a choice in play. This could be used to indirectly control the sequence of steps involved in play by accordingly setting an increasing level of difficulty which aligns with the desired sequence (where narrative events could be used for sequencing)

2. Children prefer to have a sense of control or dominance during play with other agents. Using toys and robots for pretend play should not have a dominating appearance of its characters. Also, if play is modelled through play artefact or activity, it should not outperform child's performance completely but operate at child's level or slightly higher, similar to the 'zone of proximal development'
3. Children have difficulty in comprehending feedback which involves long sentences. When embedding learning in play activity, instead of creating information heavy narrative which would be difficult for children to comprehend, actions should be used to embody learning e.g. in block matching toy, the learning happens in the motor action and not through information as narrative
4. Children improvise and create novel affordances with different toy elements and environmental artefacts, mixing abstract with concrete elements. This could be integrated in pretend and constructive play sets by including toy elements with varying form and function, to enhance engagement. Pretend play toy sets should have some abstract components to enhance possible narrative affordances
5. Design of play activity can include arranging as a desirable action, since a lot of children showed interest in arrangement of toy elements/parts without being asked to do so
6. The action of crashing cars or movable objects as a part of pretend play is seen to be playful for children, so it could be used in structured toys and activities as an action event in progression which motivates children to perform it
7. Design of play artefacts and activities should include more of manipulative handles which allow functional play in toys as they have been seen to add to playfulness e.g. the action of opening and closing lid of boxes of play doh
8. Sensory toys can explore tactile feedback also as a medium as it is seen to be playful e.g. play doh was a fairly popular toy
9. Children's play space should preferable be enclosed as some children easily get distracted especially when an unwanted noise or physical intrusion is encountered
10. Elements of play artefact or activity which need to be compared visually should be designed to follow Gestalt law of proximity as it is seen to affect their performance

positively (children made more errors when matching block and hole were diagonal than in a straight line)

11. Design of elements of play artefacts need to employ stronger differentiation strategy when the physical form is not very different in itself as sometimes it leads to confusion as seen in usual construction blocks e.g. color-coding could be used in construction blocks

7.5.3 Facilitation based recommendations (empirical insights)

The exploratory, interventional study (study 2) showed that facilitator played a central role in the free play episodes of children, and was often invited by children to show progress, seek help and participate in play. Due to the focus on design practice oriented insights, the facilitation related insights could not be explored in more depth. Based on the availability of facilitator or peer, and other infrastructural or technological constraints, the generative playfulness dimensions can be modified and applied as facilitation strategies. Apart from these dimensions, a number of other unique strategies have been identified as described below. These strategies can lead to design of guidelines and training programs for special educators to help them achieve better facilitation during play interaction and to establish themselves as play partner, as well as in design of robots and virtual assistants in the domain of special needs.

1. Role of facilitator is significant in play sustenance as he switches between a leader and a follower in different situations. Even his presence and making eye-contact from a distance leads to positive effect in engagement
2. Taking a role in pretend play which is dependent on child rather than controls the narrative helps in easier acceptance as a play partner for a facilitator
3. Playing inferior to child in terms of skills also leads to easier acceptance as a play partner (applicable to constructive and challenge-based play)
4. When child seeks attention for approval, to show acceptance or narrate play, facilitator should motivate but not give leading statements
5. When assisting a child if he gets stuck or fixated, facilitator should use gestures along with verbal triggers for better comprehension e.g. pointing with verbal cue. Our study showed that a lot of verbal triggers were ignored in the absence of gestures

6. Instead of giving immediate assistance or leading the child, facilitator should allow the child to explore during play and even experience failure, but ensure that the failure does not get prolonged to more than 2-3 consecutive failures
7. To introduce a new play affordance in an on-going pretend play activity, it is better to join the narrative and model the necessary actions rather than introducing as an external agent
8. Facilitator should ensure that play setup and infrastructure at special schools gives children exposure to variety of toys and play activities including unstructured play, to aid development and support playfulness through better internal control of the child in choosing play. Toy classification used in our study (i.e. sensory, pretend, constructive & challenge-based toys) is worth exploring
9. Designers, educators and activity planners need to ensure that children are not subjected to stress by putting them in competitive or comparative situations but are encouraged individually. Encouragement and appreciation at intermediate stages would also be helpful in boosting their self-esteem
10. Facilitator should promote friendship and bonding of children with other peers including different classrooms. It was seen that preschool children with ID are also capable of positive peer relationships and social play in unstructured situations when given a sufficient time for bonding

7.6 Limitations of the study

The present research study was conducted under the following limitations.

- The number of subjects involved in each of the three individual studies was small (around 10-12), however using a qualitative methodological framework in the initial stage allowed in-depth analysis with rich data and constant comparison technique from grounded theory. Despite of these considerations, the findings need to be applied to a larger population for further validation. It is worth reiterating that studying children with special needs would generally lead to this problem of limited number of subjects since each of these special school facilities have a small number of children with constraints of mental age and etiology, and combining multiple facilities may lead to other uncontrollable social and environmental variables.

- Another limitation of the study was that all the research was conducted at the same facility and in a fixed socio-cultural context (a special school in the metropolitan city of Mumbai, India) due to time and resource constraints. However, the students at school came from varied socio-cultural and financial backgrounds, and thus the findings are not limited to very specific strata of society. Some of the socio-economic factors like family structure, nature of play at home, family income, etc. were noted in the analysis of last study, but these factors were not used as control variables to study population, which may need a dedicated study.
- The present study was limited to looking at solitary play situations, in an attempt to reduce the number of variables which would be added with the social element. However, there were some significant insights which emerged regarding play partnership through the interactions of children with facilitator. Although, the findings are situated in use of play artefacts that are used for solitary play, it is expected that the identified dimensions would work in the context of social play also as designer can ideate to integrate them in social play situations.
- The findings from the study including the identified generative playfulness dimensions are based on a finite set of toys, which were selected methodologically to represent common, familiar age-appropriate toys for the studied population. These toys are not representative of all the possibilities and it is possible that changing the toys may lead to some new insights.

7.7 Scope for future work

Considering that the present study was done in a niche context and with very little research literature or parallel discourses to borrow from, the emerging insights were spread across multiple domains. There were choices to make at many points over the course of the study to selectively focus on some research gaps and narrow down. Because of the limited time frame of a doctoral study, we could not go in depth for a lot of potentially useful issues, but they can be a research question for further studies. We are identifying a list of some potential research areas and issues which could be interesting topics for future enquiry.

7.7.1 Validating and refining the generative playfulness dashboard

During the theoretical development of generative playfulness dimensions, a dynamic and operable visualization model called 'generative playfulness dashboard' was also proposed which would allow the designers to control each of the dimension as scalable parameter (explained with an example in chapter 5). However, it was important to first validate that the dimensions were actually effective in enhancing playfulness across different context and could be combined, before they could be used as controllable guiding principles. The present study thus focused on identification and operationalization of these dimensions as design guiding principles, but the control factor of individual dimension could not be studied within the limited time frame of our study. Nevertheless, the dashboard could be an effective tool to evaluate and design playful artefacts/ activities, and its usefulness in the creative design process needs to be studied. Considering that the dimensions have shown to significantly affect playfulness, it is expected that the dashboard will add the capability of generating useful analytical and creative inputs in the design process which add playfulness in the activity/artefact. The generative playfulness dashboard and its working is briefly presented as follows.

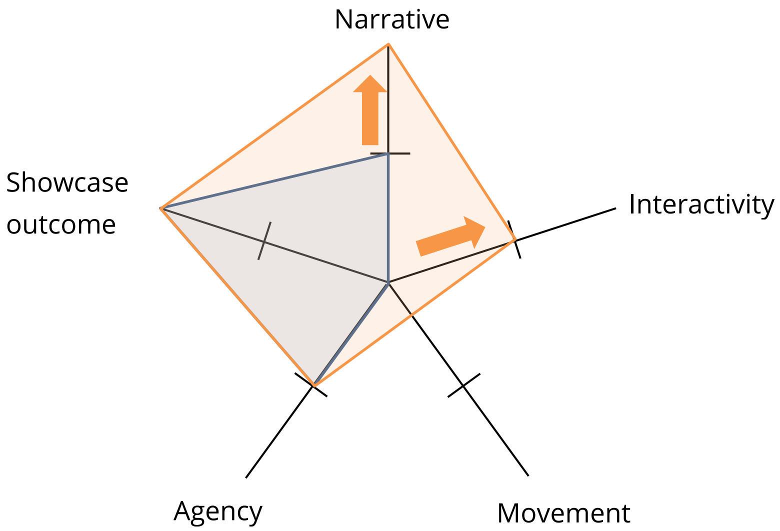


Figure 7.4. Generative playfulness dashboard to be used for controlling toy design features across different play contexts

As explained in chapter 5, the dashboard allows the designer to uniquely represent an existing concept or design of play artefact as the area covered by joining the dimensions included in its design (whose extent can be approximated by the designer as absent, moderate and high), represented in blue shaded region (figure 7.4). The dashboard can also represent a possible solution space for concepts by moving one or more of the dimensions up in scale, as represented in figure 7.4, where orange shaded region now defines the possible solution space, by moving ‘narrative’ and ‘interactivity’ dimension up the scale. The general principle here is that a higher area would represent possible design ideas which should be higher in playfulness. However, these dimensions are not checklist items but broad design guiding principles and should lead to multiple ideas allowing the designer to creatively explore the different possibilities in implementation. Thus, it is better to move only few of the dimensions at a time and explore possible set of concepts as a matrix. These conceptual ideas can be further assessed, refined or combined using the design process for feasibility and effectiveness.

As discussed in the literature review chapter earlier, there is very limited existing research that has looked at such tools in the context of toy design or designing for play. Play as an activity differs significantly from most other activities, often having no fixed structure and sequence, and focusing more on the process than the actual outcome of the activity. The focus of a play designer or activity planner is on making the activity/artefact more engaging and fun, rather than ensuring a higher efficiency, as in the case of other activities. Thus, some of the well-established design methodologies like systematic design (Pahl et al., 2007), axiomatic design (Suh, 2001), etc. cannot be directly applied in the context of play activities as they often focus on fixed mental models of usage and breaking down the artefacts/activities into functional requirements. However, a better understanding of the experiential factors of play activity and its relationship with design characteristics of toys could be a useful knowledge to integrate into the standard design process and methodologies. Our study derives from Kudrowitz and Wallace’s (2010) theory of play pyramid which is among the few studies that look into designing for play. Our work uses the same taxonomy of play, and also aligns with the basic operation of borrowing attributes from other play types. However, the generative playfulness dashboard model discussed in our work is significantly different from previous work as it aids the ideation process of designer by giving specific directions or keywords to explore (generative playfulness dimensions), which have been empirically established to perform a role in enhancing playfulness for preschool children with

ID. The dimensions act as useful handles in guiding the ideation process which would otherwise be based on assumptions and designer's prior experiences. There are a number of possibilities for further exploration of the dashboard, as discussed below:

- The effectiveness of dashboard tool needs to be validated with designers to see if the emerging concepts are able to give a better control and variety in development of playful concepts, and if the designers found the tool to be helpful in their design process
- Presently, the use of dashboard is based upon approximating the extent of the generative playfulness dimensions on a scale. It will be interesting to see if well-defined scales could be developed to bring more objectivity in evaluating an existing design concept and to develop a better control for the dimensions. The limits on the scales for each dimension can be derived from theory on age-specific capabilities of children
- While the present study took a broad representative sample of age-appropriate toys ensuring variety in terms of play types, it will be a worthwhile exercise to conduct similar research with different category of toys in terms of material and technology. This could lead to identification of some new dimensions and refinement of existing dimensions.
- It would be interesting to explore the role of the dashboard tool in relation to the design process, to see at what stage/s would this tool would be most effective to stimulate creative ideas, and how its usage could vary between novice designers and experts.

7.7.2 Developing a model for play facilitation using identified strategies

Although the present work was framed in a design-centric perspective, the role of facilitator was found to play a prominent role during the observed playful episodes. It was found that facilitator needs to carefully strike a balance between the role of a follower and a leader by switching between them depending on the needs of the child and occurrence of specific events. There is a lot of qualitative data gathered in this study which suggests the possibility of developing a predictive model elaborating the role played by facilitator in different situations arising during the play sessions and suggesting facilitation strategies that would be effective across different contexts and constraints as a function of play type in which they are used. Some of these strategies which were useful to build rapport as a play partner, to give assistive triggers and to introduce play affordances, are reported as actionable recommendations to facilitators and activity planners in an earlier section. However, a lot of future work needs to be devoted to establish the validity and reliability of different facilitation strategies in newer contexts including use of toys or activity which are unfamiliar to the children. While our study was limited to the preschool children with mild to moderate MR, it would be interesting to check the effectiveness of these facilitation insights as a function of mental age, to be used to design guidelines and training programs for special schools.

7.7.3 Developing a scientific scale to assess playfulness for children with communication difficulties

The present study contributed to the existing knowledge on the construct of playfulness by identifying observable parameters which could be used to assess playfulness as a context-dependent property of an activity when studying children who could not directly communicate. Using an iterative development approach, the theoretical construct was studied through its dimensions, and active engagement was identified as a primary parameter along-with expression of joyfulness as a secondary parameter to compare playfulness. While the present description of playfulness was sufficient for the purpose of our study, there are some interesting possibilities in further development of playfulness assessment as a scientific scale which could be used in research and play-testing for a similar population. Some of the future possibilities for exploration are described as follows.

- Defining and identifying the reliability of other significant qualitative factors which could be observed in free play to enhance the quality of active engagement e.g. instances of bored behaviour (identified by facial and body gestures), instances of focused behaviour, etc.
- Integrating physiological tools like wearables which measure electro-dermal activity (EDA) which can report the cognitive engagement aspects, not directly available through observation.
- Exploring the dimension of internal control and social connection as a function of social and material context in the studied environment, and suggesting necessary changes in the assessment procedure.

7.7.4 Integrating playfulness dimensions and learning parameters in designed artefacts

Studied population and context was difficult owing to a high number of associated individual variables. The focus of the study was thus limited to understanding how playfulness could be enhanced for preschool children with ID. Although, the present work operationalized the developed dimensions in a learning oriented play artefact and showed that there was a possibility of increased performance owing to the increased engagement, there was no attempt made to study learning parameters. However, with a rich literature looking into different learning styles and associated implementable ideas for typical and special population, the next logical step would be to see the suitability of each of these dimensions as a function of learning style of individuals and design characteristics of learning aids. This may further lead to actionable recommendations and nuances in operationalization of the dimensions.

7.7.5 Exploring the inherent variables in implementation of generative playfulness dimensions

Generative playfulness dimensions are visualized as broad design guiding principles, and in that sense, their definition might be more suited to stimulate creativity without diving into individual implementation features. However, each of these dimensions has scope for future exploration considering the limited available literature on preschool children with ID. Such explorations could give useful insights to research and practice. E.g. Narrative could further be studied for playfulness as a function of type of narrative world depicted (actual, wishful-possible or wishful-impossible), Level of detailing in representation, Type of narrative voice used, Player positioning in narrative, Level of player’s agency/ interactivity, Emotional dimension of narrative, etc. Another factor to consider is to look at the semantic and syntactic nature of the narrative information and interactive feedback for its ease of comprehension for preschool children with ID having varying level of language limitations. Another interesting domain for further exploration is looking at the notion of threshold for errors/failure to measure persistence as a function of different environmental factors. This could be useful to guide design and application in the context of learning and developmental aids.

7.7.6 Exploring the effect of mixed components in pretend play toy sets

Identified as an interesting research gap in the grounded theory analysis during study 2, it is worth looking at different combinations of contextual and abstract components on the play affordance of a pretend play toy set from completely contextual play set to completely abstract play set. Higher play affordance is a desirable property in toys as it adds to the play value and engagement with the toy and may also contribute to the development of divergent thinking in the child. Also, worth exploring in the context of play is the effect of elements of toy set on each other's affordance i.e. hierarchical and sequential affordances. The study may also focus on varying the design of abstract elements of pretend play toy set and studying its effect on play affordances based on identified insights like use of flexible form and spherical form.

7.8 Concluding remarks

The present study was an attempt to understand play of preschool children with ID in the context of special school and frame the observed playful behaviours to create guidance for designers and facilitators. It is important to note that our population along with other special needs are vulnerable especially in Indian context where lack of resources and knowledge creates a gap between the kind of play opportunities children experience in real life and what they could be capable of. Within the dominating discourses with developmental focus, it is important to study play independently as a measure of quality of life for the children. The idea of generalizable playfulness dimensions thus tries to decontextualize enjoyment and engagement from a specific activity, which could be implemented in a learning context or as play for its own sake. While a number of these insights may also be applicable to play of typical children, it was a conscious decision not to use a comparative framework for the studies, allowing us to devote more time and resources on understanding the experiential aspects of play for preschool children with ID, rather than the play skill comparison generally seen as the dominant discourse. It is recommended that more of such empirical research studies should be conducted for other special needs as well as with different types of play artefacts and activities to increase this pool of knowledge and refine it through operationalization.

At the end, it seems fitting to quote the British philosopher Alan Watts:

“This is the real secret of life –
to be completely engaged with what you are doing in the here and now.
And instead of calling it work, realize it is play.”

References

Abdul Jabbar, a. I., & Felicia, P. (2015). Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. *Review of Educational Research*, 1–40. https://doi.org/10.3102/0034654315577210

Abramovich, S., Schunn, C., & Higashi, R. M. (2013). Are badges useful in education?: It depends upon the type of badge and expertise of learner. *Educational Technology Research and Development*, *61*(2), 217–232. https://doi.org/10.1007/s11423-013-9289-2

Adams, E. (2001). Replayability, part one: Narrative. Retrieved from http://www.gamasutra.com/view/feature/131483/replayability_part_one_narrative.php

Aitken, S. C. (2001). *Geographies of Young People: the morally contested spaces of identity*. London: Routledge.

Almqvist, L. (2006). *Children's health and developmental delay: Positive functioning in every-day life*. Örebro universitetsbibliotek.

Anaby, D., Hand, C., Bradley, L., DiRezze, B., Forhan, M., DiGiacomo, A., & Law, M. (2013). The effect of the environment on participation of children and youth with disabilities: a scoping review. *Disability and Rehabilitation*, *35*(19), 1589–1598. https://doi.org/10.3109/09638288.2012.748840

Ansari, A., & Purtell, K. M. (2017). Activity settings in full-day kindergarten classrooms and children's early learning. *Early Childhood Research Quarterly*, *38*, 23–32. https://doi.org/10.1016/j.ecresq.2016.09.003

Askari, S., Anaby, D., Bergthorson, M., Majnemer, A., Elsabbagh, M., & Zwaigenbaum, L. (2015). Participation of Children and Youth with Autism Spectrum Disorder: A Scoping Review. *Review Journal of Autism and Developmental Disorders*, *2*(1), 103–114. https://doi.org/10.1007/s40489-014-0040-7

Astramovich, R. L., Lyons, C., & Hamilton, N. J. (2015). Play Therapy for Children With Intellectual Disabilities. *Journal of Child and Adolescent Counseling*, *1*(1), 27–36. https://doi.org/10.1080/23727810.2015.1015904

Athey, C. (2007). *Extending thought in young children: A parent-teacher partnership* (2nd ed.). SAGE Publications.

Aydt, H., & Corsaro, W. a. (2003). Differences in Children's Construction of Gender Across Culture: An Interrpretive Approach. *American Behavioral Scientist*, *46*(10), 1306–1325. https://doi.org/10.1177/0002764203251472

Baek, Y. (2009). Revealing new hidden curriculum and pedagogy of digital games. In R. E. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education.* (3rd ed., pp. 1025–1045). Hershey, PA: Information Science Reference.

Bambara, L. M., Spiegel-mcgill, P., Shores, R. E., & Fox, J. J. (1984). A Comparison of Reactive and Nonreactive Toys on Severely Handicapped Children â€™ s Manipulative Play. *Journal of the Association for Persons with Severe Handicaps*, *9*(2), 142–149.

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York: W.H. Freeman.

Barnett, L. A. (1991). The playful child: Measurement of a disposition to play. *Play & Culture*, *4*(1), 51–74. Retrieved from https://www.lib.uwo.ca/cgi-bin/ezpauthn.cgi?url=http://search.proquest.com/docview/617936201?accountid=15115%5Cnhttp://vr2pk9sx9w.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rfr_id=info:sid/ProQ:psycinfo&rft_val_fmt=info:of

Barton, E. E. (2010). Development of a Taxonomy of Pretend Play for Children With Disabilities. *Infants & Young Children*, *23*(4), 247–261. https://doi.org/10.1097/IYC.0b013e3181f22072

Barton, E. E. (2015). Teaching Generalized Pretend Play and Related Behaviors to Young Children With Disabilities. *Exceptional Children*, *81*(4), 489–506. https://doi.org/10.1177/0014402914563694

Barton, E. E. (2016). Critical Issues and Promising Practices for Teaching Play to Young Children with Disabilities. In B. Reichow, B. A. Boyd, E. E. Barton, & S. L. Odom (Eds.), *Handbook of Early Childhood Special Education* (pp. 267–286). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-28492-7_15

Barton, E. E., Chen, C.-I., Pribble, L., Pomes, M., & Kim, Y.-A. (2013). Coaching Preservice Teachers to Teach Play Skills to Children with Disabilities. *Teacher Education and Special Education*, *36*(4), 330–349. https://doi.org/10.1177/0888406413505113

Barton, E. E., & Wolery, M. (2008). Teaching Pretend Play to Children With Disabilities: A Review of the Literature. *Topics in Early Childhood Special Education*, *28*(2), 109–125. https://doi.org/10.1177/0271121408318799

Bassok, D., Latham, S., & Rorem, A. (2016). Is Kindergarten the New First Grade? *AERA Open*, *2*(1), 1–31. https://doi.org/10.1177/2332858415616358

Baszanger, I. (1998). The Work Sites of an American Interactionist: Anselm L. Strauss, 1917-1996. *Symbolic Interaction*, *21*(4), 353–377. https://doi.org/10.1525/si.1998.21.4.353

Bateman, J. A. (2016). From Narrative to Visual Narrative to Audiovisual Narrative: the Multimodal Discourse Theory Connection (Invited Talk). In *OASIcs-OpenAccess Series in Informatics* (Vol. 53, pp. 1–11). Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik.

Bateson, G. (1955). A theory of play and fantasy. *Psychiatric Research Reports*.

Bateson, G. (1971). The message “This is play.” In R. E. Herron & B. Sutton-Smith (Eds.), *Child’s Play* (pp. 261–266). Malabar, FL: Robert E. Kreiger.

Bayat, M. (2011). Clarifying Issues Regarding the Use of Praise With Young Children. *Topics in Early Childhood Special Education*, *31*(2), 121–128. https://doi.org/10.1177/0271121410389339

Baykal, G. E., Alaca, I. V., Yantaç, A. E., & Göksun, T. (2016). Developing transmedia puzzle play to facilitate spatial skills of preschoolers. *ACM SIGCHI Conference on Interaction Design and Children 2016*, 631–636. https://doi.org/10.1145/2930674.2936006

Benjamin, T. E., Lucas-Thompson, R. G., Little, L. M., Davies, P. L., & Khetani, M. A. (2017). Participation in Early Childhood Educational Environments for Young Children with and Without Developmental Disabilities and Delays: A Mixed Methods Study. *Physical & Occupational Therapy In Pediatrics*, *37*(1), 87–107. https://doi.org/10.3109/01942638.2015.1130007

Berlyne, D. E. (1969). Laughter, humor, and play. In G. Lindzey & E. Aronson (Eds.), *The Handbook of Social Psychology (Vol. 3, 2nd ed.)*. Reading, MA: Addison Wesley.

Besio, S. (2004). Using assistive technologies to facilitate play by children with motor impairments : A methodological proposal. *Technology and Disability*, *16*, 119–130.

Best, J. R. (2011). Exergaming immediately enhances children’s executive function. *Developmental Psychology*, *48*(5), 1501–1510. https://doi.org/10.1037/a0026648

Bhana, D. (2016). Children Are Children: Gender Doesn’t Matter? BT - Gender and Childhood Sexuality in Primary School. In D. Bhana (Ed.) (pp. 25–43). Singapore: Springer Singapore. https://doi.org/10.1007/978-981-10-2239-5_2

Bhatnagar, N., & Das, A. (2014). Regular school teachers ’ concerns and perceived barriers to implement inclusive education in New Delhi , India. *International Journal of Instruction*, *7*(2), 89–102.

Bizzocchi, J. (2007). Games and Narrative: An Analytical Framework. *Loading-The Journal of the Canadian Games Studies Association*, *1*(1), 5–10. Retrieved from http://journals.sfu.ca/loading/index.php/loading/article/view/1/1

Björk, S., Lundgren, S., & Holopainen, J. (2003). Game design patterns. *Proceedings of Level Up-1st International Digital Games Research Conference*, 180–193. https://doi.org/10.1.1.10.4097

Black, I. E., Menzel, N. N., & Bungum, T. J. (2015). The Relationship Among Playground Areas and Physical Activity Levels in Children. *Journal of Pediatric Health Care*, *29*(2), 156–168. https://doi.org/10.1016/j.pedhc.2014.10.001

Blasco, P. M., Bailey, D. B., & Burchinal, M. A. (1993). Dimensions of mastery in same-age and mixed-age integrated classrooms. *Early Childhood Research Quarterly*, *8*(2), 193–206. https://doi.org/10.1016/S0885-2006(05)80090-0

Blatchford, P., Baines, E., & Pellegrini, A. (2003). The social context of school playground games: Sex and ethnic differences, and changes over time after entry to junior school. *British Journal of Developmental Psychology, 21*(4), 481–505. https://doi.org/10.1348/026151003322535183

Boddy, L. M., Downs, S. J., Knowles, Z. R., & Fairclough, S. J. (2015). Physical activity and play behaviours in children and young people with intellectual disabilities: A cross-sectional observational study. *School Psychology International*, *36*(2, SI), 154–171. https://doi.org/10.1177/0143034314564242

Boddy, L. M., Murphy, M. H., Cunningham, C., Breslin, G., Foweather, L., Gobbi, R., … Stratton, G. (2014). Physical activity, cardiorespiratory fitness, and clustered cardiometabolic risk in 10- to 12-year-old school children: the REACH Y6 study. *American Journal of Human Biology : The Official Journal of the Human Biology Council*, *26*(4), 446–51. https://doi.org/10.1002/ajhb.22537

Booth, A., & Nolen, P. (2012). Choosing to compete: How different are girls and boys? *Journal of Economic Behavior and Organization*, *81*(2), 542–555. https://doi.org/10.1016/j.jebo.2011.07.018

Bourke, J. (2017). Children's experiences of their everyday walks through a complex urban landscape of belonging. *Children's Geographies*, *15*(1), 93–106. https://doi.org/10.1080/14733285.2016.1192582

Bradley, R. H. (1985). Social-cognitive development and toys. *Topics in Early Childhood Special Education*, *5*(3), 11–30.

Bringsjord, S. (2001). Is It Possible to Build Dramatically Compelling Interactive Digital Entertainment (in the form, e.g., of computer games)? *Game Studies*, *1*(1), 1–19. Retrieved from http://gamestudies.org/0101/bringsjord/

Brodin, J. (2005). Diversity of aspects on play in children with profound multiple disabilities. *Early Child Development and Care*, *175*(7–8), 635–646. https://doi.org/http://dx.doi.org/10.1080/0300443042000266222

Brodin, J., & Lindstrand, P. (2000). Reflections on children with disabilities and computer play. *EUROREHAB-BRATISLAVA-*, (3), 153–158.

Bundy, A. C. (1997). Play and playfulness: What to look for. In L. D. Parham & L. S. Fazio (Eds.), *Play in occupational therapy for children* (pp. 52–66). St. Louis, MO: Mosby.

Bundy, A. C. (2000). Assessing play. In M. Law, W. Dunn, & C. Baum (Eds.), *Measurement of Occupational Therapy Performance: Supporting Best Practice in Occupational Therapy*. Thorofare, NJ: Slack.

Bundy, A. C., & Clifton, J. L. (1998). Construct validity of the children's playfulness scale. *Play and Culture Studies*, *1*, 137–147.

Burghardt, G. M. (2014). A Brief Glimpse at the Long Evolutionary History of Play. *Animal Behavior and Cognition*, *1*(2), 90–98. https://doi.org/10.12966/abc.05.01.2014

Burke, C. (2005). "Play in focus": Children researching their own spaces and places for play. *Children Youth and Environments*, *15*(1), 27–53.

Butler, L. P., & Walton, G. M. (2013). The opportunity to collaborate increases preschoolers' motivation for challenging tasks. *Journal of Experimental Child Psychology*, *116*(4), 953–961. https://doi.org/10.1016/j.jecp.2013.06.007

Calvert, S. L. (2005). Control as an Engagement Feature for Young Children's Attention to and Learning of Computer Content. *American Behavioral Scientist*, *48*(5), 578–589. https://doi.org/10.1177/0002764204271507

Cameron, J., & Pierce, D. W. (2002). *Rewards and intrinsic motivation: resolving the conflict*. Westport, CT: Bergin and Garvey.

Caracciolo, M. (2015). Playing Home: Videogame Experiences between Narrative and Ludic Interests. *Narrative*, *23*(3), 231–251. https://doi.org/10.1353/nar.2015.0022

Carr, M. (2000). Technological affordance, social practice and learning narratives in an early childhood setting. *International Journal of Technology and Design Education, 10*(1), 61–79. https://doi.org/10.1023/A:1008986002620

Case-Smith, J., & Kuhaneck, H. M. (2008). Play preferences of typically developing children and children with developmental delays between ages 3 and 7 years. *OTJR: Occupation, Participation and Health*, *28*(1), 19.

Center for Universal Design, T. (1997). The Principles of Universal Design. Retrieved January 4, 2017, from https://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm

Christie, J. F., & Johnsen, E. P. (1983). The Role of Play in Social-Intellectual Development. *Review of Educational Research*, *53*(1), 93–115. Retrieved from http://www.jstor.org/stable/1170328

Cicchetti, D., Beeghly, M., & Weiss-Perry, B. (1994). Symbolic development in children with Down syndrome and in children with autism: An organizational, developmental psychopathology perspective. *Children at Play: Clinical and Developmental Approaches to Meaning and Representation*, 206–227.

Clements, D. H., Swaminathan, S., Anne, M., & Hannibal, Z. (1999). Young Children â€™ s Concepts of Shape. *Journal for Research in Mathematics Education*, *30*(2), 192–212.

Cohen, L., & Uhry, J. (2011). Naming Block Structures: A Multimodal Approach. *Early Childhood Education Journal*, *39*(1), 79–87. https://doi.org/10.1007/s10643-010-0425-x

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, *88*(4), 715–730. https://doi.org/10.1037/0022-0663.88.4.715

Corsaro, W. A. (1997). *The sociology of childhood*. Wiley Online Library.

Corsaro, W. A. (2005). *The Sociology of Childhood* (2nd ed.). Thousand Oaks, CA: Pine Forge Press.

Crawford, S. K., Stafford, K. N., Phillips, S. M., Scott, K. J., & Tucker, P. (2014). Strategies for Inclusion in Play among Children with Physical Disabilities in Childcare Centers: An Integrative Review. *Physical & Occupational Therapy In Pediatrics*, *34*(4), 404–423. https://doi.org/10.3109/01942638.2014.904470

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: SAGE Publications. https://doi.org/10.4135/9781473907676

Creswell, J. W., & Plano-Clark, V. L. (2007). *Designing and Conducting Mixed Methods Research.* Thousand Oaks, CA: SAGE Publications.

Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper Perennial.

Czalczynska-Podolska, M. (2014). The impact of playground spatial features on children's play and activity forms: An evaluation of contemporary playgrounds' play and social value. *Journal of Environmental Psychology, 38,* 132–142. https://doi.org/10.1016/j.jenvp.2014.01.006

Denzin, N. K., & Lincoln, Y. S. (2008). The discipline and practice of qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 1–43). Thousand Oaks, CA: SAGE Publications.

Desurvire, H., Caplan, M., & Toth, J. a. (2004). Using heuristics to evaluate the playability of games. *CHI'04*

Extended Abstracts on Human Factors in Computing Systems, 1509–1512. https://doi.org/10.1145/985921.986102

Dicarlo, C. (2005). *Embedding Sensory Preferences into Toys to Enhance Toy Play in Toddlers with Disabilities*. University of New Orleans.

Dickey, M. D. (2005). Engaging by design: How engagement strategies in popular computer and video games can inform instructional design. *Educational Technology Research and Development*, *53*(2), 67–83. https://doi.org/10.1007/BF02504866

Doctoroff, S. (2001). Adapting the physical environment to meet the needs of all young children for play. *Early Childhood Education Journal*, *29*(2), 105–109. Retrieved from http://accounts.smccd.edu/franciscoe/ece260/Adapting.pdf

Dondlinger, M. J. (2007). Educational video game design: A review of the literature. *Journal of Applied Educational Technology*, *4*(July), 21–31. https://doi.org/10.1108/10748120410540463

Douglas, Y., & Hargadon, A. (2000). The pleasure principle: immersion, engagement, flow. In *Proceedings of the eleventh ACM on Hypertext and hypermedia* (pp. 153–160). ACM.

Droumeva, M., de Castell, S., & Wakkary, R. (2007). Investigating sound intensity gradients as feedback for embodied learning. In *Proceedings of the 13th International Conference on Auditory Display, Montréal, Canada* (pp. 403–410). Montreal, Canada.

Einarsson, I. O., Olafsson, A., Hinriksdóttir, G., Jóhannsson, E., Daly, D., & Arngrímsson, S. A. (2015). Differences in physical activity among youth with and without intellectual disability. *Medicine and Science in Sports and Exercise*, *47*(2), 411–418. https://doi.org/10.1249/MSS.0000000000000412

Einarsson, I. Þ., Jóhannsson, E., Daly, D., & Arngrímsson, S. Á. (2016). Physical activity during school and after school among youth with and without intellectual disability. *Research in Developmental Disabilities*, *56*, 60–70. https://doi.org/10.1016/j.ridd.2016.05.016

Ekstein, S., Glick, B., Weill, M., Kay, B., & Berger, I. (2011). Down Syndrome and Attention-Deficit/Hyperactivity Disorder (ADHD). *Journal of Child Neurology*, *26*(10), 1290–1295. https://doi.org/10.1177/0883073811405201

Else, P. (2009). *The value of play*. Bloomsbury Publishing.

Elton-Chalcraft, S., Cammack, P. J., & Harrison, L. (2016). Segregation, Integration, Inclusion and Effective Provision: A Case Study of Perspectives from Special Educational Needs Children, Parents and Teachers in Bangalore India. *International Journal of Special Education*, *31*(1), 2–9.

Erikson, E. H. (1950). *Childhood and Society*. New York: Norton.

Eriksson, L., Welander, J., & Granlund, M. (2007). Participation in everyday school activities for children with and without disabilities. *Journal of Developmental and Physical Disabilities*, *19*(5), 485–502. https://doi.org/10.1007/s10882-007-9065-5

Evaldsson, A.-C. C., & Corsaro, W. A. (1998). Play and Games in the Peer Cultures of Preschool and Preadolescent Children An Interpretative Approach. *Childhood*, *5*(4), 377–402.

Falstein, N. (2002). Better by design: The 400 project. *Game Developer Magazine*, *9*(3).

Fantuzzo, J., Sutton-Smith, B., Coolahan, K. C., Manz, P. H., Canning, S., & Debnam, D. (1995). Assessment of preschool play interaction behaviors in young low-income children: Penn Interactive Peer Play Scale. *Early Childhood Research Quarterly*, *10*(1), 105–120. https://doi.org/10.1016/0885-2006(95)90028-4

Federoff, M. a. (2002). *Heuristics and usability guidelines for the creation and evaluation of fun in video games (Masters Thesis)*. Indiana University. https://doi.org/10.1.1.89.8294

Feeley, K. M., & Jones, E. a. (2006). Addressing challenging behaviour in children with Down syndrome: the use of applied behaviour analysis for assessment and intervention. *Down's Syndrome, Research and Practice : The Journal of the Sarah Duffen Centre / University of Portsmouth*, *11*(2), 64–77.

https://doi.org/10.3104/perspectives.316

Ferrari, E., Robins, B., & Dautenhahn, K. (2010). “Does it work?” A framework to evaluate the effectiveness of a robotic toy for children with special needs. In *19th International Symposium in Robot and Human Interactive Communication* (pp. 100–106). Viareggio, Italy: IEEE. https://doi.org/10.1109/ROMAN.2010.5598734

Ferreira, R., Matos, D., Carvalho, V., & Soares, F. (2016). “HugMe” Development of an inclusive toy: first insights. In *2nd International conference of the portuguese society for engineering education* (Vol. 63, pp. 1–6). https://doi.org/10.1109/CISPEE.2016.7777733

Fidler, D. J. (2006). The emergence of a syndrome-specific personality profile in young children with Down syndrome. *Down Syndrome: Neurobehavioural Specificity*, 139–152.

Filsecker, M., & Hickey, D. T. (2014). A multilevel analysis of the effects of external rewards on elementary students’ motivation, engagement and learning in an educational game. *Computers and Education*, *75*, 136–148. https://doi.org/10.1016/j.compedu.2014.02.008

Flaes, S. A. M. B., Chinapaw, M. J. M., Koolhaas, C. M., Mechelen, W. Van, & Verhagen, E. A. L. M. (2016). More children more active: Tailored playgrounds positively affect physical activity levels amongst youth. *Journal of Science and Medicine in Sport*, *19*(3), 250–254. https://doi.org/10.1016/j.jsams.2015.03.001

Fromberg, D. P., & Bergen, D. (2015). *Play from Birth to Twelve*. New York: Routledge.

Frost, J. L. (1998). Neuroscience, Play, and Child Development. In *IPA/USA Triennial National Conference*. Longmont, CO. Retrieved from http://files.eric.ed.gov/fulltext/ED427845.pdf

Fullerton, T., Swain, C., & Hoffman, S. (2004). Improving Player Choices. Retrieved from http://www.gamasutra.com/view/feature/2039/improving_player_choices.php

Gamberini, L., Spagnolli, A., Nucci, M., DeGiuli, G., Villa, C., Monarca, V., … Leclerq, S. (2016). A Gamified Solution to Brief Interventions for Nightlife Well-Being. In A. Meschtscherjakov, B. De Ruyter, V. Fuchsberger, M. Murer, & M. Tscheligi (Eds.), *Persuasive Technology: 11th International Conference, PERSUASIVE 2016, Salzburg, Austria, April 5-7, 2016, Proceedings* (Vol. 9638, pp. 230–241). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-31510-2_20

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, *1*(1), 20. https://doi.org/10.1145/950566.950595

Gielen, M. a. (2010). Essential concepts in toy design education: aimlessness, empathy and play value. *International Journal of Arts and Technology*, *3*(1), 4. https://doi.org/10.1504/IJART.2010.030490

Gilmore, L., Cuskelly, M., & Browning, M. (2015). Mastery Motivation in Children with Intellectual Disability: Is there Evidence for a Down Syndrome Behavioural Phenotype? *International Journal of Disability, Development, and Education*, *62*(3), 265–275. https://doi.org/http://dx.doi.org/10.1080/1034912X.2015.1020923

Ginsburg, H. P., & Opper, S. (1988). *Piaget’s theory of intellectual development* . Prentice-Hall, Inc.

Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: The Sociology Press.

Glaser, B. G. (1998). *Doing Grounded Theory: Issues and Discussions*. Mill Valley, California: The Sociology Press.

Glaser, B. G. (2009). *Jargonizing: Using the grounded theory vocabulary*. Mill Valley, CA: The Sociology Press.

Glaser, B. G., & Strauss, A. (1967). The discovery of grounded theory: strategies for qualitative research. Chicago: Aldine Publishing Company.

Gneezy, B. U., Leonard, K. L., & List, J. A. (2009). Gender Differences in Competition: Evidence\\ From a Matrilineal and a Patriarchal Society. *Econometrica*, *77*(5), 1637–1664.

https://doi.org/10.3982/ECTA6690

Gooch, D., Vasalou, A., Benton, L., & Khaled, R. (2016). Using Gamification to Motivate Students with Dyslexia. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16* (pp. 969–980). New York, New York, USA: ACM Press. https://doi.org/10.1145/2858036.2858231

Goodman, J. F., & Linn, M. I. (2003). "Maladaptive" behaviours in the young child with intellectual disabilities: A reconsideration. *International Journal of Disability, Development and Education*, *50*(2), 137–148. https://doi.org/http://dx.doi.org/10.1080/1034912032000089648

Government-of-India(GOI). (2016a). *Disabled Persons in India: A Statistical profile 2016*. New Delhi. Retrieved from http://www.mospi.gov.in/sites/default/files/publication_reports/Disabled_persons_in_India_2016.pdf

Government-of-India(GOI). (2016b). *THE RIGHTS OF PERSONS WITH DISABILITIES ACT*. New Delhi. Retrieved from http://www.disabilityaffairs.gov.in/upload/uploadfiles/files/RPWD ACT 2016.pdf

Gowen, J. W., Johnson-Martin, N., Goldman, B. D., & Hussey, B. (1992). Object play and exploration in children with and without disabilities: a longitudinal study. *American Journal of Mental Retardation : AJMR*, *97*(1), 21–38. Retrieved from http://europepmc.org/abstract/MED/1386741

Gray, J. A., Zimmerman, J. L., & Rimmer, J. H. (2012). Built environment instruments for walkability, bikeability, and recreation: Disability and universal design relevant? *Disability and Health Journal*, *5*(2), 87–101. https://doi.org/10.1016/j.dhjo.2011.12.002

Green, M. C., Brock, T. C., & Kaufman, G. F. (2004). Understanding media enjoyment: The role of transportation into narrative worlds. *Communication Theory*, *14*(4), 311–327. https://doi.org/10.1093/ct/14.4.311

Greenberg, J. H., Lau, W., & Lau, S. (2016). Teaching Appropriate Play to Replace Stereotypy Using a Treatment Package with Students Having Autism. *Global Education Review*, *3*(3), 94–104.

Greenberg, P. J. (1932). Competition in Children: An Experimental Study. *The American Journal of Psychology*, *44*(2), 221–248. https://doi.org/10.2307/1414824

Grimshaw, M. (2008). Sound and immersion in the first-person shooter. *International Journal of Intelligent Games & …*, 119–124. https://doi.org/10.1016/j.intcom.2010.04.005

Groos, K. (1898). *The Play of Animals*. New York: D. Appleton.

Groos, K. (1901). *The Play of Man*. London: Heinemann.

Gupta, A., & Singhal, N. (2005). Psychosocial Support for Families of Children With Autism. *Asia Pacific Disability Rehabilitation Journal*, *62*(123), 16–2.

Guralnick, M. J., Connor, R. T., Neville, B., & Hammond, M. a. (2006). Promoting the peer-related social development of young children with mild developmental delays: effectiveness of a comprehensive intervention. *American Journal of Mental Retardation : AJMR*, *111*(5), 336–356. https://doi.org/10.1352/0895-8017(2006)111[336:PTPSDO]2.0.CO;2

Guralnick, M. J., Hammond, M. A., Connor, R. T., & Neville, B. (2006). Stability, change, and correlates of the peer relationships of young children with mild developmental delays. *Child Development*, *77*(2), 312–324. Retrieved from http://www.jstor.org/stable/3696471

Hall, G. S. (1905). *Adolescence: its psychology and its relations to physiology, anthropology, sociology, sex, crime, religion and education*. New York: D. Appleton.

Hamm, E. M., Mistrett, S. G., & Ruffino, A. G. (2006). Play outcomes and satisfaction with toys and technology of young children with special needs. *Journal of Special Education Technology*, *21*(1), 29–35. https://doi.org/10.1080/17409292.2013.742286

Hanline, M. F., & Fox, L. (1993). Learning within the context of play: Providing typical early childhood experiences for children with severe disabilities. *Research and Practice for Persons with Severe*

Disabilities, *18*(2), 121–129.

Hanna, L., Risden, K., & Alexander, K. (1997). Guidelines for usability testing with children. *Interactions*, *4*(5), 9–14. https://doi.org/10.1145/264044.264045

Harker, C. (2005). Playing and affective time-spaces. *Children's Geographies*, *3*(1), 47–62.

Harris, M. K. E. (2016). *An Analysis of Variability of Play Behavior with Preschool Children with Autism*. Utah State University. Retrieved from http://digitalcommons.usu.edu/etd

Harrop, C., Green, J., & Hudry, K. (2016). Play complexity and toy engagement in preschoolers with autism spectrum disorder: Do girls and boys differ? *Autism*, 1–14. https://doi.org/10.1177/1362361315622410

Hauser-Cram, P. (1996). Mastery motivation in toddlers with developmental disabilities. *Child Development*, *67*(1), 236–48. https://doi.org/10.2307/1131698

Herman, D. (2011). *Basic elements of narrative*. John Wiley & Sons.

Herrington, S., & Lesmeister, C. (2006). The design of landscapes at child-care centres: Seven Cs. *Landscape Research*, *31*(1), 63–82. https://doi.org/10.1080/01426390500448575

Hertz-Lazarowitz, R., & Sharan, S. (1984). Enhancing Prosocial Behavior through Cooperative Learning in the Classroom. In E. Staub, D. Bar-Tal, J. Karylowski, & J. Reykowski (Eds.), *Development and Maintenance of Prosocial Behavior: International Perspectives on Positive Morality* (pp. 423–443). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4613-2645-8_26

Hestenes, L., & Carroll, D. (2000). The play interaction of young children with and without disabilities: individual and enviromental influences. *Early Childhood Research Quarterly*, *15*(2), 229–246. Retrieved from http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6W4B-40S0DBM-6-5&_cdi=6538&_user=4429&_orig=search&_coverDate=12%2F31%2F2000&_sk=999849997&view=c&wchp=dGLbVzW-zSkWA&md5=b3c9c6bee782941186237a3937fb7814&ie=/sdarticle.pdf

Hidi, S. (2016). Revisiting the Role of Rewards in Motivation and Learning: Implications of Neuroscientific Research. *Educational Psychology Review*, *28*(1), 61–93. https://doi.org/10.1007/s10648-015-9307-5

Hidi, S., & Harackiewicz, J. M. (2000). Motivating the Academically Unmotivated: A Critical Issue for the 21st Century. *Review of Educational Research*, *70*(2), 151–179. https://doi.org/10.3102/00346543070002151

Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational Psychologist*, *41*(2), 111–127. https://doi.org/10.1207/s15326985ep4102_4

Hinckson, E. A., & Curtis, A. (2013). Measuring physical activity in children and youth living with intellectual disabilities: A systematic review. *Research in Developmental Disabilities*, *34*(1), 72–86. https://doi.org/10.1016/j.ridd.2012.07.022

Hinske, S., Langheinrich, M., & Lampe, M. (2008). Towards guidelines for designing augmented toy environments. *Proceedings of the 7th ACM Conference on Designing Interactive Systems - DIS '08*, 78–87. https://doi.org/10.1145/1394445.1394454

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). *Putting Education in "Educational" Apps: Lessons From the Science of Learning*. *Psychological Science in the Public Interest* (Vol. 16). https://doi.org/10.1177/1529100615569721

Holt, R. J., Moore, A.-M., & Beckett, A. E. (2014). Together Through Play: Facilitating Inclusive Play Through Participatory Design. In *Inclusive Designing Joining Usability, Accessibility, and Inclusion* (pp. 241–275). https://doi.org/10.1016/j.intcom.2010.08.007

Honig, A. S. (1983). Programming for preschoolers with special needs: How child development knowledge can help. *Early Child Development and Care*, *11*(2), 165–196. https://doi.org/10.1080/0300443830110206

Howie, E. K., & Pate, R. R. (2012). Physical activity and academic achievement in children: A historical perspective. *Journal of Sport and Health Science*, *1*(3), 160–169. https://doi.org/10.1016/j.jshs.2012.09.003

Hsiao, H.-S., & Chen, J.-C. (2016). Using a gesture interactive game-based learning approach to improve preschool children's learning performance and motor skills. *Computers & Education*, *95*, 151–162. https://doi.org/10.1016/j.compedu.2016.01.005

Hsieh, H. C. (2008). Effects of ordinary and adaptive toys on pre-school children with developmental disabilities. *Research in Developmental Disabilities*, *29*(5), 459–466. https://doi.org/10.1016/j.ridd.2007.08.004

Hu, J., Li, L., Li, X., Zhang, C., Liu, W., & Fu, Z. (2016). BabyTalk: Interactive Design of Intelligent Toys for Pre-school Children in China. In *Proceedings of the Fourth International Symposium on Chinese CHI - ChineseCHI2016* (pp. 1–9). New York, New York, USA: ACM Press. https://doi.org/10.1145/2948708.2948716

Hughes, B. (1996). *A Playworker's Taxonomy of Play Types*. London: Playlink.

Hughes, F. P. (2010). *Children, play, and development*. Thousand Oaks, CA: SAGE.

Huizinga, J. (1949). *Homo ludens: A study of the play-element in our culture*. Routledge & Kegan Paul. Retrieved from http://art.yale.edu/file_columns/0000/1474/homo_ludens_johan_huizinga_routledge_1949_.pdf

Hung, C.-Y., Sun, J. C.-Y., & Yu, P.-T. (2015). The benefits of a challenge: student motivation and flow experience in tablet-PC-game-based learning. *Interactive Learning Environments*, *23*(2), 172–190. https://doi.org/10.1080/10494820.2014.997248

Ibrahim, R., & Jaafar, A. (2009). Educational games (EG) design framework: Combination of game design, pedagogy and content modeling. *Proceedings of the 2009 International Conference on Electrical Engineering and Informatics, ICEEI 2009*, *1*(April 2015), 293–298. https://doi.org/10.1109/ICEEI.2009.5254771

Ioannidi, D., Zidianakis, E., Antona, M., & Stephanidis, C. (2016). Designing Games for Children with developmental disabilities in Ambient Intelligence Environments. *International Journal of Child-Computer Interaction*. https://doi.org/10.1016/j.ijcci.2016.10.008

Jenvey, V. B., & Jenvey, H. L. (2002). Criteria used to categorise children‟s play: preliminary findings. *Social Behaviour and Personality*, *30*(8), 733–740.

Jester, M., & Johnson, C. J. (2016). Differences in Theory of Mind and Pretend Play Associations in Children with and Without Specific Language Impairment. *Infant and Child Development*, *25*(1), 24–42. https://doi.org/10.1002/icd.1912

Johansson, S. (2009). Sniff: Designing Characterful Interaction in a Tangible Toy. In *Proceedings of the 8th International Conference on Interaction Design and Children* (pp. 186–189). https://doi.org/10.1145/1551788.1551824

John, A. (2012). Stress among Mothers of Children with Intellectual Disabilities in Urban India: Role of Gender and Maternal Coping. *Journal of Applied Research in Intellectual Disabilities*, *25*(4), 372–382. https://doi.org/10.1111/j.1468-3148.2011.00672.x

Johry, A., & Patil, K. (2011). *Play and body image of special children: A design intervention*. Indian Institute of Technology Kanpur.

Johry, A., & Poovaiah, R. (2014). Paradigms of play in a special school setting in India. In *19th IPA Triennial World Conference*. Istanbul: International Play Association.

Johry, A., & Poovaiah, R. (2015). Competitive Play in Children with Intellectual Disability: Informing Design. In *Smart Innovation, Systems and Technologies* (Vol. 34, pp. 399–409). https://doi.org/10.1007/978-81-322-2232-3_35

Jones, R. A., Downing, K., Rinehart, N. J., Barnett, L. M., May, T., McGillivray, J. A., … Hinkley, T. (2017). Physical activity, sedentary behavior and their correlates in children with Autism Spectrum Disorder: A systematic review. *PLOS ONE*, *12*(2), e0172482. https://doi.org/10.1371/journal.pone.0172482

Kapur, M. (2014). Productive failure in learning math. *Cognitive Science*, *38*(5), 1008–1022. https://doi.org/10.1111/cogs.12107

Karimi, A., & Lim, Y. P. (2010). Children, engagement and enjoyment in digital narrative. *ASCILITE 2010 - The Australasian Society for Computers in Learning in Tertiary Education*, (2001), 475–483. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84870734315&partnerID=40&md5=5ffbf45449733fbf1dce396462fc3b75

Karsten, L. (2003). Children's Use of Public Space: The Gendered World of the Playground. *Childhood*, *10*(4), 457–473. https://doi.org/10.1177/0907568203104005

Ke, F. (2016). Designing and integrating purposeful learning in game play: a systematic review. *Educational Technology Research and Development*, *64*(2), 219–244. https://doi.org/10.1007/s11423-015-9418-1

Ke, F., & Abras, T. (2013). Games for engaged learning of middle school children with special learning needs. *British Journal of Educational Technology*, *44*(2), 225–242. https://doi.org/10.1111/j.1467-8535.2012.01326.x

Kemp, C., Kishida, Y., Carter, M., & Sweller, N. (2013). The effect of activity type on the engagement and interaction of young children with disabilities in inclusive childcare settings. *Early Childhood Research Quarterly*, *28*(1), 134–143. https://doi.org/10.1016/j.ecresq.2012.03.003

Khoshali, A. K., & Venkatesan, S. (2007). Play behaviors in children with mental retardation. *PSYCHOLOGICAL STUDIES-UNIVERSITY OF CALICUT*, *52*(1), 90–94.

Kiliç, E. (2007). *Effects of the Design of Toys onthe Child-Toy Interaction in Special Education*. Middle East Technical University.

King, G., Lawm, M., King, S., Rosenbaum, P., Kertoy, M. K., & Young, N. L. (2003). A Conceptual Model of the Factors Affecting the Recreation and Leisure Participation of Children with Disabilities. *Physical & Occupational Therapy In Pediatrics*, *23*(1), 63–90. https://doi.org/10.1080/J006v23n01_05

Kirk, S., Gallagher, J. J., Coleman, M. R., & Anastasiow, N. J. (2011). *Educating exceptional children*. Cengage Learning.

Knight, G. P., Berning, A. L., Wilson, S. L., & Chao, C. C. (1987). The effects of information-processing demands and social-situational factors on the social decision making of children. *Journal of Experimental Child Psychology*, *43*(2), 244–259. https://doi.org/10.1016/0022-0965(87)90062-2

Koster, R. (2005). A grammar of gameplay. In *Game Developers Conference, 2005.* San Francisco. Retrieved from http://www.theoryoffun.com/grammar/gdc2005.htm

Krakow, J. B., & Kopp, C. B. (1983). The Effects of Developmental Delay on Sustained Attention in Young Children. *Child Development*, *54*(5), 1143–1155.

Kreimeier, B. B. (2002). The Case For Game Design Patterns. Retrieved February 4, 2017, from http://www.gamasutra.com/view/feature/132649/the_case_for_game_design_patterns.php

Kubicki, S., Wolff, M., Lepreux, S., & Kolski, C. (2015). RFID interactive tabletop application with tangible objects: exploratory study to observe young children??? behaviors. *Personal and Ubiquitous Computing*, *19*(8), 1259–1274. https://doi.org/10.1007/s00779-015-0891-7

Kudrowitz, B. M., & Wallace, D. R. (2010). The play pyramid: a play classification and ideation tool for toy design. *International Journal of Arts and Technology*, *3*(1), 36–56. https://doi.org/10.1504/IJART.2010.030492

Langdon, P., Lewis, T., & Clarkson, J. (2007). The effects of prior experience on the use of consumer products. *Universal Access in the Information Society*, *6*(2), 179–191. https://doi.org/10.1007/s10209-007-0082-z

Larsson, P., Västfjäll, D., Kleiner, M., Vastfjall, D., & Kleiner, M. (2001). Ecological acoustics and the multi-modal perception of rooms: Real and unreal experiences of auditory-visual virtual environments. *International Conference on Auditory Display*, 245–249. Retrieved from https://smartech.gatech.edu/handle/1853/50616%5Cnhttp://www.icad.org/Proceedings/2001/LarssonVaestfjaell2001.pdf

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, MA: Cambridge university press.

Lazarus, M. (1883). *Über die reize des spiels*. F. Dümmler.

Lazzaro, N. (2004). Why We Play Games: Four Keys to More Emotion Without Story. *Game Developer Conference (GDC)*, 1–8. https://doi.org/10.1111/j.1464-410X.2004.04896.x

Lazzaro, N., & Keeker, K. (2004). What's my method?: a game show on games. *CHI'04 Extended Abstracts on Human Factors in Computing Systems*, 1093–1094. https://doi.org/10.1145/985921.985922

Lester, S., & Russell, W. (2010). *Children's right to play*. *Early Childhood Development* (Vol. 57). https://doi.org/10.4135/9781473907850.n25

Lieber, J., & Beckman, P. J. (1991). The role of toys in individual and dyadic play among young children with handicaps. *Journal of Applied Developmental Psychology*, *12*(2), 189–203. https://doi.org/10.1016/0193-3973(91)90011-R

Lieberman, D. a., Bates, C. H., & So, J. (2009). Young Children's Learning With Digital Media. *Computers in the Schools*, *26*(4), 271–283. https://doi.org/10.1080/07380560903360194

Lieberman, J. N. (1965). Playfulness and Divergent Thinking: An Investigation of their Relationship at the Kindergarten Level. *The Journal of Genetic Psychology*, *107*(2), 219–224. https://doi.org/10.1080/00221325.1965.10533661

Lin, Y. W., & Bratton, S. C. (2015). A Meta-analytic Review of Child Centered Play Therapy Approaches. *Journal of Counseling & Development*, *93*(1), 45–58.

Lindon, J. (2001). *Understanding children's play*. Cheltenham: Nelson Thornes.

Literat, I. (2013). "A Pencil for your Thoughts": Participatory Drawing as a Visual Research Method with Children and Youth. *International Journal of Qualitative Methods*, *12*(1), 84–98. https://doi.org/10.1177/160940691301200143

Lloyd, M. (2016). Physical Activity of Individuals with Intellectual Disabilities: Challenges and Future Directions. *Current Developmental Disorders Reports*, (April), 91–93. https://doi.org/10.1007/s40474-016-0079-5

Lorch, E. P., & Castle, V. J. (1997). Preschool children's attention to television: Visual attention and probe response times. *Journal of Experimental Child Psychology*, *66*, 111–127. https://doi.org/10.1006/jecp.1997.2372

Lu, A. S., Baranowski, T., Hong, S. L., Buday, R., Thompson, D., Beltran, A., … Chen, T.-A. (2016). The Narrative Impact of Active Video Games on Physical Activity Among Children: A Feasibility Study. *Journal of Medical Internet Research*, *18*(10), e272. https://doi.org/10.2196/jmir.6538

Luiselli, J. K., Matson, J. L., & Singh, N. N. (1992). *Self-Injurious Behavior: Analysis, Assessment and Treatment.* New York: Springer-Verlag.

Luttropp, A., & Granlund, M. (2010). Interaction – it depends – a comparative study of interaction in preschools between children with intellectual disability and children with typical development. *Scandinavian Journal of Disability Research*, *12*(February 2015), 151–164. https://doi.org/10.1080/15017410903175677

Malone, D. M. (2006a). Contextually influenced patterns of play-developmental age associations for preschoolers with and without mental retardation. *Early Childhood Education Journal*, *34*(3), 215–225. https://doi.org/10.1007/s10643-006-0134-7

Malone, D. M. (2006b). Differential Expression of Toy Play by Preschoolers With and Without Mental Retardation. *Journal of Research in Childhood Education*, *21*(2), 117–131. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/02568540609594583

Malone, D. M. (2009). Patterns of home- and classroom-based toy play of preschoolers with and without intellectual disabilities. *International Journal of Disability, Development and Education*, *56*(4), 333–347. https://doi.org/http://dx.doi.org/10.1080/10349120903306558

Malone, D. M., & Stoneman, Z. (1990). Cognitive play of mentally retarded preschoolers: Observations in the home and school. *American Journal on Mental Retardation*. US: American Assn on Mental Retardation.

Malone, K. (2013). "The future lies in our hands": children as researchers and environmental change agents in designing a child-friendly neighbourhood. *Local Environment*, *18*(3), 372–395. https://doi.org/10.1080/13549839.2012.719020

Marco, J., Cerezo, E., & Baldassarri, S. (2013). Bringing tabletop technology to all: Evaluating a tangible farm game with kindergarten and special needs children. *Personal and Ubiquitous Computing*, *17*(8), 1577–1591. https://doi.org/10.1007/s00779-012-0522-5

Maria Roussou. (2004). Learning by Doing and Learning Through Play:An Exploration of Interactivity in Virtual Environment for Children. *Procedia - Social and Behavioral Sciences*, *2*(1), 1–17. https://doi.org/10.1016/j.sbspro.2010.12.027

Martin, P., & Caro, T. M. (1985). On the Functions of Play and Its Role in Behavioral Development. *Advances in the Study of Behavior*, *15*, 59–103. https://doi.org/http://dx.doi.org/10.1016/S0065-3454(08)60487-8

Matson, J. L., & Boisjoli, J. A. (2009). The token economy for children with intellectual disability and/or autism: A review. *Research in Developmental Disabilities*, *30*(2), 240–248. https://doi.org/10.1016/j.ridd.2008.04.001

McCabe, J. R., Jenkins, J. R., Mills, P. E., Dale, P. S., & Cole, K. N. (1999). Effects of Group Composition, Materials, and Developmental Level on Play in Preschool Children With Disabilities. *Journal of Early Intervention*, *22*(2), 164–178. https://doi.org/10.1177/105381519902200208

Mccarthy, B., Tiu, M., & Li, L. (2014). *Learning Math with Curious George : PBS KIDS Transmedia and Digital Learning Games in the Preschool Classroom*. Retrieved from https://www.wested.org/wp-content/files_mf/1456767519resourcelearningmathwithcuriousgeorge.pdf

McQuiggan, S. W., Rowe, J. P., Lee, S., & Lester, J. C. (2008). Story-based learning: The impact of narrative on learning experiences and outcomes. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *5091 LNCS*, 530–539. https://doi.org/10.1007/978-3-540-69132-7-56

McWilliam, R. A., & Bailey, D. B. (1995). Effects of Classroom Social Structure and Disability on Engagement. *Topics in Early Childhood Special Education*, *15*(2), 123–147. https://doi.org/10.1177/027112149501500201

Mead, G. H. (1934). *Mind, Self, and Society*. Chicago: University of Chicago Press.

Meire, J. (2007). Qualitative research on children's play. In J. Jambor, T., Van Gils (Ed.), *Several Perspectives on Children Play: Scientific Reflections for Pratictioners.* Garant Uitgevers, Apeldoorn, NL.

Mellou, E. (1994). Play Theories: A contemporary review. *Early Child Development and Care*, *102*(1), 91–100. https://doi.org/10.1080/0300443941020107

Memisevic, H. (2015). Self-Regulation in Children with Intellectual Disability. *Journal of Special Education and Rehabilitation*, *16*(3–4), 71–83. https://doi.org/10.1515/jser-2015-0012

Messier, J., Ferland, F., & Majnemer, A. (2008). Play behavior of school age children with intellectual disability: Their capacities, interests and attitude. *Journal of Developmental and Physical Disabilities*, *20*(2), 193–207. https://doi.org/10.1007/s10882-007-9089-x

Miller-Day, M., & Hecht, M. L. (2013). Narrative Means to Preventative Ends: A Narrative Engagement Framework for Designing Prevention Interventions. *Health Communication*, *28*(7), 657–670. https://doi.org/10.1080/10410236.2012.762861

Mills, P. E., Beecher, C. C., Dale, P. S., Cole, K. N., & Jenkins, J. R. (2014). Language of Children with Disabilities to Peers at Play: Impact of Ecology. *Journal of Early Intervention*, *36*(2), 111–130. https://doi.org/http://dx.doi.org/10.1177/1053815114561518

Moore, G. T. (1985). The designed environment and cognitive development : A brief review of five domains of research. *Children's Environments Quarterly*, *2*(2), 26–33. Retrieved from http://www.jstor.org/stable/41525033

Morelock, M. J., Brown, P. M., & Morrissey, A. (2003). Pretend play and maternal scaffolding: Comparisons of toddlers with advanced development, typical development, and hearing impairment. *Roeper Review*, *26*(1), 41–51. https://doi.org/10.1080/02783190309554238

Morgan, D. L. (2007). Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research*, *1*(1), 48–76. https://doi.org/10.1177/2345678906292462

Morgan, G. A., Harmon, R. J., & Maslin-Cole, C. A. (1990). Mastery motivation: Definition and measurement. *Early Education and Development*, *1*(5), 318–339.

Murphy, G., Carr, J., & Callias, M. (1986). Increasing simple toy play in profoundly mentally handicapped children: II. Designing special toys. *Journal of Autism and Developmental Disorders*, *16*(1), 45–58. https://doi.org/10.1007/BF01531577

Nacher, V., Garcia-Sanjuan, F., & Jaen, J. (2016). Interactive technologies for preschool game-based instruction: Experiences and future challenges. *Entertainment Computing*, *17*, 19–29. https://doi.org/10.1016/j.entcom.2016.07.001

Neitzel, J., & Wolery, M. (2009a). *Steps for implementation: Least-to-most prompts*. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorders, Frank Porter Graham Child Development Institute, The University of North Carolina.

Neitzel, J., & Wolery, M. (2009b). *Steps for Implementation: Time Delay*. Chapel Hill, NC: National Professional Development Center on Autism Spectrum Disorders, Frank Porter Graham Child Development Institute, The University of North Carolina.

Ng, K., & Hase, S. (2008). Grounded suggestions for doing a grounded theory business research. *Electronic Journal of Business Research Methods*, *6*(2), 155–170. https://doi.org/1477-7029

Niccols, A., Atkinson, L., & Pepler, D. (2003). Mastery motivation in young children with Down's syndrome: relations with cognitive and adaptive competence. *Journal of Intellectual Disability Research*, *47*(2), 121–133. https://doi.org/10.1046/j.1365-2788.2003.00452.x

Norman, D. A. (1999). Affordance, conventions, and design. *Interactions*, *6*, 38–42. https://doi.org/10.1145/301153.301168

Norman, D. A. (2002). *The Design of Everyday Things.* New York: Basic books.

O'Brien, H. L., & Toms, E. G. (2008). What is user enagement? A Conceptual Framework for defining user engagement with technology. *Journal of the American Society for Information Science and Technology*, *59*(6), 938–955. https://doi.org/10.1002/asi.20801.1

Okimoto, A. M., Bundy, A., & Hanzlik, J. (2000). Playfulness in children with and without disability: Measurement and intervention. *American Journal of Occupational Therapy*, *54*(1), 73–82. https://doi.org/10.5014/ajot.54.1.73

Padilla-Zea, N., Gutiérrez, F. L., López-Arcos, J. R., Abad-Arranz, A., & Paderewski, P. (2014). Modeling storytelling to be used in educational video games. *Computers in Human Behavior*, *31*(1), 461–474. https://doi.org/10.1016/j.chb.2013.04.020

Pahl, G., Beitz, W., Feldhusen, J., & Grote, K.-H. (2007). *Engineering Design*. London: Springer London. https://doi.org/10.1007/978-1-84628-319-2

Palmer, S. B., Summers, J. A., Brotherson, M. J., Erwin, E. J., Maude, S. P., Stroup-Rentier, V., … Haines, S. J. (2012). Foundations for Self-Determination in Early Childhood: An Inclusive Model for Children With Disabilities. *Topics in Early Childhood Special Education*, *33*(1), 38–47. https://doi.org/10.1177/0271121412445288

Papacek, A. M., Chai, Z., & Green, K. B. (2015). Play and Social Interaction Strategies for Young Children With Autism Spectrum Disorder in Inclusive Preschool Settings. *Young Exceptional Children*, 1–15. https://doi.org/10.1177/1096250615576802

Parasuram, K. (2006). Variables that affect teachers' attitudes towards disability and inclusive education in Mumbai, India. *Disability & Society*, *21*(3), 231–242. https://doi.org/10.1080/09687590600617352

Parry, J. (2015). Exploring the social connections in preschool settings between children labelled with special educational needs and their peers. *International Journal of Early Years Education*, *23*(4), 352–364. https://doi.org/10.1080/09669760.2015.1046158

Parten, M. B. (1933). Social play among preschool children. *The Journal of Abnormal and Social Psychology*, *28*(2), 136.

Patrizia, M., Claudio, M., Leonardo, G., & Alessandro, P. (2009). A robotic toy for children with special needs: From requirements to design. In *2009 IEEE 11th International Conference on Rehabilitation Robotics* (pp. 918–923). Kyoto, Japan: IEEE.

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, *18*(4), 315–341. https://doi.org/10.1007/s10648-006-9029-9

Pellegrini, A. D., & Smith, P. K. (1998). Physical activity play: The nature and function of a neglected aspect of play. *Child Development*, *69*(3), 577–598. Retrieved from http://www.jstor.org/stable/pdf/1132187.pdf

Pesce, C. (2012). Shifting the focus from quantitative to qualitative exercise characteristics in exercise and cognition research. *Journal of Sport & Exercise Psychology*, *34*(6), 766–86. https://doi.org/10.1016/j.mhpa.2009.02.001

Pesce, C., Crova, C., Marchetti, R., Struzzolino, I., Masci, I., Vannozzi, G., & Forte, R. (2013). Searching for cognitively optimal challenge point in physical activity for children with typical and atypical motor development. *Mental Health and Physical Activity*, *6*(3), 172–180. https://doi.org/10.1016/j.mhpa.2013.07.001

Piaget, J. (1962). *Play, dreams and imitation in childhood.* New York: Norton.

Pijl, S. J., & Frostad, P. (2010). Peer acceptance and self-concept of students with disabilities in regular education. *European Journal of Special Needs Education*, *25*(1), 93–105. https://doi.org/10.1080/08856250903450947

Plomin, R. E., DeFries, J. C., Craig, I. W., & McGuffin, P. E. (2003). *Behavioral genetics in the postgenomic era.* American Psychological Association.

Prazak, B., Kronreif, G., Hochgatterer, A., & Fürst, M. (2004). A Toy Robot for Physically Disabled Children. *Technology and Disability*, *16*(3), 131–136.

Prellwitz, M., & Skär, L. (2016). Are Playgrounds a Case of Occupational Injustice? Experiences of Parents of Children with Disabilities. *Children, Youth and Environments*, *26*(2), 28–42. https://doi.org/10.7721/chilyoutenvi.26.2.0028

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment*, *1*(1), 21. https://doi.org/10.1145/950566.950596

Prensky, M. (2006). *Don't bother me, Mom, I'm learning!: How computer and video games are preparing your kids for 21st century success and how you can help!* St. Paul, MN: Paragon house.

Price, S., & Rogers, Y. (2004). Let's get physical: The learning benefits of interacting in digitally augmented physical spaces. *Computers and Education*, *43*(1–2 SPEC ISS.), 137–151. https://doi.org/10.1016/j.compedu.2003.12.009

Prince, G. (1982). *Narratology: The form and functioning of narrative* (Vol. 108). Walter de Gruyter.

Prince, G. (1996). Remarks on narrativity. *Perspectives on Narratology*, 95–106.

Prochner, L. (2002). Preschool and Playway in India. *Childhood*, *9*(4), 435–453. https://doi.org/10.1177/0907568202009004005

Pykhtina, O., Balaam, M., Wood, G., Pattison, S., Kharrufa, A., & Olivier, P. (2012). Magic Land: The Design and Evaluation of an Interactive Tabletop Supporting Therapeutic Play with Children. In *Proceedings of the Designing Interactive Systems Conference* (pp. 136–145). New York, NY, USA: ACM. https://doi.org/10.1145/2317956.2317978

Rasberry, C. N., Lee, S. M., Robin, L., Laris, B. A., Russell, L. A., Coyle, K. K., & Nihiser, A. J. (2011). The association between school-based physical activity, including physical education, and academic performance: A systematic review of the literature. *Preventive Medicine*, *52*, S10–S20. https://doi.org/10.1016/j.ypmed.2011.01.027

Reid, D. H., DiCarlo, C. F., Schepis, M. M., Hawkins, J., & Stricklin, S. B. (2003). Observational Assessment of Toy Preferences Among Young Children With Disabilities in Inclusive Settings : Efficiency Analysis and Comparison With Staff Opinion. *Behavior Modification*, *27*(2), 233–250. https://doi.org/10.1177/0145445503251588

Resnick, I., Verdine, B. N., Golinkoff, R., & Hirsh-Pasek, K. (2016). Geometric toys in the attic? A corpus analysis of early exposure to geometric shapes. *Early Childhood Research Quarterly*, *36*(September), 358–365. https://doi.org/10.1016/j.ecresq.2016.01.007

Richard, B. O. (2014). Families, well-being, and inclusion: Rethinking priorities for children with cognitive disabilities in Ladakh, India. *Childhood-a Global Journal of Child Research*, *21*(3, SI), 308–323. https://doi.org/10.1177/0907568214526264

Rogers, C. S., Impara, J. C., Frary, R. B., Harris, T., Meeks, A., Semanic-Lauth, S., & Reynolds, M. (1998). Measuring playfulness: Development of the child behaviors inventory of playfulness. *Play and Culture*, *4*, 121–135.

Rohrmann, B., & Bishop, I. (2002). Subjective Responses To Computer Simulations of Urban Environments. *Journal of Environmental Psychology*, *22*(4), 319–331. https://doi.org/10.1006/jevp.2001.0206

Rolandelli, D. R., Wright, J. C., Huston, A. C., & Eakins, D. (1991). Children's auditory and visual processing of narrated and nonnarrated television programming. *Journal of Experimental Child Psychology*, *51*(1), 90–122. https://doi.org/10.1016/0022-0965(91)90078-7

Rovniak, L. S., Hovell, M. F., Wojcik, J. R., Winett, R. A., & Martinez-Donate, A. P. (2005). Enhancing theoretical fidelity: An e-mail-based walking program demonstration. *American Journal of Health Promotion*, *20*(2), 85–95. https://doi.org/10.4278/0890-1171-20.2.85

Rowe, J. P., McQuiggan, S. W., & Lester, J. C. (2007). Narrative Presence in Intelligent Learning Environments. *Proceedings of the AAAI Fall Symposium on Intelligent Narrative Technologies*, *1*, 126–133.

Rowe, J. P., Shores, L. R., Mott, B. W., & Lester, J. C. (2011). Integrating learning, problem solving, and engagement in narrative-centered learning environments. *International Journal of Artificial Intelligence in Education*, *21*(1–2), 115–133. https://doi.org/10.3233/JAI-2011-019

Rubin, K. H., Bowker, J. C., McDonald, K. L., & Menzer, M. (2013). *Peer Relationships in Childhood*. (P. D. Zelazo, Ed.), *Social and personality development: An advanced textbook.* (Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199958474.013.0011

Rubin, K. H., Fein, G. G., & Vandenberg, B. (1983). Play. In P. H. Mussen (Ed.), *Handbook of Child Psychology* (4th ed., pp. 695–774). New York: John Wiley and Sons.

Rudy, D., & Grusec, J. E. (2006). Authoritarian parenting in individualist and collectivist groups: Associations with maternal emotion and cognition and children's self-esteem. *Journal of Family Psychology*, *20*(1), 68–78. https://doi.org/10.1037/0893-3200.20.1.68

Ruef, M., Poston, D., & Humphrey, K. (2004). *PBS: Putting the "positive" into behavioral support: An introductory training packet* (2nd ed.). Lawrence: Beach Center on Disability, University of Kansas.

Ruffino, A. G., Mistrett, S. G., Tomita, M., & Hajare, P. (2006). The Universal Design for Play Tool : Establishing Validity and Reliability. *Journal of Special Education Technology*, *21*(4), 21–38.

Ryan, R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.

Salivia, G., Hall, W., & Hourcade, J. P. (2013). PointAssist : Assisting Individuals with Motor Impairments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1213–1222). https://doi.org/10.1145/2470654.2466157

Sameroff, A. (2010). A Unified Theory of Development : A Dialectic Integration of Nature and Nurture. *Child Development*, *81*(1), 6–22. Retrieved from http://www.jstor.org/stable/40598962

Sanderson, R. C. (2010). *Towards a New Measure of Playfulness: The Capacity to Fully and Freely Engage in Play*. Loyola University Chicago. Retrieved from http://ecommons.luc.edu/cgi/viewcontent.cgi?article=1231&context=luc_diss

Saracho, O. N. (1995). Preschool children's cognitive style and their selection of academic areas in their play. *Early Child Development and Care*, *112*(1), 27–42. https://doi.org/10.1080/0300443951120103

Saracho, O. N., & Spodek, B. (1995). CHILDREN'S PLAY AND EARLY CHILDHOOD EDUCATION: INSIGHTS FROM HISTORY AND THEORY. *The Journal of Education*, *177*(3), 129–148. Retrieved from http://www.jstor.org/stable/42742374

Schiller, F. (1875). *Essays Aesthetical and Philosophical*. London: George Bell & Sons.

Schneider, E. F., Lang, A., Shin, M., & Bradley, S. D. (2004). Death with a Story. *Human Communication Research*, *30*(3), 361–375. https://doi.org/10.1111/j.1468-2958.2004.tb00736.x

Sigafoos, J., Roberts-Pennell, D., & Graves, D. (1999). Longitudinal assessment of play and adaptive behavior in young children with developmental disabilities. *Research in Developmental Disabilities*, *20*(2), 147–161. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed4&NEWS=N&AN=1999118409%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=10198944

Simonsen, J., Svabo, C., Strandvad, S. M., Samson, K., Hertzum, M., & Hansen, O. E. (2014). *Situated Design Methods*. *Situated Design Methods*. The MIT Press.

Simpson, C. G., & Lynch, S. A. (2003). Adapting and Modifying Toys for Children with Special Needs. Retrieved from http://0-search.ebscohost.com.brum.beds.ac.uk/login.aspx?direct=true&db=eric&AN=ED481092&site=eds-live&scope=site

Singal, N. (2006). Inclusive education in India: International concept, national interpretation. *International Journal of Disability, Development and Education*, *53*(3), 351–369. https://doi.org/10.1080/10349120600847797

Singer, E., Nederend, M., Penninx, L., Tajik, M., & Boom, J. (2014). The teacher's role in supporting young children's level of play engagement. *Early Child Development and Care*, *184*(8), 1233–1249. https://doi.org/10.1080/03004430.2013.862530

Smiley, P. A., Tan, S. J., Goldstein, A., & Sweda, J. (2016). Mother Emotion, Child Temperament, and Young Children's Helpless Responses to Failure. *Social Development*, *25*(2), 285–303.

https://doi.org/10.1111/sode.12153

Smith, P. K., & Vollstedt, R. (1985). On Defining Play: An Empirical Study of the Relationship between Play and Various Play Criteria. *Child Development*, *56*(4), 1042–1050. https://doi.org/10.2307/1130114

Sobel, K., O'Leary, K., & Kientz, J. a. (2015). Maximizing Children's Opportunities with Inclusive Play: Considerations for Interactive Technology Design. *Proceedings of the 14th International Conference on Interaction Design and Children,* 39–48. https://doi.org/10.1145/2771839.2771844

Soltani, S. H. K., Abbas, M. Y., & Awang, M. Bin. (2012). Disabled Children in Public Playgrounds : A Pilot Study. *Procedia - Social and Behavioral Sciences*, *36*, 670–676. https://doi.org/10.1016/j.sbspro.2012.03.073

Sparks, S. L. (2013). *Increasing choice-making and choice awareness for students with intellectual disability*. University of Nevada, Las Vegas. Retrieved from http://search.proquest.com/docview/1466666480?accountid=26642%5Cnhttp://link.periodicos.capes.gov.br/sfxlcl41?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+%26+theses&sid=ProQ:ProQuest+Dissertations+%26+Theses+Globa

Stagnitti, K. (2007). *Child-Initiated Pretend Play Assessment*. Melbourne, Australia: Co-ordinates Therapy Publications.

Sterman, J., Naughton, G., Froude, E., Villeneuve, M., Beetham, K., Wyver, S., & Bundy, A. (2016). Outdoor Play Decisions by Caregivers of Children with Disabilities: a Systematic Review of Qualitative Studies. *Journal of Developmental and Physical Disabilities*, *28*(6), 931–957. https://doi.org/10.1007/s10882-016-9517-x

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research* (Vol. 15). Newbury Park, CA: SAGE Publications.

Strauss, K., Esposito, M., Polidori, G., Vicari, S., Valeri, G., & Fava, L. (2014). Facilitating play , peer engagement and social functioning in a peer group of young autistic children : Comparing highly structured and more flexible behavioral approaches. *Research in Autism Spectrum Disorders*, *8*(4), 413–423. https://doi.org/10.1016/j.rasd.2014.01.002

Suh, N. (2001). *Axiomatic Design: Advances and Applications (The Oxford Series on Advanced Manufacturing)*. Oxford University Press, USA. Retrieved from citeulike-article-id:225343

Sun, H., & Gao, Y. (2016). Impact of an active educational video game on children's motivation, science knowledge, and physical activity. *Journal of Sport and Health Science*, *5*(2), 239–245. https://doi.org/10.1016/j.jshs.2014.12.004

Sutton-Smith, B. (1986). *Toys as Culture.* New York: Gardner Press.

Sutton-Smith, B. (1997). *The ambiguity of play*. Cambridge, Mass.: Harvard University Press.

Sweetser, P., & Wyeth, P. (2005). GameFlow: A Model for Evaluating Player Enjoyment in Games. *Computers in Entertainment (CIE)*, *3*(3), 3–3. https://doi.org/10.1145/1077246.1077253

Tam, V., Gelsomini, M., & Garzotto, F. (2017). Polipo. In *Proceedings of the Tenth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '17* (pp. 11–20). https://doi.org/10.1145/3024969.3025006

Temple, V. A., Crane, J. R., Brown, A., Williams, B.-L., & Bell, R. I. (2016). Recreational activities and motor skills of children in kindergarten. *Physical Education & Sport Pedagogy*, *21*(3), 268–280. https://doi.org/10.1080/17408989.2014.924494

Thompson, K. (1999). *Storytelling in the new Hollywood.* Cambridge, MA: Harvard University Press.

Toda, M., Shinotsuka, H., McClintock, C. G., & Stech, F. J. (1978). Development of competitive behavior as a function of culture, age, and social comparison. *Journal of Personality and Social Psychology*, *36*(8), 825–839. https://doi.org/10.1037/0022-3514.36.8.825

Tomkins, C. C. (2006). An introduction to non-parametric statistics for health scientists. *Universiti of Alberta HEalth Sciences Journal*, *3*(1), 20–26. https://doi.org/10.1039/c3ay90070c

Tomporowski, P. D., Lambourne, K., & Okumura, M. S. (2011). Physical activity interventions and children's mental function: An introduction and overview. *Preventive Medicine*, *52*, S3–S9. https://doi.org/10.1016/j.ypmed.2011.01.028

Trawick-Smith, J., Wolff, J., Koschel, M., & Vallarelli, J. (2014). Effects of Toys on the Play Quality of Preschool Children: Influence of Gender, Ethnicity, and Socioeconomic Status. *Early Childhood Education Journal*, *43*(4), 249–256. https://doi.org/10.1007/s10643-014-0644-7

Troseth, G. L., Russo, C. E., & Strouse, G. A. (2016). Journal of Children and Media What's next for research on young children's interactive media? What's next for research on young children's interactive media? *Journal of Children and Media*, *10*(1), 54–62. https://doi.org/10.1080/17482798.2015.1123166

Turnbull, J., & Jenvey, V. B. (2006). Criteria used by adults and children to categorize subtypes of play. *Early Child Development and Care*, *176*(5), 539–551. https://doi.org/10.1080/03004430500258172

Unesco Instıtute for Statistics. (2005). *Children out of school: Measuring Exclusion from Primary Education*. Retrieved from http://www.uis.unesco.org/Library/Documents/oosc05-en.pdf

Van Eck, R. (2006). Digital Game-Based Learning : It â€™ s Not Just the Digital Natives Who Are Restless …. *Educause Review*, *41*(2), 1–16. https://doi.org/10.1145/950566.950596

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. *Advances in Motivation and Achievement*, *16 PARTA*, 105–165. https://doi.org/10.1108/S0749-7423(2010)000016A007

Vaughn, J., & Diserens, C. M. (1938). The Experimental Psychology of Competition. *The Journal of Experimental Education*, *7*(1), 76–97. https://doi.org/10.1080/00220973.1938.11010120

Venkatesan, S. (2000). Play activities in children with mental retardation. *Indian Journal of Clinical Psychology*, *27*(1), 124–128.

Verdine, B. N., Lucca, K. R., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2016). The Shape of Things: The Origin of Young Children's Knowledge of the Names and Properties of Geometric Forms. *Journal of Cognition and Development*, *17*(1), 142–161. https://doi.org/10.1080/15248372.2015.1016610

Vriens-van Hoogdalem, A.-G., de Haan, D. M. P., & Boom, J. (2016). The role of language ability in young children's cooperation during play and collaborative interactions. *Early Child Development and Care*, *186*(9), 1491–1504. https://doi.org/10.1080/03004430.2015.1108312

Vygotsky, L. S. (1967). Play and its Role in the Mental Development of the Child. *Soviet Psychology*, *5*(3), 6–18.

Waldman-Levi, A., & Bundy, A. (2016). A Glimpse into Co-Occupations: Parent/Caregiver's Support of Young Children's Playfulness Scale. *Occupational Therapy in Mental Health*, *32*(3), 217–227. https://doi.org/10.1080/0164212X.2015.1116420

Waldman-Levi, A., & Erez, A. B.-H. (2015). Will Environmental Interventions Affect the Level of Mastery Motivation among Children with Disabilities? A Preliminary Study. *Occupational Therapy International*, *22*(1), 19–27. https://doi.org/10.1002/oti.1380

Watts, C. M., Moyer-Packenham, P. S., Tucker, S. I., Bullock, E. P., Shumway, J. F., Westenskow, A., … Jordan, K. (2016). An examination of children's learning progression shifts while using touch screen virtual manipulative mathematics apps. *Computers in Human Behavior*, *64*, 814–828. https://doi.org/10.1016/j.chb.2016.07.029

Weber, R., Behr, K.-M., & DeMartino, C. (2014). Measuring Interactivity in Video Games. *Communication*

Methods and Measures, *8*(2), 79–115. https://doi.org/10.1080/19312458.2013.873778

Wehmeyer, M. L., Sands, D. J., Doll, B., & Palmer, S. (1997). The Development of Self Determination and Implications for Educational Interventions with Students with Disabilities. *International Journal of Disability, Development and Education*, *44*(4), 305–328. https://doi.org/10.1080/0156655970440403

Wehmeyer, M. L., Smith, S. J., Palmer, S. B., & Davies, D. K. (2004). Technology use by students with intellectual disabilities: An overview. *Journal of Special Education Technology*, *19*(4), 7–21. https://doi.org/10.1177/016264340401900405

Wilde, L., Mitchell, A., & Oliver, C. (2016). Differences in Social Motivation in Children with Smith???Magenis Syndrome and Down Syndrome. *Journal of Autism and Developmental Disorders*, *46*(6), 2148–2159. https://doi.org/10.1007/s10803-016-2743-3

Wolf, W. (2003). Narrative and narrativity: a narratological reconceptualization and its applicability to the visual arts. *Word & Image: A Journal of Verbal/Visual Enquiry*, *19*(3), 180–197. https://doi.org/10.1080/02666286.2003.10406232

Wolf, W. (2011). Narratology and Media (lity): The Transmedial Expansion of a Literary Discipline and Possible Consequences. *Current Trends in Narratology. Berlin*, 145–180.

Wolfson, S., & Case, G. (2000). Effects of sound and colour on responses to a computer game. *Interacting with Computers*, *13*(2), 183–192. https://doi.org/10.1016/S0953-5438(00)00037-0

Woodmansee, C., Hahne, A., Imms, C., & Shields, N. (2016). Comparing participation in physical recreation activities between children with disability and children with typical development: A secondary analysis of matched data. *Research in Developmental Disabilities*, *49–50*, 268–276. https://doi.org/10.1016/j.ridd.2015.12.004

Wooldridge, M. B., & Shapka, J. (2012). Playing with technology: Mother-toddler interaction scores lower during play with electronic toys. *Journal of Applied Developmental Psychology*, *33*(5), 211–218. https://doi.org/10.1016/j.appdev.2012.05.005

World Health Organisation. (1996). *ICD-10 guide for mental retardation*. *WHO*. Geneva, Switzerland. Retrieved from http://www.who.int/mental_health/media/en/69.pdf

Xie, L., Antle, A. N., & Motamedi, N. (2008). Are tangibles more fun? Comparing Children’s Enjoyment and Engagement Using Physical, Graphical and Tangible User Interfaces. *Proceedings of the 2nd International Conference on Tangible and Embedded Interaction - TEI ’08*, 191–198. https://doi.org/10.1145/1347390.1347433

Youell, B. (2008). The importance of play and playfulness. *European Journal of Psychotherapy & Counselling*, *10*(2), 121–129. https://doi.org/10.1080/13642530802076193

Young, R. M., & Cardona-Rivera, R. E. (2011). Approaching a Player Model of Game Story Comprehension Through Affordance in Interactive Narrative. *Papers from the 2011 AIIDE Workshop, Intelligent Narrative Technologies IV (INT 4)*, 123–130. Retrieved from http://aaai.org/ocs/index.php/AIIDE/AIIDE11WS/paper/download/4103/4470

Yu, S. Y. (2011). Relationships between preschoolers’ attitudes and play behaviors toward classmates with disabilities. *ProQuest Dissertations and Theses*, 112. https://doi.org/http://dx.doi.org/10.1177/0271121414554432

Yuill, N., Strieth, S., Roake, C., Aspden, R., & Todd, B. (2007). Brief report: Designing a playground for children with autistic spectrum disorders - Effects on playful peer interactions. *Journal of Autism and Developmental Disorders*, *37*(6), 1192–1196. https://doi.org/10.1007/s10803-006-0241-8

Zhou, Q., Hofer, C., Eisenberg, N., Reiser, M., Spinrad, T. L., & Fabes, R. A. (2007). The Developmental Trajectories of Attention Focusing, Attentional and Behavioral Persistence, and Externalizing Problems during School Age Years. *Developmental Psychology*, *43*(2), 369–385. https://doi.org/10.1016/j.virol.2008.08.028.Macropinocytosis

Annexure A: Pilot study 1

Competitive Play in children with intellectual disability: Informing design

Abstract: The purpose of the present multi-disciplinary study was to inform toy and game designers about the presence and degree of competitive play in children with moderate intellectual disability (ID), as a function of their mental age. Toy design industry, especially in developing nations like India, has not looked at children with special needs as a target sector and thus there is a need to address the absence of theoretical understanding about the play behavior of these children and convert it into practical implications in design of playing aids. Considering competitive play in childhood plays a significant role in the social and moral development of the children, it becomes important to understand the nature of competitive play for children with ID.

The present study is an attempt to study the emergence and degree of competitive play in children having moderate ID in India through a pilot experimental study involving children (N=8) divided into four age groups of mental age 2-4, 4-6, 6-8 and 8-10 years as they respond to a situation of building blocks play when controlled competition is introduced explicitly through a facilitator. The results based on a qualitative analysis show that competition emerges after the mental age of around 4 years, however a negative correlation between relative degree of competition with mental age was seen unlike typical children [1]. Also, children in age-group of 2-4 years exhibited self-initiated cooperation. The findings are argued using relevant research literature from a sociological perspective and design recommendations are made like incorporating cooperative strategies and replacing competition in design of play activities. The standard group goals in activities need to be made flexible and customized and process should allow incremental outcomes to account for variation in the abilities of the children. Study also touches on the need for balanced facilitation in play activities and pedagogical interventions that allows children with free play opportunities

***Keywords**: Competitive play, Intellectual disability, Designing for play, Cooperation, Social interaction.*

1 Introduction

Competition in children has been a well-researched domain in psychology, sociology, evolutionary science and education for many years. It is found in situations where there is a negative correlation between goal attainments of the participants. The present study uses a more generalized definition by Greenberg, who states competition as “a desire to excel, an impulse to do better than our rivals” [1].

This may involve rivalrous actions between players (trying to lower other's outcomes) as well as self-reflective actions for enhancing the prospects of goal attainment.

The presence of competition in human behavior has been well established. However it was Greenberg who studied the age-effects as a variable with competition in children during their play session involving building with blocks and concluded that competition emerged as early as around four years in children increasing as a function of the age of the children [1]. Studies have further substantiated these results [2, 3]. There are fewer studies that attempt to understand occurrence of competition in children with ID. One such study showed the effect of competition on children with ID in stimulating a better performance judged by enhancement in speed to finish a cognitive task [4]. Madsen and Connor [5] compared the degree of competition and cooperation in a play situation involving marble-pull apparatus among 6-7 years aged and 11-12 years aged children with ID as well as typical children, forming four groups. They concluded that 6-7 years aged children with ID group was actually the most cooperative of all, and competition seemed to increase with age in these children, which confirms to the findings for typical children. However, none of these studies specifically looked competition in play as a function of mental age across all age-groups in children with ID. It is quite possible that this function is different for these children. Social interactions of handicapped children during play have been found to be inhibited and solitary play has been preferred over social play [6]. A recent study showed that to comprehend competition, a child needs capacity for 'instrumental' and 'telic' perspective taking [7]. It becomes important to know how and when competition will emerge for children with moderate intellectual disability with their inherent cognitive limitations. The present study uses a qualitative analytical approach to study this relationship for children with ID by testing two hypotheses derived from the study by Greenberg [1]. Hypothesis 1 states that children with moderate ID will show emergence of competitive play after mental age of four years. Hypothesis 2 states that there is a positive correlation between the mental age and degree of competitive play exhibited by children with moderate ID.

2 Methods and Procedure

2.1 Subjects

Subjects (N=8) were selected in pairs from each of the mental age groups namely, 2-4 years, 4-6 years, 6-8 years and 8-10 years, having moderate intellectual disability (IQ = 35-49), roughly matched upon their mental and chronological age, taken from the school records, updated annually. The subjects attended a special school in Mumbai city, India and all were Indian in ethnicity living in local neighborhood. Each pair included one girl and one boy belonging to different classrooms to keep gender and level of familiarity as a constant during the experiment. S3 and S4 (each subject represented by 1st letter in the name and group no) were the only subjects who had Down's Syndrome besides ID. Table 1 represents the demographic data of the subjects briefly.

Table 1 Demographic data of the subjects taken from school records (assessed 2 years prior).

Group	Name	Sex	IQ	Chronological Age (years)	Mental Age (years)
1	S1	M	41	7.1	2.9
	A1	F	40	7.4	3
2	A2	M	49	9.3	4.5
	J2	F	46	10.5	4.8
3	A3	M	45	15	6.8
	S3	F	47.5	13.8	6.5
4	S4	M	49	17.3	8.5
	A4	F	48	16.6	8

2.2 Procedure

The present study derives from the procedure used by Greenberg where he studied competitive play between a pair of typical children using building blocks, [1] while controlling a number of variables unaccounted earlier. The present study involved a pre-experimental phase referred as 'warm-up sessions' lasting fifteen minutes each, conducted for two days and in the same week as the experiment to expose the subjects to constructive play using building blocks and balance their level of exposure and comfort with this form of play (constructive play was absent in school prior to the study). The children were brought in pairs into the 'play space' (school recreation room) by the facilitator (recreation teacher) and they sat facing each other, while facilitator helped them play with Jenga brick set (refer Figure 1.a). These were free play sessions however the facilitator modeled the play activity initially for the purpose of explanation. The subjects didn't interact with their paired experimental partner but a classmate. This was done to avoid experimental pairs developing any bias towards each other.

(a) (b)

Figure 1 Constructive toys used for (a) warm up sessions and (b) experimental sessions.

The experiment was divided into two stages. In the first stage, facilitator escorted the selected pair of children (refer Table 1) to play space. It was checked that subjects were in normal mood and exhibited natural behavior. They were made to sit comfortably, facing each other on a mat and allowed to play, similar to the warm-up sessions (refer Figure 2). However, they were given a new set of block toys having variable colors and shapes (refer Figure 1.b). This ensured that the play material was novel, interesting and provided more opportunities to elicit competition and at the same time be familiar. Children were not given any instruction on how to interact with each other while sharing the play space.

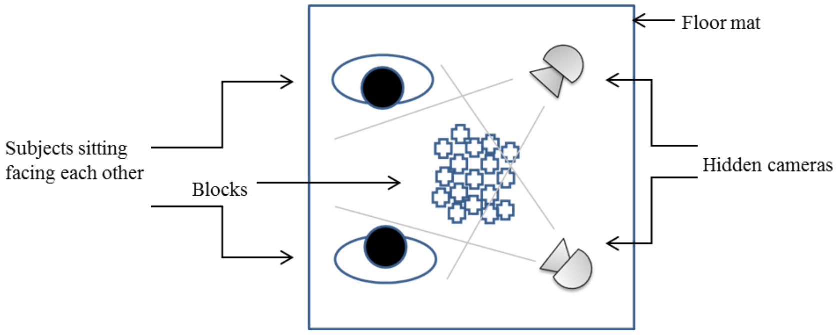


Figure 2 Top view of the experimental setup for the study.

The facilitator initially checked if the subjects were able to build with new blocks and helped once if needed. Then she left children to play freely and sat at a comfortable distance to make notes of the activity and didn't interfere in play. This session lasted till first 5 minutes or if all blocks were exhausted before it, or both the children didn't show interest in activity for a minute. The facilitator then approached the subjects to initiate 2nd stage encouraging the children to build again but this time she gave an assignment by saying, "I would like to see who can build prettier this time?" (Translated from Hindi: "Kaun zyada sundar banayega?"), with the objective to induce comparison and introduce competition for the extrinsic reward of teacher's praise. There was no specific target in construction for children and it is possible that the children might interpret notion of making 'prettier' to be different but it would not affect the results since their perception might affect the performance and competition is assessed from the play interactions of children and not the overall performance. She left the play space after pushing blocks back at center. The facilitator ended the 2nd session with a remark that both subjects performed nicely and applauded them. The facilitator, the play-space, the time and the toy remained constant for all the children.

The activities, remarks and the gestures recorded in video data using hidden cameras were transcribed into series of events on a time line where each event is defined as an action or a set of repetitive actions that can be grouped together to represent a verbal or gestural interaction with the material, competitor or other environmental factors. These codes were then analyzed along with facilitator's notes to draw insights. The aim was to determine presence and to some extent relative degree of competition.

The subject indicates the degree of competition which he experiences through three parameters - his interaction with the competitor, interaction with the material and his interest in play activity. The parameters were divided into sub-categories (refer table 2) taken from the categorization used by

Greenberg [1] with introduction of new sub-categories like 'smiled', 'imitated', 'cooperated' and 'played without building' emerging from the data. Interaction was compared along the sub-categories between the two stages of experiment to support the qualitative insights and inter-rater reliability was checked. It is important to realize that performance of subject including the shape and form of their final construction was not included in the analysis to identify competition as it might vary with child's ability, and competition had to be studied independently.

Table 2 Operational definitions of sub-categories of parameters for classifying events.

Parameter	Sub-category	Operational definition
Interaction with the competitor	Looked at competitor	Looks or gives a glance to competitor or his construction, but doesn't smile or speak anything or imitate.
3	Smiled at competitor	Smiles looking at competitor or his construction, but doesn't speak anything or imitate.
4	Imitated competitor	Copies one or more of competitor's action while building.
5	Verbal communication	All the verbal interaction directed clearly towards competitor excluding the subsequent statements made in conversation during cooperation.
6	Cooperated with competitor	Helps competitor by guiding him on how to build or helping him in imitating.
Interaction with the material	Blocks used as needed	Builds using blocks as needed, reaching out for one or two at a time, either taking those nearest at hand or which seem best fitted to the construction.
	Grabbed	Picks up a block rising from their position deliberately from near the competitor, or from the other side, often disregarding the competitor's activity or cautiously trying to disturb the competitor.
	Given	Offers a block to the competitor to help him or guide him in building.
	Played without building	Holds, fiddles and plays, exploring the block itself but not indulging in the building activity.
Interest in play activity	Distracted	Gets distracted from building without any external influence (self-initiated) and excluding instances of imitation and cooperation since they are a part of building.
	Physical signs	Calls facilitator or competitor to show his construction, shows interest at start, and/or shows hesitation at end to submit and continues building

Age group (mental)	Relative degree of competition	Signifiers
2-4 years	Absent	Cooperation shown, relaxed state in 2nd session
4-6 years	Clearly Present	Competitive verbal comments, grabbing the blocks, increased interest in building in 2nd session
6-8 years	Might be present	Disliking being imitated, using side-glance to imitate, reluctance to end and submit in 2nd session
8-10 years	Absent	Negligible interaction, *inability to build of one player may have led to error in sustaining competition*

Table 3 Summarized results showing relative degree of competition across age-groups.

Subject name	S1		A1		A2		J2		A3		S3		S4		A4	
Parameter	Frequency (duration in seconds-s)															
Session	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Interaction with competitor																
Looked	1 (1s)	0	1(4s)	3(32s)	6(11s)	6(8s)	3(3s)	6(6s)	8(8s)	8(9s)	6(10s)	9(11s)	2(6s)	0	1(1s)	1(1s)
Smiled	2(13s)	3(10s)	2(5s)	3(17s)	0	0	1(1s)	0	0	0	0	0	0	0	0	0
Imitated	0	0	7(64s)	5(141s)	0	0	0	0	1(37s)	1(56s)	0	0	0	0	0	0
Verbal communication	0	4	2	2	0	4	0	1	0	0	0	0	0	0	0	0
Cooperated	0	3(36s)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interaction with material																
Used as needed	Each time	Each time	Each time	Each time	Each time	Each time	Each time	15 (179s)	Each time	Each time	Each time	Each time	Each time	Each time	Each time	Each time
Grabbed	0	0	0	0	0	0	0	5(25s)	0	0	0	0	0	0	0	0
Given	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Played without building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest in play-activity																
Distracted	3(14s)	5(12s)	10(20s)	9(38s)	6(21s)	6(12s)	7(20s)	8(8s)	4(4s)	3(4s)	7(13s)	10(12s)	4(63s)	3(167s)	3(4s)	0
Physical signs	2	7	5	2	1	3	0	3	0	0	1	1	0	1	0	1

Table 4 Frequency and duration of various parameters as observed during both sessions for all subjects to estimate relative degree of competition.

7 Results

Each subject was individually analyzed in detail to establish relative degree of competition as summarized in Table 3. Children were always seen making their own construction rather than collaborating on one. Hypothesis 1 was found to be true as competitive play emerged after mental age of 4 years (age group 4-6 years) in children with moderate ID. Hypothesis 2 was nullified as a positive correlation between the mental age and degree of competitive play exhibited by the children could not be established. Competitive play was most convincingly seen in age group 4-6 years and seemed to decrease as the mental age increased. It is to be noted that these results do not represent conclusive remarks but give substantial directions for further enquiry and need to be validated by increasing the number of participants. However, inter-rater reliability was assessed for 50% of randomly selected video data by an independent play researcher and 95% of agreement in code assignment was found. Pearson's r was calculated and found to be significantly correlated for sub-categories having higher disagreement, namely looked at competitor (r =0.89, p<0.01), smiled at competitor (r =0.86, p<0.01) and cooperated with competitor (r =0.92, p<0.01). Results of each age-group are briefly discussed below derived from rich qualitative insights and comparing parameters quantified from sessions (refer Table 4).

7.1 Group 1: 2-4 years mental age

Subjects in this group didn't show any competition. On the contrary, there was a display of self-initiated cooperation in 2nd session when A1 who had been imitating S1 was guided and helped by S1 as seen from following transcript:

> {64}[5] Talks to A1 and points at his construction saying, "A1, make like this". Looks into her face for the first time and gives a big smile. {72} Replies "Like this", smiling and pointing to his construction. {78} Calls A1 by saying "Do it. This way". He is very happy and smiling as he shifts his construction (train) towards A1 to explain her the design. {82} Reaches A1's construction and points at locations and speaks, "It has to be placed there". Smiles as she places it.

This result supports the finding of study conducted by Madsen and Connor [5] showing that younger children (chronological age 6-7 years) with ID were more cooperative than their elder counterparts. The clear increase in interaction among competitors in 2nd session (refer Table 4) might again be attributed to the cooperative behavior.

Increase in physical signs for S1 was because he repeatedly called facilitator and competitor to show that he constructed a train from blocks using wheels and felt happy about his achievement. However, A1 showed a decline in her interest in building in 2nd session and looked more anxious as she was not constantly smiling anymore. This further supports that she was not looking to compete with S1.

[5] The numbers in {} represent the event number as transcribed during analysis for ease of reference.

7.2 *Group 2: 4-6 years mental age*

Competition was clearly visible in both the subjects as a remarkable difference was seen in behaviour between the two sessions. A2 was the only subject in the experiment who communicated competition verbally as well as through his body language in 2nd session, as seen in following excerpts.

> {274} Raises both his hands, smiles and exclaims," I will win". {276} Seems excited. Sits upright smiling and claps couple of times raising his shoulders and says, "Yes". {277} Stops smiling. Gives a side glance to ***J2***. {288} Exclaims loudly, "I will win it" while putting blocks. {319} "Mine is better. 11 floors".

J2 showed competitiveness though her interaction with material as seen in grabbing and body language including instances of babbling, tightening of muscles and restlessness, seen as follows.

> {400} Rises up and picks a pink block from other side, although it was available near her. {401} Turns and looks at facilitator. {402} Again rises up to pick up a yellow block from near A2 and babbles as she places it over. {403} Rises up and picks a set of block from other side. {404} Gives a quick side-glance to *A2.* {405} Holding the previous block in one hand, rises and picks up a yellow block from very near *A2*. {408} Puts a block on construction moving restlessly. {412} Beats a block on construction for the first time to fit it over.

Both subjects showed a clear increase in interest towards play-activity in 2nd session as distractions got reduced (refer Table 4).

7.3 *Group 3: 6-8 years mental age*

Subjects didn't show competition as apparently as group 2 showing similar behaviour in both sessions but there were some signs of competitive spirit (refer Table 4). However, A3 was seen using side-glance while imitating S3, more often in 2nd session. A3 also showed disappointment on his face when asked by facilitator if he had finished at the end of 2nd session, which might be due to dissatisfaction, shown in the following excerpt.

> {508} Looks at facilitator and tightens his teeth, drops forward and looks down.

While A3 imitated, S3 was seen showing displeasure when she noticed being imitated in both sessions, as shown below.

> {535} Looks at A3's construction. Scratches her head and twists her mouth side-ways. {572} Looks at A3 and his construction as he is imitating. Twists her mouth sideways. Gets distracted.

While these instances do not clearly establish presence of competition, further experimentation in this age-group should give a clearer picture.

7.4 *Group 4: 8-10 years mental age*

S4 was largely, unable to build, as later reported to be generally lethargic by teachers. It would be unfair to derive conclusive insights from this group, however some interesting patterns emerged. Though S4 was seen disinterested almost throughout the experiment, it became much more prominent in 2nd session as his duration of being distracted increased almost three times (refer Table 4).

On the other hand, A4 displayed good building ability and was not at all a match to S4. She also didn't show any sign of competition and hardly any interaction with S4. There was however a period at the start of 2nd session when she was seen struggling with building activity and shivered, which appears to be an outcome of nervousness, as seen below. A1 has also been found to show anxiety due to competition.

{724} Tries putting a block over other but fails 4 times as her hands are shaking.

8 Discussion

Hypothesis 1 showed that competitive play in children with moderate ID emerges at the same age (around 4 years) as seen in typical children when matched on mental age, however hypothesis 2 was nullified and the results didn't match the progressive pattern in degree of competitive play shown by typical children [1]. In fact, results suggest that competitive play decreased with growing mental age. It can be argued by looking at the sociological perspective of competition which emphasizes that it is the social and cultural environment in which an individual is brought up that determines the character of this competitive urge [8, 9]. Vaughn and Diserens [10] sum this up well by stating, "The particular form, intensity, and objects of competition are largely dependent on the nature of the social environment. They vary considerably among individuals and groups, and seem to be dependent on the degree of socialization which the individual and the group have achieved." Children with intellectual disability are subjected to a very different social environment and exposure as they often fail to compete with their typical peers. This vulnerability in social and peer acceptance, and failures in peer acceptance substantiate the negative self-concept among special children [11]. This could have led the children to avoid a competitive play situation as their age increased.

Presence of significant amount of social associative play in children with ID has been identified by Johry and Poovaiah [12] in their ethnographic study at the same facility. In such situations, competitive strategies should be replaced with cooperative strategies during play activities and pedagogy interventions. Present study reported emergence of anxiety due to competition in two children. Using cooperative learning techniques has been linked with reduction in tension and conflict among typical children [13], which becomes more significant considering the existing low self-esteem in these children [11]. Focusing on group goals and cooperatively co-constructing solutions also aids in the moral development of the children [14]. While the study did not analyze the performance of children, it is fairly evident that performance varied significantly within groups. The design of play activities and toys involving challenge can do away with having a standard target to compete against and allow facilitators to set individual specific goals which can stretch children beyond their abilities while still being achievable. Furthermore, design should involve incremental outcomes, so the child can self-regulate his play and set his own target. Block play is a good example of a toy with such flexibility. The design of toys should also be adaptable and flexible so that it can address wider audience by being applicable at different, interrelated stages of development, from the instructor giving maximum help, to the user operating the toy unaided [15]. The present study controlled facilitation where the child was observed but not led into play. Such a balanced facilitation will provide the opportunities for free play found lacking with these children [12]. Exposure to social open and permissive conditions will also benefit in creating a positive self-concept among children thus reducing their avoidance tendencies.

The present study didn't address a number of factors like effect of gender or socio-economic background of children with ID on competitive play exhibited by them. While the present study used inter-rater reliability, there is still a need to confirm the validity of the findings with increase in the number of participants.

References

1 Greenberg, P.J., "Competition in children: An experimental study", American Journal of Psychology, 44, 221-248, 1932.

2 Leuba, C.J., "An experimental study of rivalry in young children", Journal of Comparative Psychology, 16, 367-378, 1933.

3 Owens, L.L., "Competition in children as a function of age, race, sex and socioeconomic status", Ph.D. Thesis, Texas Tech University, 1969.

4 Stoneman, Z., and Keilman, P.A., "Competition and social stimulation effects on simple motor performance of EMR children", American Journal of Mental Deficiency, 78, 98-100, 1973.

5 Madsen, M.C., and Connor, C., "Cooperative and competitive behavior of retarded and nonretarded children at two ages", Child Development, 44, 174-178, 1973.

6 Guralnick, M.J., and Groom, J.M., "The peer relations of mildly delayed and non-handicapped preschool children in mainstreamed playgroups", Child Development, 58, 1556-1572, 1987.

7 Priewasser, B., Roessler, J., and Perner, J., "Competition as rational action: Why young children cannot appreciate competitive games", *Journal of experimental child psychology*, *116*(2), 545-559, 2013.

8 Booth, Alison, and Patrick Nolen. "Choosing to compete: How different are girls and boys?", *Journal of Economic Behavior & Organization*, *81*(2), 542-555, 2012.

9 Gneezy, U., Leonard, K. L., & List, J. A. (2009). Gender differences in competition: Evidence from a matrilineal and a patriarchal society.*Econometrica*, *77*(5), 1637-1664.

10 Vaughn J. and Diserens C.M., "The Experimental Psychology of Competition", The Journal of Experimental Education, 7(1), 76-97, 1938.

11 Pijl, S.J., and Frostad, P., "Peer acceptance and self-concept of students with disabilities in regular education", European Journal of Special Needs Education, 25, 93-105, 2010.

12 Johry, A., and Poovaiah, R., "Paradigms of play in a special school setting in India", *19th International Play Association World Conference.* Istanbul, May 2014.

13 Hertz-Lazarowitz, Rachel, and Shlomo Sharan. "Enhancing prosocial behavior through cooperative learning in the classroom." *Development and maintenance of prosocial behavior. Springer US*, 423-443, 1984.

14 Kruger, A. C., "Peer collaboration: Conflict, cooperation, or both?", *Social Development*, *2*(3), 165-182, 1993.

15 Airey, B. and Hirst, R., "Toys for mentally handicapped people", Leads, UK: Leads and District Active Toy Project, 1982.

Annexure B: Pilot study 2

Paradigms of play in a special school setting in India

Abstract: The aim of this research was to study and develop an understanding of the state of play and the associated environmental factors within a special school setting in India. Children (N=12, aged 6 to 11 years) of the same classroom having mild to moderate Mental Retardation, and different etiological conditions, were analyzed in structured and free play situations at different spaces in school using video and diary notes. Semi-structured interviews were held with the staff of the school (n=7) to understand the belief-pattern on play. Data was analyzed using thematic analysis to identify connections and patterns, and compared on the three paradigms of play, namely play as disposition, play as observational behaviour and play as context (Rubin, Fein, and Vandenberg, 1983). The results showed that higher numbers of dispositional play characteristics were seen in unstructured, free play situations than guided situations. Sensorimotor practice play was the most frequent form of play, while more advanced forms like symbolic play or constructive play were negligibly present, owing to the environmental factors. In unstructured situations, play was generally associative in nature, involving high level of social interaction. School staff focused on developmental needs of children while play for its own sake was negligibly present and rather play was used as a scaffolding tool for development. The findings have been discussed in relation to existing literature and possible research directions are suggested.

***Keywords**: Play behaviour, Mental retardation, Play spaces, Belief pattern of play*

1 Introduction

The significance of play has been acknowledged in diverse fields like psychology, biology and neuroscience as a universally present behaviour type linked to the development of children (Frost, 1998). Studies on play behaviour of children with developmental disabilities have shown that presence of pretend, imaginative, or symbolic play was much lower than their typical peers (Malone & Langone, 1998; Sigafoos, Roberts-Pannell & Graves, 1999). Furthermore, these children have also been linked with serious problem behaviours, such as frequent aggression, self-injury, or extreme tantrums (Luiselli, Matson, & Singh, 1992). It is apparent that children with developmental delays may need direct intervention to learn how to play appropriately with toys. File and Kontos (1993) recognized the importance of programs where caregivers involve in sensitive, responsive, and verbally stimulating interactions with the children for their proper development. The role of special education and associated environmental factors thus becomes very important while studying play.

While there has been an increase in studies involving play of children with special needs e.g. role of contextual factors (Malone, 2009), motivations to play (Askins, Diasio, & Szewerniak, 2013), etc., many research gaps have not been dealt sufficiently. Moreover, there have been very few studies on play conducted in developing nations like India. Prochner (2002) in his study of Indian preschools, states that "local ideas about play in early childhood settings are created out of the tension between culturally and historically situated beliefs and international ideas" (p. 436). Play has also been found to be influenced by different environmental settings like home, community and school within a culture (Rigby, 2007). The present study thus explores the play opportunities and behaviour of children with developmental delays in a typical special school setting in a metro city of a developing nation (India). The focus of the study is to identify the occurrence and typology of play behaviour, the role of environmental factors and the belief-pattern in special school on play.

2 Theoretical background

2.1 The definition of play

Harker (2005) points out that the characteristics of play that most of the existing definitions suggest are often contradicted empirically. Studies suggest two major obstacles in arriving at a universal definition of play, namely, multi-disciplinary nature of play (Smith & Vollstedt, 1985), and not acknowledging play as a multi-dimensional (Martin & Caro, 1985; Jenvey & Jenvey, 2002). Pellegrini & Smith (1998a) suggested that play should be defined multi-dimensionally by complementing structural definitions of play with antecedent and consequential dimensions. Rubin, Fein, and Vandenberg (1983) have defined play as "a behavioural disposition that occurs in describable and reproducible contexts and is manifest in a variety of observable behaviors" (p. 698), thus focusing on three distinct paradigms to understand play, namely, play as observable behavior, play as context, and play as disposition.

The paradigm of play as disposition attempts to identify play from other activities by looking at child's approach towards the activity. Rubin et al. (1983) stated a set of dispositional characteristics that could be related to play including intrinsic motivation, focus on means versus ends, active engagement, absence of external rules, going beyond functional properties of object and pretense/ non-literality. Subsequent studies have further tried to define other dispositional characteristics of play. Bundy, Nelson, Metzger, & Bingaman (2001) further extended the concept of play by placing it on a continuum of varying playfulness depending on the number of dispositional characteristics that have been met, unlike discrete states of play and non-play. Paradigm of play as observable behaviour classifies play in terms of behaviours that follow play often leading to taxonomies like symbolic play, rough-n-tumble play, parallel play, etc. The present study used two classical typologies to delineate play behaviours based on cognitive thinking involved (Piaget, 1962) and social interaction (Parten, 1933). Lastly, paradigm of play as context substantiates the understanding of play by focusing on the circumstances that elicit and support play like culture, props and people in immediate environment, gender, etc.

2.2 Play and children with developmental disabilities

While the literature on play in general is abundant, play in relation with children with developmental disabilities is still an emerging research domain. Due to obvious socio-cultural and limiting factors, the play conditions available for children with developmental disabilities are different than their typical peers. There have been contradictory findings on the differences in play behaviour of disabled children and typical children. While, Malone and Langone (1995) found similar patterns of categorical and sequential play behaviour in children with and without cognitive disabilities, Mahoney (1992) argued that role of play to the development of a child differs for children with mental retardation than their typical peers. Moreover, there have been a growing number of studies that suggest that disabilities in children significantly affect their play behaviour (e.g. Pierce-Jordan & Lifter, 2005; Poulsen and Ziviani, 2004). Children with special needs have been found to have lesser opportunities for free play (Missiuna & Pollock, 1991).

Reid et al. (2003) studied the toy-play preference of children with developmental disabilities using observational assessments. Recent studies have used a term „adaptive toys" referring to the typical play materials modified to include adaptive mechanisms like Velcro strips for better holding of toy or switches for easy operation (Klauber, 1996; Hsieh, 2008). Such toys selected based on different needs or treatment goals of children with developmental disabilities have shown considerable improvement in children’s participation in toy play (Hsieh, 2008). However, there is still a lot of scope for exploration in this domain. With the progress made in technology and growing acknowledgement of the significance of special education, play materials and associated environmental factors to facilitate play for children with special needs in research and practice, many basic issues on the relationship of play to these affecting factors still remain to be investigated as the research literature on this topic is limited.

3 Methods and Procedure

The research data was collected using multiple resources and the process was divided into two phases: (1) Observation phase and (2) Interview phase.

3.1 Observation phase

In this phase, children (N=12): 5 girls and 7 boys with mild to moderate mental retardation and variable etiological conditions, belonging to the same class titled as ‘pre-primary’ class were observed at different spaces in school to include all possible structured play as well as free play contexts. The children were 6 to 11 years old with mental age between 2.9 to 6.3 years (mean mental age = 4.3

years). Only three children had other etiological conditions apart from mental retardation, namely ADHD (Attention deficit-hyperactivity disorder), Autism and Cerebral Palsy, respectively. The subjects attended Holy Cross special school in Mumbai city, India and all were Indian in ethnicity living in local neighbourhood. Table 1 represents the demographic data of the subjects briefly.

Name	Sex	IQ	Level of MR	Chronological Age (years)	Mental Age (years)	Etiology
Ta	F	69	Mild	6.1	4.2	
Ra	M	58	Mild	8.5	4.9	
Su	M	62	Mild	7.4	4.6	
Ri	M	56	Mild	11.2	6.3	
Sho	M	60	Mild	6.5	3.9	
An	F	64	Mild	7.4	4.7	
Shr	F	55	Mild	8	4.4	
Ni	M	48	Moderate	7.1	3.4	
Po	M	60	Mild	7.1	4.3	
Di	F	56	Mild	8.2	4.6	ADHD
Sha	F	45	Moderate	6.4	2.9	Autism
Sus	M	42	Moderate	8.8	3.7	CP

Table 1.Demographic data of the subjects taken from school records (Personal details have been purposefully omitted for ethical reasons).

The researcher followed the principles of the ethnographic method while observing the children in their natural environment with minimal interference in the regular state of affairs. The observed classes included academic class session (mathematics period), recreational skills session, occupational therapy session, and outdoor and indoor free play session. Observations were taken into a research diary while sitting at a comfortable gap from the active area. The diary was divided into two sections: descriptive data where description of activity and context was noted and reflective data where researcher's reflexivity and thoughts were recorded during the observation periods. Table 2 briefly illustrates the structure of research diary. However, to record indoor free play behaviour in its true sense, it was decided to video record the data using hidden cameras in complete absence of observer or any facilitator, as suggested by Elderkin-Thompson & Waitzkin (1999).

Date: March 18th, 2013; 10:30 – 11:15 am Descriptive data	Reflective data
Teacher now calls few children one by one at the centre and asks him to repeat the song with actions while other copy him. Majority of children like doing actions as they can be seen smiling and laughing while performing it. Teacher draws the same fruits on board and reads the name, and children repeat it along with him	Is it mere imitation or symbolic play? If it is symbolic play, it is the usage of highest form where the substituted object is absent, and is it the best possible form?

Table 2.An illustration of note making in research diary.

3.2 Interview phase

The primary focus of this phase was to develop an understanding of the belief-pattern of play among the school staff associated with the observed classroom, which included the class teachers, occupational therapist, recreation teacher and the principal of the school. The researcher used semi-structured interview technique for all the interviews. Table 3 describes the basic set of questions used for interviewing class teachers. Some of these questions emerged from the initial assessment of observational phase.

Section	Questions
Perception of play	What are different classroom activities? Which one involve play? When and how frequently do they occur?
Role of environment	Which artefacts are used for play activities? Do play opportunities occur apart from class? Where?
Structure of school	Difference in play possibilities between recreation skills, motor skills, occupational skills, communication skills, sports, AV, arts & crafts, ADL classes (different subjects)
Suggestions	Any changes or add-ons to existing system and infrastructure? Is there a need of separate time and space for play apart from classroom? Is there a need to integrate more free play?

Table 3. Set of questions used for semi-structured interviews of class teachers.

4 Analysis

Data collected at different phases of the study was then analysed using qualitative thematic analysis. As explained by Namey, Guest, Thairu and Johnson (2008), thematic analysis provides a richer understanding by focusing on identifying and describing both implicit and explicit ideas, instead of mere counting of explicit words or phrases. The diary notes, recorded video data of free play session and the audio interviews of the school staff were all transformed into a transcript. MS-Excel was used to develop codes or themes linking back to raw data as summary markers. Each unit of transcript data could be assigned with multiple codes, depending on relevance. Using a data-driven approach (Glaser and Strauss 1967), the keywords, trends, themes, or ideas emerged from the data itself based upon the repetition and co-occurrence of the codes. Twelve major themes that emerged from the data included play possibility, joy, engagement, intrinsic motivation, social interaction, organization, tangible and intangible artefacts, teaching/therapy strategy, behavioural issues, usability issues, observer's effect and suggestion/discussion. To develop a comprehensive understanding on play, individual insights that emerged from each theme were compared upon the three paradigms of play, namely play as disposition, play as observational behaviour and play as context (Rubin et. al, 1983).

5 Results

Children's play was found to be present in different extents in structured as well as free play contexts across various spaces in school. While the exhibited behaviour and interaction patterns revealed the variability across different stages of play, the role of contextual factors also emerged prominently in guiding these behaviours, as discussed below.

5.1 Play as disposition

A number of dispositional characteristics emerged from insights that helped in identifying the playfulness during activities. Active engagement as opposed to inactivity was generally associated with unstructured, free play situations than guided activities along with intrinsic motivation and joyfulness. Joyfulness was observed through verbal comments, facial expressions and body language of children. The excerpt below from the Research Diary illustrates these instances of active engagement and joyfulness.

> 'Di' who had been jumping without interacting much with other children also quickly jumps in ball pool following 'Ta'. Then 'An' and 'Po' also jump in as 'Po' calls 'Ri' to join. They all seem to be enjoying, and shouting with happiness, although space inside is limited. (Research Diary, March 14th, 2013: Indoor free play session)
>
> Children start running and reaching the park equipment, as soon as they reach there. Slide is the most famous out of all, as lot of them start climbing it together and making a queue for their turn. Some of them shout and smile. (Research Diary, March 19th, 2013: Outdoor free play session)

However, some of the structured and supervised play activities also involved children showing intrinsic motivation and joyfulness. These activities had a common set of characteristics that lead to high engagement in children, which were involvement through physical participation, rich in sensory stimulation and offered an optimum level of challenge, as seen in some of the diary excerpts below. Meire (2007) has also emphasized the significance of bodily sensations and the feeling of control and challenge as being related to fun aspect of play of typical children.

> Teacher now calls few children one by one at the centre and asks him to repeat the song with actions while other copy him. Majority of children like doing actions as they can be seen smiling and laughing while performing it. Teacher leaves the class for some work but the children continue to repeat the song and they interact with each other by facing and guiding the actions of some other classmates. (Research Diary, March 18th, 2013: Recreational class session)
>
> 'Ni' is smiling and appears to like the challenge, especially climbing ladder. He enjoys physical activity. He doesn't mind repeating the same activity and picks up a ball to run through the obstacle path 3rd time. OT assists only when he faces difficulty during the activity. (Research Diary, March 13th, 2013: Occupational therapy session)

Classroom activities, on the other hand, were generally passive and did not allow exploration or physical involvement of children, leading to low engagement. The children did not seem to have much control over the activities and followed upon the instructions given by the class teacher. While the behaviour of class teacher was never found to be aggressive in observation sessions, level of interaction was generally low in his presence. The following excerpt from the Research Diary illustrates one of the many instances of increase in level of interaction in the absence of class teacher.

> Teacher goes out of class for some work. A girl from another class comes to the door, „An" gets up and starts dancing in front of her and smiles. Some children start looking around who seemed to have been passively looking down. (Research Diary, March 6th, 2013: Maths class session)

5.2 Play as observable behaviour

Children's behaviour during the different play activities could be characterized by different subtypes using some of the existing classifications. One of the most widely discussed classifications was given by Piaget (1962) consisting of practice play, symbolic play, and games with rules. Sensorimotor practice play was the most common forms of play observed in school. This type of play could also be classified as activity/locomotor play which encompass chasing and climbing as well as rough-and-tumble styles of play (Pellegrini & Smith, 1998b). More advanced sub-types of play like symbolic play was almost absent except two instances where „An" and „Ta" showed object substitution, however the episodes were very small in length (see excerpt below). These findings further substantiate the findings of Malone and Langone (1998) who also found children with disabilities to engage more likely in functional play than constructive and dramatic play. There were no instances of games with rules for the studied age-group.

> 'An' sits on the rubber lion and starts singing, "Lakdi ki kaathi, kaathi ka ghoda1". 'Ta' shouts from inside the pool asking to give it back to her.
>
> 'Ta' picks up a trapeze bar and wears it over like a uniform and shows to 'An'. (Research Diary, March 14th, 2013: Indoor free play session)

Play was also classified based on the level of social engagement among children while using play materials (Parten, 1933) and found to be generally associative with some instances of parallel play. Some of the children got involved in playful interactions like pranking, teasing during the play activity. A number of pairs were seen like „An"-„Ta", „Di"-„Po", etc. who appeared to show association and friendship however the reliability is questionable as it would take a longitudinal study to understand such associations in children. The following excerpt from the Research Diary illustrates these some of the instances of associative play.

> 'Po' takes the ball from 'Ri' and goes and keeps it on the slide where 'Ta' and 'An' are playing and runs away with a smile as 'An' shouts.
>
> 'Po' and 'Di' are playing on trampoline. 'Po' calls for 'Di's' attention and shows her how to land on bottom. 'Di' laughs out loud. They both get involved in jumping again. (Research Diary, March 14th, 2013: Indoor free play session)

A pattern of self-organization that seemed to emerge repeatedly during unstructured activities involved children assembling and participating as a group, moving together. Small conflicts that occurred in unstructured play situations were soon resolved among the children themselves. Also, ‘An’, who had the most developed communication skills in class, seemed to have an authoritative position and thus influenced this organization, acting as the coordinator on occasions, as seen in the research diary excerpt below.

> ‘Po’ and ‘Di’ then get out and go to slide. ‘An’ follows and she calls everyone to the slide and decides order of sliding. Other children follow ‘An’'s instruction. They all seem to enjoy and giggle at times. (Research Diary, March 14th, 2013: Indoor free play session)

As a contrast, structured classroom activities were generally solitary in nature, and the movement was constrained. The identified play sub-types and social interaction patterns, as discussed above, were also seen to be related to etiological conditions of children. E.g. „Di" who had ADHD showed high affinity for solitary or parallel exercise play, while „Su" who had Cerebral Palsy showed a low affinity for exercise play than the rest of his peers.

5.3 Play as context

This paradigm of play focused on understanding the role of environmental artefacts and spaces to define play. The present study revealed that the most prominently used spaces for play activities were outdoor park and Occupational Therapy (OT) room. These were also the only two spaces in school where unstructured free play occurred, and had equipment which were specifically meant for sensorimotor practice play or exercise play. Some of the outdoor park equipment included slides, climber web, see-saw, swings, rotating round-abouts, etc. while the OT equipment included trampoline, ball pool, slide, rope ladder, platform swing, big therapeutic balls, etc. (Refer figure 1 and 2), out of which, slide and ball pool were the most popular play equipment. Most of these equipment focussed on stimulation of vestibular and proprioceptive senses, and thus linked to gross-motor skills of the children. It is also worth noting that the available play artefacts did not acknowledge etiological differences and some of them would have been unsafe during unstructured play especially for children with Cerebral Palsy. There was almost no play equipment which was specifically meant to facilitate symbolic play or game with rules.

On the other hand, classroom space clearly seemed oriented for teaching. The available tangible and intangible aids had a clearly defined developmental purpose and were found to offer limited interactivity to the children e.g. usage of blackboard, charts, models, pen and paper, etc.

(a) (b) (c)

*Figure 1.*Some of the outdoor play equipments in park: (a) climber web, (b) Slide, and (c) Swing.

(a) (b) (c)

*Figure 2.*Some of the indoor play equipment in OT room: (a) trampoline, rope ladder, therapy balls, (b) platform swing, and (c) ball pool.

5.4 Play v/s Learning: The belief pattern of play in a special school

The interview data helped substantially to deduce the perception of play and its relevance alongside developmental needs for special children among the school staff. The main consensus that emerged in almost all interviews was that play for its own sake was never mentioned but was rather used as a scaffolding tool for learning in all activities except a trip to park which happened once a week for half an hour. There was a frequent reference to 'playway method' to teach most of the subjects which included action songs, flash-cards, memory games, etc. Playway method is the Indian version of play-based education which derives inspiration from Western play theorists like Froebel, Montessori and Dewey. The significance given to learning skills over play could be clearly seen in a number of interview replies by the staff, as mentioned below.

> "In indoors, visuo-perceptual and visuo-spatial activities, like lacing games, beads with clay, etc. Okay, so all these activities are play-through only, that is along with development, play is also involved… There should be goals, and only when those goals, are covered, one should go to the next level." (Transcript: Occupational therapist interview)

"In games, we generally take number games, alphabet games, naming games which is basically to develop the social and communication skills. In number games, one has to just tell the number in sequence, like one child says 1, the other says 2, and next so on. So you can't just look at one aspect, but multiple aspects have to be seen, that it will involve learning, social skills, speech, memory games also is involved in this one." (Transcript: Primary 1 teacher interview)

While the need for a separate space and time for play was agreed upon almost unanimously, it is felt that the question was close-ended and itself may have led to this particular answer. The significance of free play was associated with several concerns, as mentioned in some of the interview excerpts below.

"We shouldn't give them too much of free play but a little. There should also be games that can be played in free play, e.g. games of cognition, or mechanical games like joining parts. So such stuff increases their activity, because what happens is that many children will not do anything when left free, while others play. So the children will start fighting and all that and other children also learn from that." (Transcript: Pre-primary teacher interview)

"Yes, but there should not be any risk factor because these are special children so chances of injury are more, so under supervision. Creative play is not there, but if you want to give creative play than one has to ensure that risk is not there. They might hurt each other, and there is lot of answering if something happens. e.g. this child in my class had brain operation and he is very delicate." (Transcript: Primary 1 teacher interview)

6 Discussion

The present study revealed that higher number of dispositional play characteristics were generally associated with unstructured, free play contexts in school. The relevance of creating situations which allow the child to control the level of participation, intensity and manner of play and exploration is acknowledged by Berlyne (1969) who emphasized that child should be able to modulate the arousal from play for it to sustain. However, a number of studies on children with cognitive disabilities have shown they lack internal motivation to play and their interaction with environment may not be spontaneous with simple exposure to toys (Malone, 1994; Malone & Langone, 1994). Rasmussen (1983) has emphasized that adults play an important role in assisting children in play and resolving conflicts, especially with children with disabilities. At the same time, it has to be ensured that what Corsaro (2005) calls to be an interactive shared space of play, is not intruded by adults. Hanline & Fox (1993) states, "A fundamental role of the adult is to structure the environment to allow children to learn through active exploration and interaction with adults, other children and materials." The role of preschool teachers at special schools thus becomes pivotal in maintaining a balance between assistance and supportive guidance while allowing the child with opportunities to explore and modulate his stimulation during play by following his lead more than participating in the play itself.

The adaptability and flexibility of the toy also becomes significant as Airey and Hirst (1982) state, “It needs to be applicable at different, interrelated stages of development, from the instructor giving maximum help, to the user operating the toy unaided” (p. 2).

A set of common characteristics that were found related to high engagement in children were involvement through physical participation, rich sensory stimulation and optimum level of challenge. A number of studies based on children with severe and profound disabilities have stressed upon the use of toys that give sensory stimulation (Janssen, 1989; Murphy, Callias, & Carr, 1986). The presence of sensorimotor practice play to be most prominent in the studied age group corroborates to the findings by Pellegrini & Smith (1998b) in their review of literature on typical children where such activity play peaks during preschool years while rough and tumble play is prominent in middle childhood to early adolescence.

A paradox that seems to affect the belief-pattern of play in special schools was based on the coexistence of play and learning. While the developmental aspect was heavily emphasized in all activities, the playfulness of such activities became questionable due to limited internal control and social connection allowed to the children. While, play and toys are, for children with special needs, an essential tool for learning and development, and not treated as a goal in itself, it would be beneficial to promote more unstructured, free play opportunities in the present diagnostic society.

While the present study was limited in scope in a number of ways including limited population, short span of observations and other contextual factors, it provided some interesting findings on the play possibilities and its perception in a special school setup in India. The present study was focused on observing a particular classroom and may not present a valid picture of the functioning of the whole school. It would be interesting to further explore some of these findings through a longitudinal study for enhancing the reliability of data. Further research directions include the effect on play behaviour due to age, gender and socio-economic conditions of the children. The perception on play of school staff as a function of their work-experience and gender may also yield interesting results. The present study, at a number of occasions, acknowledged differences in play behaviour and interaction patterns based on etiological differences. It would be interesting to study the design issues needed to accommodate these differences to allow an inclusive play context for children.

References

Airey, B. & Hirst, R. (1982). Toys for mentally handicapped people. Leads, UK: Leads and District Active Toy Project.

Askins, L., Diasio, B., & Szewerniak, D. (2013). Children with Developmental Disabilities and their Motivation to Play. The Open Journal of Occupational Therapy, 1(4), 4.

Berlyne, D. E. (1969). Laughter, humor, and play. In G. Lindzey & E. Aronson (Eds.), The Handbook of Social Psychology (Vol. 3, 2nd ed.). Reading, MA: Addison Wesley.

Bundy, A. C., Nelson, L., Metzger, M., & Bingaman, K. (2001).Reliability and validity of a test of playfulness. Occupational Therapy Journal of Research, 21, 276-292.

Corsaro, W. (2005). The sociology of childhood (2nd ed.). Thousand Oaks: Pine Forge Press.

Elderkin-Thompson, J., & Waizkin, H. (1999). Using videotapes in qualitative research. In B.F. Crabtree & W.L. Miller (Eds.), Doing qualitative research (2nd ed., pp. 239–252). Thousand Oaks, CA: Sage.

File, N. & Kontos, S. (1993). The relationship of program quality to children‟s play in integrated early intervention settings. Topics in Early Childhood Special Education, 12, 1-18.

Frost, J. L. (1998, June). Neuroscience, play, and child development. Paper presented at the IPA/USA Triennial National Conference, Longmont, CO.

Harker, C. (2005). Playing and affective time-spaces. Children's Geographies, 3(1), 47-62.

Hsieh, H. C. (2008). Effects of ordinary and adaptive toys on pre-school children with developmental disabilities. Research in developmental disabilities, 29(5), 459-466.

Glaser, B. G., and Strauss A.L. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. New York: Aldine.

Hanline, M.F. & Fox, L. (1993). Learning within the context of play. Providing typical early childhood experiences for children with severe disabilities. Journal of the Association for Persons with Severe Handicap, 18, 121-129.

Janssen, M. (1989). Increasing independent toy play by self reinforcing toys. In A.B. BEST (Ed.), Papers on the Education of the Deaf-Blind Proceedings of the Warwich 1989 Conference (Vol. 2, pp. 112-123). Warwick, UK: Warwick University.

Jenvey, V. B. & Jenvey, H. L. (2002) Criteria used to categorise children‟s play: preliminary findings, Social Behaviour and Personality, 30(8), 733–740.

Klauber, J. (1996). Toy story: How to select and buy adaptive toys. School Library Journal, 42(7), 22–24.

Malone, D. M., & Langone, J. (1998). Variability in the play of preschoolers with cognitive delays across different toy sets. International Journal of Disability, Development and Education, 45, 127–142.

Luiselli, J. K., Matson, J. L., & Singh, N. N. (Eds.) (1992). Self-Injurious Behavior: Analysis, Assessment and Treatment. New York: Springer-Verlag.

Mahoney, G. (1992, July). Constructivism, play and children with disabilities. Paper presented at the Gulf Coast Conference on Early Intervention, Point Clear, Alabama.

Malone, D.M. (1994). Developmental correlates of social engagement in preschool children with mental retardation. International Play Journal, 2, 189-207.

Malone, M. (2009). Patterns of Home-and Classroom-based Toy Play of Preschoolers With and Without Intellectual Disabilities. International Journal of Disability, Development and Education, 56(4), 333-347.

Malone, D. M., & Langone, J. (1994). Object-related play skills of youths with mental retardation: A review of single-subject design research. Remedial and Special Education, 15, 177–188.

Malone, M.D. & Langone, J. (1995). Gender differences in the object-oriented play of preschoolers with cognitive delays. Journal of Early Intervention, 19, 302-314.

Martin, P. & Caro, T. M. (1985). On the functions of play and its role in development, Advances in the Study of Behavior, 15, 59–103.

Meire, J. (2007). Qualitative research on children‟s play. In Jambor, T., Van Gils, J., Several Perspectives on Children Play: Scientific Reflections for Practitioners. Apeldoorn, NL: Garant Uitgevers.

Missiuna, C., & Pollock, N. (1991). Play deprivation in children with physical disabilities: The role of the occupational therapist in preventing secondary disability. American Journal of Occupational Therapy, 45, 882-888.

Murphy, G., Carr, J., & Callias, M. (1986). Increasing simple toy play in profoundly mentally handicapped children: II. Designing special toys. Journal of Autism and Developmental Disorders, 16(1), 45-58.

Namey, E., Guest, G., Thairu, L. U. C. Y., & Johnson, L. (2008). Data reduction techniques for large qualitative data sets. Handbook for team-based qualitative research, 137-161.

Parten, M. (1933) Social play among preschool children, Journal of Abnormal and Social Psychology, 28, 136–147.

Pellegrini, A. D. & Smith, P. K. (1998a). The development of play during childhood: forms and possible functions, Child Psychology & Psychiatry Review, 3(2), 51–57.

Pellegrini, A. D., & Smith, P. K. (1998b). Physical activity play: The nature and function of a neglected aspect of play. Child development, 69(3), 577-598.

Piaget, J. (1962). Play, dreams, and imitation in childhood. New York: Norton.

Pierce-Jordan, S., & Lifter, K. (2005). Interaction of social and play behaviors in preschoolers with and without pervasive developmental disorder. Topics in Early Childhood Special Education, 25(1), 34–47.

Poulsen, A. A., & Ziviani, J. M. (2004). Can I play too? Physical activity engagement of children with developmental coordination disorders. Canadian Journal of Occupational Therapy, 71(2), 100-107.

Prochner, L. (2002). Preschool and playway in India. Childhood, 9(4), 435-453.

Rasmussen, T. H. (1983). Lekens betydelse [The importance of play]. Lund, Sweden: Liber Förlag.

Reid, D. H., DiCarlo, C. F., Schepis, M. M., Hawkins, J., & Stricklin, S. B. (2003). Observational assessment of toy preferences among young children with disabilities in inclusive settings: Efficiency analysis and comparison with staff opinion. Behavior Modification, 27, 233–250.

Rigby, P. (2007). Stability of playfulness across environmental settings: A pilot study. Physical & Occupational Therapy in Pediatrics, 27, 27-43.

Rubin, K. H., Fein, G. G., & Vandenberg, B. (1983). Play . In P. H. Mussen (Series Ed.) & E. M. Hetherington (Vol. Ed.), Handbook of child psychology: Vol. 4. Socialization, personality, and social development (pp. 693 – 774). New York: Wiley.

Sigafoos, J., Roberts–Pennell, D., & Graves, D. (1999). Longitudinal assessment of play and adaptive behavior in young children with developmental disabilities. Research in developmental disabilities, 20(2), 147-161.

Smith, P. K., & Vollstedt, R. (1985). On defining play: An empirical study of the relationship between play and various play criteria. Child Development, 56, 1042- 1050.

Annexure C: Codes created in analysis during exploratory study (phase 2)

Following codes were created in the grounded theory based analysis performed in the exploratory, interventional study in phase 2. List of codes is presented below in the following format – Code name {frequency of occurrence}

Code: adjusts her hair {2}
Code: arranging her handkerchief {0}
Code: asks for a particular toy {2}
Code: brings toy from other room {2}
Code: challenge toy 3.1 jigsaw puzzle {4}
Code: challenge toy 3.2 beads {7}
Code: challenge toy 4.1 beads {2}
Code: challenge toy 4.2 jigsaw puzzle {4}
Code: challenge toy 5.1 beads {8}
Code: challenge toy 5.2 jigsaw puzzle {2}
Code: challenge toy 6.1 shape sorting bucket {5}
Code: challenge toy 6.2 jigsaw puzzles {2}
Code: challenge toy 7.1 stacking cups {4}
Code: challenge toy 7.2 beads {2}
Code: check environmental object {1}
Code: checks other toys {4}
Code: child singing and blabbering {1}
Code: child tells he broke the toy {1}
Code: combines two tower {0}
Code: communication difficulty {31}
Code: constructive toy 3.1 playdoh {7}
Code: constructive toy 3.2 pinboard {8}
Code: constructive toy 4.1 blocks {8}
Code: constructive toy 4.2 playdoh {4}
Code: constructive toy 5.1 playdoh {6}
Code: constructive toy 5.2 blocks {6}
Code: constructive toy 6.1 playdoh {6}
Code: constructive toy 6.2 blocks {5}
Code: constructive toy 7.1 playdoh {6}
Code: constructive toy 7.2 blocks {3}
Code: creating play artifact of normal object {3}
Code: creating play space {3}
Code: difficulty to use (cognitive) {5}
Code: difficulty to use (motor) {10}
Code: doesn't want to leave play {9}
Code: doing mischief {8}
Code: ease of using toy {1}
Code: external interference error {14}

Code: facilitator error {1}
Code: facilitator stops play {3}
Code: feedback - checks beads growth {1}
Code: feedback - checks tower size {2}
Code: feedback - light from phone {1}
Code: feedback - putting in mouth {1}
Code: feedback - sensory ball light {4}
Code: feedback - smell {3}
Code: feedback - sound {24}
Code: feedback - tactile {4}
Code: feedback - visual on screen {1}
Code: feeling bored {7}
Code: feeling conscious {4}
Code: feeling dissappointed {3}
Code: feeling distracted: looks outside/around {21}
Code: feeling excited {9}
Code: feeling happy: smiles {95}
Code: feeling uninterested {0}
Code: focused {9}
Code: interaction with facilitator - verbal, gestural trigger {64}
Code: interaction with facilitator: child asks for approval {2}
Code: interaction with facilitator: child glances at fac {41}
Code: interaction with facilitator: child plays with fac {46}
Code: interaction with facilitator: child speaks {56}
Code: interaction with facilitator: fac speaks {33}
Code: interaction with facilitator: fac speaks - motivation {19}
Code: interaction with toys: arranging {5}
Code: interaction with toys: challenge play {9}
Code: interaction with toys: constructive play {8}
Code: interaction with toys: derived use {43}
Code: interaction with toys: explored {39}
Code: interaction with toys: gross motor play {7}
Code: interaction with toys: imaginary play {9}
Code: interaction with toys: packing/storing {7}
Code: interaction with toys: played as intended {44}
Code: interaction with toys: points at a toy {1}
Code: interaction with toys: pretend play {57}
Code: interaction with toys: sensory play {19}
Code: leaves play space {8}
Code: looks at himself in glass {3}
Code: looks for a particular color & size {3}
Code: makes sounds {8}
Code: moves his body playfully/rolls/dances {0}
Code: multiple color block {0}
Code: not focused on outcome or target {2}
Code: play affordance: doc set equipments not used as intended {1}
Code: plays with external toy {4}
Code: possible gender issue {0}
Code: pre-session context {10}
Code: repetitive play {3}

Code: seeking attention {21}
Code: sensory toy 3.1 xylophone {11}
Code: sensory toy 3.2 sensory balls {7}
Code: sensory toy 4.1 sensory ball {4}
Code: sensory toy 4.2 interactive phone {10}
Code: sensory toy 5.1 drum {8}
Code: sensory toy 5.2 sensory balls {5}
Code: sensory toy 6.1 drum {4}
Code: sensory toy 6.2 sensory balls {2}
Code: sensory toy 7.1 drum {4}
Code: sensory toy 7.2 interactive phone {10}
Code: starting from scratch {3}
Code: symbolic toy 3.1 kitchen set {2}
Code: symbolic toy 3.2 doll {12}
Code: symbolic toy 4.1 teddy bear {1}
Code: symbolic toy 4.2 doctor set {14}
Code: symbolic toy 5.1 kitchen set {2}
Code: symbolic toy 5.2 car {3}
Code: symbolic toy 5.3 doctor set {4}
Code: symbolic toy 6.1 doctor set {9}
Code: symbolic toy 6.2 cars {5}
Code: toy affordance: beads as maala {1}
Code: toy affordance: bouncing {0}
Code: toy affordance: light {0}
Code: toy affordance: moving the car {0}
Code: toy affordance: not understanding cup size difference {1}
Code: toy affordance: opening the sound ball {0}
Code: toy affordance: playing with playdoh box {2}
Code: toy affordance: pressing buttons {1}
Code: toy affordance: purple blocks for train {8}
Code: toy affordance: random beating {5}
Code: toy affordance: squeezing clay for tactile sensory play {1}
Code: toy affordance: squeezing for noise {3}
Code: toy affordance: swiping screen of mobile {4}
Code: toy affordance: using a specific utensil purposefully {5}
Code: toy breaks down {9}
Code: toy error {6}
Code: trigger - assistive {48}
Code: trigger - introductory {64}
Code: trigger denied {13}
Code: trigger enacted {38}
Code: trigger ignored {16}
Code: trying to take out stuck utensil {2}
Code: uses previous construction {0}

Annexure D: List of final concepts developed in exploratory study (phase 2)

List of concepts developed in the grounded theory based analysis during exploratory, interventional study in phase 2:

1. Child asks for approval from facilitator on which block to use in construction
2. Child plays with facilitator mostly in pretend play (over other types)
3. Allowing child to lead in play and being a follower might help establishing as a play partner
4. Playing down (inferior) and allowing child to dominate might help establishing as a play partner e.g. taking orders, showing lesser skill than child
5. Play affordance (unidentified usage of a toy to play) can be successfully introduced through modelling (gestural triggers) more often than verbal triggers in pretend and sensory play
6. Play affordance (unidentified usage of a toy to play) can be successfully introduced by indulging in on-going play narrative than explaining without indulging in pretend play
7. Children try to seek facilitator’s attention during play
8. Facilitator uses different techniques for facilitation based on play type
9. Children often ask facilitator to join in play
10. Child leaves play space (room) in the absence of facilitator
11. Child loses interest in play activity when facilitator withdraws from it
12. Pretend play is more meaningful and complex in the presence of facilitator
13. Children show meta-conversations in pretend play
14. Pretend play toy sets are always explored (looking around without playing) more than other play type toys
15. Pretend play is often repetitive to different degrees
16. Children derive play affordances from toys (not pretend play type toys) mostly in pretend play sessions
17. Play doh and beads are used most often for deriving (using for purposes other than expected) multiple play affordances
18. Level of creative play varies across children
19. Level of pretend play varies across children – depends on a set of indicators
20. Children like closing the lid of play doh box
21. Children like arranging parts/elements of toy as a part of their play
22. Children generally pack toys back after playing
23. Child becomes conscious when he breaks a toy

24. Sound feedback is related to expression of joy by the child
25. Expression of joy is related to child interacting with facilitator
26. Smiling is seen & can be used as an indicator of joyfulness during pretend play (as it involves interaction with facilitator in most cases)
27. Playing with facilitator leads to longer sessions than otherwise
28. Either pretend or constructive play, leads to highest engagement over other play types
29. Children like to swipe the screen of interactive phone toy
30. Children like to wear thread with beads as a maala (garland)
31. Play doh is often used for sensory play
32. Children can't differentiate between usual blocks & wedge-wheel based (special) blocks despite being told earlier
33. Children beat xylophone/drum randomly for sound & not in a rhythm
34. Children do not understand the difference in feedback for sensory balls (light vs sound) and get confused on which one leads to what, despite being told
35. Children show attachment to their construction after constructive play
36. Children love touch phone (real phone)
37. Children like to crash cars during pretend play with it
38. Children like to interact with their mirror image in glass during play
39. Children use multiple toys in a single play episode mixing toys from different play types
40. Children use one toy for multiple play purposes (different play types)
41. Children show a strong liking or attachment with a particular toy
42. Children's response to toys is not checked as a function of time (longitudinal study)
43. Children are in good mood while starting a session
44. Children seek enclosed play space on unwanted intrusion/ noise
45. Toys break down easily during play
46. Toys do not function properly and have ergonomic issues
47. Facilitator leads to error by leading or stopping a play episode
48. Play is interrupted by external interference caused by people walking by the room
49. Play is interrupted when child is stopped from making loud noise causing disturbance to other classes
50. Children ignore introductory triggers (used to introduce a new toy) which are only gestural (not verbal) in nature
51. A combination of verbal and gestural communication is more effective than only verbal communication from facilitator
52. Children make meaningful construction in constructive play
53. Xylophone/ drum is played more often than other toys in sensory play

54. Individual sensory episodes are small in duration, either because child is uninterested or external factors
55. Children face motor difficulty in joining blocks at times due to applying force at a wrong angle
56. Challenge element in toy often does not motivate a child to sustain interest in the play activity
57. Child may play a challenge based toy that offers difficulty if he is offered assistance by a facilitator
58. Child may play a challenge based toy if it offers difficulty which is not easy but achievable with assistance from a facilitator ensuring child does not make consecutive mistakes (2-3) and failure should not be sustained for long.
59. Beads never offer difficulty during challenge play
60. Jigsaw puzzle often is difficult for child to play on his own.
61. Children use objects from the environment to derive play
62. Children's level of interaction with environmental artefacts varies on personality
63. Children's level of interaction with facilitator and expressive behaviour varies based on personality
64. Children's order of selecting toys to play depends on child's personality and how interactive they are
65. Child seeks attention of facilitator to show progress in play
66. Gross motor play/ physical activity is related to expression of joy

Annexure E: Operational definition of analysis parameters in validation study (phase 3)

Validation, interventional study (phase 3) used a quantitative analytical framework, which looked at the play interaction of preschool children with ID using a set of parameters and associated terms, which are operationally defined as follows.

Trial: A trial is one complete cycle of inserting four shapes of the intervention stimulus. A condition may have multiple trials depending upon the number of times, child wanted to repeat playing with intervention stimulus. A trial may have multiple events, depending upon number of attempts made during the trial.

Fail attempt: This included instances where the subject was not able to insert the block in a hole and thus either moved to another hole, or got assistance after a certain interval, thus there could be multiple fail attempts in the same trial as level of assistance increased. Also, when a subject quickly placed a block or hovered over a hole to match the shape, we did not count it as a failed attempt unless the child had tried for more than 2s, as this was simple a way of comparison. [code: fail attempt].

Orientation problem: It included subject holding the block in wrong orientation [code: orientation problem - 2D] which was primarily a visual perception error, as well as the instances when orientation was correct but block was held in an oblique or vertical plane and thus didn't go inside [code: orientation problem - 3D] which was a combination of visual perception and motor coordination error. A combination of above two was also possible in some instances.

Joyfulness: It is measured by no. of instances subject was seen expressing joy by smiling or laughing. This happened most often when the block was placed successfully [code: child expresses joy], and in some instances, during restart protocols and playing of signal triggers and action fidelity feedback [code: children expresses joy – not on success]. We are excluding those instances though when subject was simply smiling back at facilitator seeing her laugh [code: child smiles back at fac].

Distraction: It included instances when subject was looking around and not focusing on toy, and there was no significant external interference at that point of time. This behaviour was prominent in very few children [code: distracted – looks around].

Facilitation compensation time (FCT): There were few cases in the initial data collection stage where the 15s assistance triggers protocol was not followed exactly, and these conditions could not be redone also. This error would make the condition difficult to compare with other conditions where protocols were followed timely, as the engagement time and effort time would be skewed. To normalize this error, a compensation factor was introduced called as FCT, whose value was 15 sec (ideal time between two triggers). In instances where the protocol was given before 13s (15s – 2s buffer) or after 17s (15s + 2s buffer), FCT would be used in place of the engagement time and effort time taken for that event, thus removing the error due to introduction of trigger, too early or too late. A buffer of 2s was treated as acceptable human error. Thus, the maximum a single shape insertion task lasted was 45s (15s X 3levels).

Total engagement time: Total engagement time (E_T) for a condition was calculated as: E_T = Total time taken for a condition **-** (Initiation time + Total time taken for restart protocols + time taken while child is distracted from the toy due to environmental factors + FCT if any) where, Initiation time is the time taken to introduce and model the toy (in some conditions) before the child started playing. Time taken for restart protocols is the time between two trials to reset the toy. FCT (defined above) may be positive or negative, if any.

Total effort time: Total effort time (Ef) for a condition was the time taken once the subject started insertion attempt till the time the block was inserted or left. Thus, success as well as fail attempts together constituted effort time. A high effort time implied that performance was low for a specific condition. Effort time, along with number of assistive triggers, was calculated primarily to check if there was any practice effect due to serial exposure to conditions.

Annexure F: Codes created in analysis during validation study (phase 3)

List of codes used during the analysis in validation study, allowing multiple perspectives on the emerging insights from statistical analysis -

1st time success
Action fidelity feedback does seem to affect
Action fidelity feedback doesn't affect
assistance - direct
assistance - guiding to chose right animal
assistance - indirect
assistance - modeling
child beats the block on toy
child claps hands
child does not wait for signal feedback
child does not wait for success feedback
child expressed joy - not on success
child expresses dissappointment
child expresses joy
child identifies animal sound
child interacts with character
child leaves the block stuck on hole
child looks at fac
child looks confused
child looks excited
child looks scared
child not able to follow rules/instruction
child not able to identify animal graphics
child not able to identify animal sound
child seemed interested
child shows fac selected block
child smiles back at fac
child speaks to fac
child waits for feedback
child waits for feedback - absent
circle
clear decision making
distracted - looks around
error - apply FCT
error - apply FCT-tot
error - toy part breaks
error - block goes in wrong hole
error - child moves the flap & puts block
error - delay due to coughing
error - external interference
error - high ambient noise
error - wrong sound played by mistake

explores the toy
fac appreciation
fail attempt
fail attempt - child feeds wrong animal
initiation protocol
no clear decision making
orientation problem
orientation problem - 3D
persistence
persistence - short
position - LB
position - LT
position - RB
position - RT
puts hand in hole
Reapproaches toy in same session
restart protocol
shows pretend play
square
success attempt
termination phase
trapezium
triangle
tries to take block out from hole
wrongly fed - cat/triangle
wrongly fed - cow/circle
wrongly fed - dog/square
wrongly fed - tiger/trapezium

Annexure G: Statistical analysis in the validation study (phase 3) using parametric tests

The validation study primarily used a quantitative analytical framework, by statistical analysis of measured variables including engagement, joyfulness and effort time. Following tables were developed using *SPSS statistics* by application of parametric tests on these variables.

1. Engagement duration

Descriptive statistics

	Mean	Std. Deviation	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
Cond 1	2.691	1.6294	1.436	.661	2.004	1.279
Cond 2	4.255	2.6523	.241	.661	-.988	1.279
Cond 3	2.891	1.5443	.496	.661	.086	1.279
Cond 4	7.791	4.1455	.318	.661	-1.076	1.279
Cond 5	7.082	3.6826	.249	.661	-1.720	1.279

Table G1. Descriptive statistics for pooled means of engagement duration for each condition, including the Skewness and Kurtosis values.

1 way Analysis of Variance (ANOVA)

Source		df	F	Sig.	Partial Eta Squared
condition	Sphericity Assumed	4	11.082	.000	.526
	Greenhouse-Geisser	2.417	11.082	.000	.526
	Huynh-Feldt	3.242	11.082	.000	.526
	Lower-bound	1.000	11.082	.008	.526
Error (condition)	Sphericity Assumed	40			
	Greenhouse-Geisser	24.171			
	Huynh-Feldt	32.425			
	Lower-bound	10.000			

Table G2. One-way ANOVA applied on pooled means of engagement duration between conditions using alpha (α) = 0.5

Paired samples t test

Pair	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Cond 1 - Cond 2	-1.5636	1.8046	.5441	-2.874	10	.017*
Cond 1 - Cond 3	-.2000	1.5620	.4710	-.425	10	.680
Cond 1 - Cond 4	-5.1000	3.0695	.9255	-5.511	10	.000*
Cond 1 - Cond 5	-4.3909	3.7684	1.1362	-3.864	10	.003*
Cond 2 - Cond 3	1.3636	1.7031	.5135	2.656	10	.024*
Cond 2 - Cond 4	-3.5364	3.5319	1.0649	-3.321	10	.008*
Cond 2 - Cond 5	-2.8273	4.2379	1.2778	-2.213	10	.051
Cond 3 - Cond 4	-4.9000	3.8856	1.1716	-4.182	10	.002*
Cond 3 - Cond 5	-4.1909	3.8250	1.1533	-3.634	10	.005*
Cond 4 - Cond 5	.7091	4.3585	1.3142	.540	10	.601

Table G3. Paired samples t-test for pooled means of engagement duration between conditions using alpha (α) = 0.5

2. Engagement frequency

Descriptive statistics

	Mean	Std. Deviation	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
Cond 1	1.80	.789	.407	.687	-1.074	1.334
Cond 2	2.90	1.663	.739	.687	-.310	1.334
Cond 3	1.60	.516	-.484	.687	-2.277	1.334
Cond 4	5.30	3.401	.717	.687	-1.427	1.334
Cond 5	2.60	1.430	.319	.687	-1.163	1.334

Table G4. Descriptive statistics for pooled means of (re)engagement frequency for each condition, including the Skewness and Kurtosis values **for all children excluding 'Shl' who was an outlier**

Mauchly's test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse - Geisser	Huynh-Feldt	Lower-bound
condition	.010	34.027	9	.000	.470	.591	.250

Table G5. Mauchly's test of sphericity performed on pooled means of (re)engagement frequency showing a violation of sphericity and corresponding epsilon values foor correction

1 way Analysis of Variance (ANOVA)

Source		df	F	Sig.	Partial Eta Squared
condition	Sphericity Assumed	4	7.565	.000	.457
	Greenhouse-Geisser	**1.881**	**7.565**	**.005**	**.457**
	Huynh-Feldt	2.362	7.565	.002	.457
	Lower-bound	1.000	7.565	.022	.457
Error (condition)	Sphericity Assumed	36			
	Greenhouse-Geisser	**16.933**			
	Huynh-Feldt	21.259			
	Lower-bound	9.000			

Table G6. One-way ANOVA with Greenhouse-Geisser correction applied on pooled means of (re)engagement frequency between conditions using alpha (α) = 0.5

Paired samples t test

Pair	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Cond 1 - Cond 2	-1.100	1.370	.433	-2.538	9	.032*
Cond 1 - Cond 3	.200	.422	.133	1.500	9	.168
Cond 1 - Cond 4	-3.500	3.206	1.014	-3.452	9	.007*
Cond 1 - Cond 5	-.800	1.619	.512	-1.562	9	.153
Cond 2 - Cond 3	1.300	1.337	.423	3.074	9	.013*
Cond 2 - Cond 4	-2.400	3.204	1.013	-2.369	9	.042*
Cond 2 - Cond 5	.300	2.627	.831	.361	9	.726
Cond 3 - Cond 4	-3.700	3.302	1.044	-3.544	9	.006*
Cond 3 - Cond 5	-1.000	1.633	.516	-1.936	9	.085
Cond 4 - Cond 5	2.700	3.199	1.012	2.669	9	.026*

Table G7. Paired samples t-test for (re)engagement frequency between conditions using alpha (α) = 0.5

3. Effort time/ trial

Descriptive statistics

	Mean	Std. Deviation	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
Cond 1	.9391	.48502	1.635	.661	2.659	1.279
Cond 2	.7664	.58575	.611	.661	-.991	1.279
Cond 3	1.1618	.75261	1.748	.661	2.929	1.279
Cond 4	.6710	.43605	.760	.687	-.831	1.334
Cond 5	.6136	.51802	.780	.661	-.996	1.279

Table G8. Descriptive statistics for pooled means of rate of effort time for each condition, including the Skewness and Kurtosis values

Mauchly's test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse - Geisser	Huynh-Feldt	Lower-bound
condition	.183	12.605	9	**.191**	.625	.884	.250

Table G9. Mauchly's test of sphericity performed on pooled means of rate of effort time

1 way Analysis of Variance (ANOVA)

Source		df	F	Sig.	Partial Eta Squared
Condition	Sphericity Assumed	**4**	**6.328**	**.001**	**.413**
	Greenhouse-Geisser	2.499	6.328	.004	.413
	Huynh-Feldt	3.536	6.328	.001	.413
	Lower-bound	1.000	6.328	.033	.413
Error (Condition)	Sphericity Assumed	**36**			
	Greenhouse-Geisser	22.490			
	Huynh-Feldt	31.825			
	Lower-bound	9.000			

Table G10. One-way ANOVA applied on pooled means of rate of effort time between conditions using alpha (α) = 0.5

Paired samples t test

Pair	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Cond 1 - Cond 2	.17273	.48038	.14484	1.193	10	.261
Cond 1 - Cond 3	-.22273	.60559	.18259	-1.220	10	.251
Cond 1 - Cond 4	.31500	.47633	.15063	2.091	9	.066**
Cond 1 - Cond 5	.32545	.38526	.11616	2.802	10	.019*
Cond 2 - Cond 3	-.39545	.46813	.14115	-2.802	10	.019*
Cond 2 - Cond 4	.15000	.29140	.09215	1.628	9	.138
Cond 2 - Cond 5	.15273	.27108	.08173	1.869	10	.091
Cond 3 - Cond 4	.56500	.44096	.13945	4.052	9	.003*
Cond 3 - Cond 5	.54818	.40052	.12076	4.539	10	.001*
Cond 4 - Cond 5	.01200	.18701	.05914	.203	9	.844

Table G11. Paired samples t-test for pooled means of rate of effort time between conditions using alpha (α) = 0.5

Annexure H: Statistical analysis in the validation study (phase 3) using non-parametric tests

To account for the small sample size and nature of data in the form of frequencies, non-parametric tests were used to further check the results obtained from parametric tests. Following tables were developed using *SPSS statistics* by application of non-parametric tests on these variables.

Friedman test followed by Wilcoxon signed-rank tests for post-hoc analysis using the same level of significance i.e. $p<0.05$.

1. Engagement frequency

Descriptive statistics

	N	Percentiles		
		25th	50th (Median)	75th
Cond 1	11	1.00	2.00	3.00
Cond 2	11	2.00	3.00	5.00
Cond 3	11	1.00	2.00	2.00
Cond 4	11	3.00	5.00	10.00
Cond 5	11	1.00	3.00	4.00

Table H1. Descriptive statistics for pooled means of (re)engagement frequency of all children for each condition

Friedman's test for variance between conditions

N	11
Chi-Square	26.989
df	4
Asymp. Sig.	.000

Table H2. Friedman's test applied on pooled means of (re)engagement frequency between conditions using alpha (α) = 0.5

Wilcoxon Signed Ranks test

Condition pair	Z	Asymp. Sig. (2-tailed)
Cond 2 – 1	-2.414[b]	.016*
Cond 3 – 1	-1.414[c]	.157
Cond 4 – 1	-2.950[b]	.003*
Cond 5 – 1	-1.723[b]	.085
Cond 3 – 2	-2.555[c]	.011*
Cond 4 – 2	-2.552[b]	.011*
Cond 5 – 2	-.060[c]	.952
Cond 4 – 3	-2.952[b]	.003*
Cond 5 – 3	-1.990[b]	.047*
Cond 5 – 4	-2.201[c]	.028*

Table H3. Wilcoxon Signed Ranks test for (re)engagement frequency between conditions using alpha (α) = 0.5. [b]based on positive ranks, [c]based on negative ranks

2. Effort time/ trial

Descriptive statistics

		Percentiles		
	N	25th	50th (Median)	75th
Cond 1	10	.7125	.8450	1.1725
Cond 2	10	.2850	.7350	1.2700
Cond 3	10	.7075	.9300	1.6500
Cond 4	10	.3600	.4700	1.1100
Cond 5	10	.2100	.4350	1.1325

Table H4. Descriptive statistics for pooled means of rate of effort time of all children for each condition

Friedman's test for variance between conditions

N	10
Chi-Square	13.374
df	4
Asymp. Sig.	.010

Table H5. Friedman's test applied on pooled means of rate of effort time between conditions using alpha (α) = 0.5

Wilcoxon Signed Ranks test

Condition pair	Z	Asymp. Sig. (2-tailed)
Cond 2 – 1	-1.067[b]	.286
Cond 3 – 1	-.968[c]	.333
Cond 4 – 1	-1.886[b]	.059
Cond 5 – 1	-2.136[b]	.033*
Cond 3 – 2	-2.179[c]	.029*
Cond 4 – 2	-1.482[b]	.138
Cond 5 – 2	-1.779[b]	.075
Cond 4 – 3	-2.701[b]	.007*
Cond 5 – 3	-2.849[b]	.004*
Cond 5 – 4	-.408[b]	.683

Table H6. Wilcoxon Signed Ranks test for rate of effort time between conditions using alpha (α) = 0.5. [b]based on positive ranks, [c]based on negative ranks

Annexure I: Classifications based on user behavioural characteristics in validation study (phase 3)

To complement the quantitative analysis in validation study, qualitative analysis included a number of classification based on observed behaviour of children, which helped in identifying commonalities and patterns within the population, in relation to playfulness and other significant variables. These classifications are listed below:

1. Based on signals given in condition 5
   a. Rules itself not comprehended
   b. Signals not comprehended in multiple occasions
   c. Signals comprehended but not identified
   d. Signals comprehended and identified
2. Ability to identify animal graphics
   a. Always
   b. Sometimes
   c. Never
3. Child's interaction with narrative & characters
   a. Shows gestures of interaction
   b. No gestures but playfulness in condition 4 & 5 > condition 2
   c. No gestures & playfulness in condition 4&5 not > condition 2
4. Initial interest in the toy
   a. Low (less than 3)
   b. Medium (less than 5)
   c. High (5 or more)
5. Decision making ability in restart protocols
   a. Poor
   b. Moderate
   c. Good
6. Relationship with facilitator
   a. Friendly & makes independent decisions
   b. Indifferent but makes independent decisions
   c. Follower & doesn't make independent decisions

7. Shape perception ability (fail attempts, orientation problem, wrong insertion error)
    a. High (0 of 3 issues present)
    b. Medium (1 of 3 issues present)
    c. Poor (2 of 3 issues present)
    d. Very Poor (3 of 3 issues present)
8. Motor coordination ability (orientation 3D)
    a. Low (all shapes)
    b. Medium (1 or 2 shapes)
    c. High (no shape)
9. Child's level of patience
    a. Waits for signal & success feedback
    b. Waits for only success feedback
    c. Doesn't wait for any feedback
10. Child's response to feedback
    a. Expresses joy only on success
    b. Expresses joy on all auditory feedback, triggers
    c. Expresses fear on feedback
    d. No response
11. Child's ability to focus
    a. Poor focus and short attention span
    b. Moderate focus (some cond show poor focus)
    c. Good focus (no cond shows poor focus)
12. Action fidelity feedback
    a. Always understood
    b. Sometimes understood
    c. Never understood
    d. Can't decide but seems never understood
    e. Can't decide but seems always understood

Annexure J: List of selected memos cited in the thesis

A total of 180 memos were created during the analysis process, playing a crucial role in theory formation. Some of the memos which have been cited in the thesis are listed below for reference. It is worth noting that memos were created and edited over the course of the analysis, as data was revisited multiple times, and the associated date represents the creation of memo and not the date of corresponding data collection.

Memo 3: It became clear in this session that she knows how to play ring game by inserting rings in the needles. She also seems to have a control on how much and often to press the button, however she did not care to wait till the end to complete all rings and shook the gamepad after she had completed 3-4. This also shows that target is not as important for her as the process. She does not strive for going beyond her usual limit. After 2-3 turns, she loses interest. (‘Tan’, May 5th 2014)

Memo 6: In this sequence, we notice that the child takes apart blocks from what she was doing and redoes it with changes, which could mean that the child is not randomly connecting and might have some idea for construction. Also, in a number of occasions later, the child is seen to make constructions from blocks of different size and colors which are not linear thus again leading to a possibility that the child is making something not random, however due to lack of communication ability, we could not ask what she was making.3

In third session, she is actually conversing and tells should i make this? She does seem to have an idea of what she is making. However, in no occasion one could figure out from the shape as it looks random. (‘Tan’, May 2nd 2014)

Memo 13:

She is keen on arranging and tiding while playing -

1. She took out all the blocks after playing and stored them (no attatchment to what she made),
2. She took out the beads also.
3. Uses Hankerchief and folds it very meticulously

Approaches all toys almost serially (‘Tan’, May 4th 2014)

Memo 22: ‘Swa’ approaches beads without any trigger. He likes to check everytime he puts a bead (similar to ‘Tan’'s play with blocks) and also shows it to facilitator and becomes happy on appreciation.

He says he will finish till the end but leaves it after some time. (process over outcome) (‘Swa’, July 18th 2014)

Memo 23:

1) Child asks facilitator to make 'kursi' with blocks which he had done in the last session, although he himself doesn't play with it. Later in the same session, he again asks facilitator to make a 2nd kursi after facilitator has made one.

2) In 2nd session, it is the child who has invited facilitator to participate – for blocks, pretend play with mobile. (‘Swa’, July 18th 2014)

Memo 27: It seemed that when facilitator left the child initially, he lost interest in all the toys after some time but when facilitator came back, he could play with the same toys for a much longer time as he could talk to him or in some cases make him play partener. Thus, it is possible that presence of facilitator may enhance the duration of engagement. (‘Swa’, July 19th 2014)

Memo 29: facilitator explains about the injection by modeling it on himself. He produces a sound while pushing the injection. The child seems to like it and laughs at it. Later, child also uses the injection and gets surprised when the facilitator produces the sound which makes child laugh. (‘Swa’, July 17th 2014)

Memo 30:

1. After initially asking facilitator to make kursi using blocks couple of times, he finally starts playing himself. He seems intended to make a meaningful construction and even keeps narrating what he is doing. It also becomes clear when he is looking for a particular block.
2. In the end he shows off his construction to not only the facilitator but also the teacher in the next room. This tendency of showing and seeking appreciation was seen in playing with beads too. (‘Swa’, July 18th 2014)

Memo 34: ‘Swa’ asks the facilitator not to break his construction but to keep it as it is on the shelf. Some of the earlier children did not show any attachment to their creation. - related to process over outcome category (edit - this category had been later rejected) (‘Swa’, July 18th 2014)

Memo 35: ‘Sid’ invited facilitator to play couple of times and likes playing with him. She followed him as he swept over the planks of xylophone serially. This is another instance of learning an affordance from facilitator. There is an interesting interaction between the two as they both play together.

‘Tan’ had shown similar behavior. (‘Sid’, July 8th 2014)

Memo 41: ‘Sid’ seems to exhibit the longer and more complex of pretend play episodes compared to some other children like ‘Tan’ and ‘Par’. In parts, her behavior seems very focused. She pretended to first make food using kitchen set and play doh and then fed the doll with food and water. She acted scenes like blowing the vessel containing water as it was hot to make it cooler for doll (imaginary play). Again she went back to make something using play doh. She used the 'kaddukas' to shred the playdoh like done for vegetables. She also brushes her hair using the sticks of xylophone and puts jigsaw piece in her hair (derived play). She talks to the doll, beats and gets angry on her and pats her like a play companion it seems. At the end of the first session, she tries to do the beads and xylophone through doll's hands while talking to her (3rd person perspective). Here play doh is being used as pretend as well as constructive toy since it is being molded to make something meaningful by the child. Again playing with doll and beads/xylophone together, led to mixing of play categories.

This mixing of categories in play episode has been seen in case of ‘Par’ too. 2nd session was generally repetitive in terms of overall act however it did not include the episodes with doll and focused more on making a dish, however her actions were different at times e.g. the utensils she used or sequence. Her pretend play seems to be most meaningful in terms of interpretation and process based rather than disjoint small acts. (‘Sid’, July 8th 2014)

Memo 43: ‘Sid’ did not seem as excited as in earlier session on seeing just the beads. She does play but seems distracted throughout the session. She is easily able to put beads in thread but after a few she looses interest and takes them out. She wraps string on her hand, and tries to derive play. (‘Sid’, July 11th 2014)

Memo 49: Child constantly communicates back and forth with the facilitator by humming and nodding. While I was not able to understand exactly what was being conveyed, he seems to be comfortably communicating.
He even plays an imaginary play episode with facilitator using hands as gun to shoot each other. Without language, play can also be used to communicate? (‘Par’, June 27th 2014)

Memo 51: Child showed a number of creative derived play possibilities with beads - rotating, wearing it like a garland, arranging it on ground, wearing it in fingers, striking them like in carrom. These affordances were all drawn by him without any trigger. (‘Par’, June 27th 2014)

Memo 62: The facilitator interacted with the child during his play with cars. The child responded positively and let the facilitator be a part. He passed a car to the facilitator.
Child than learned the aspect of making sound (zoooo) while pushing a car and also to imaginatively fly the car rather than pushing on the ground only, after seeing facilitator doing it himself. The child could learn these new affordances after being modeled during play once. Could it be said that it is easier to teach the child new affordances by being a play partener? Would all children accept the facilitator like he did? Learning to play is a domain where this memo can be useful.
Sequence of play - Car, Sound ball, (‘Par’, June 23rd 2014)

Memo 64: Interestingly, till now the child was being helped by facilitator as he was unable to join puzzle pieces but when he fails to do it on his own, he soon makes a disappointing sound and loses interest. He then picks sound ball kept next to him.

Does this substantiate that the children do not continue as soon as they find it difficult? Although he has a lot of options right now for switching. Also, it looks like that there is a need of facilitator intervention when introducing challenges to these children so that they remain interested. (insight for facilitation)

After sound ball, child again comes back to puzzle. This time he is helped by facilitator but still he does not manage to finish the puzzle and loses interest. (‘Par’, June 27th 2014)

Memo 70: Child invites facilitator to play - play seems to be basic functional play involving moving the car and striking them with each other - child gets excited when a car bumps with other car or any other object - there is no meaningful sequence (narrative)involved (‘Mok’, July 28th 2014)

Memo 73: Similar to earlier instance with another child, ‘mok’ is seen here calling for facilitator when he goes outside. ‘Mok’ follows him and looks mischievous as he is asked to go back. (‘Mok’, July 29th 2014)

Memo 74: This is the first time we have seen that beads are not put one by one, but 4 of them put together without seeing the progress.

He was also seen to put thread with beads across his neck like a maala, like earlier children, without a trigger. (‘Mok’, July 28th 2014)

Memo 77: ‘mok’ derives play from beads by counting it although he does not do it correctly. He also keeps on pointing the beads towards the facilitator and smiling at him. (‘Mok’, July 28th 2014)

Memo 110: On 2nd instance, he shows connected sequences of **imaginary play** where he makes food, roti using utensil and gas and serves to facilitator 3-4 times (trigger was given). The overall act seems repetitive but actions are not always the same. This more complex version happens when **facilitator introduces himself in play, making it more meaningful**. Also, to note, that earlier instance was much shorter and ‘Mok’ lost interest much sooner when playing alone.

Sequence of events in 2nd play with kitchen set-

1. pretends to use belan and chakla to make roti
2. puts roti on gas stove

    fac says, "I also want to eat", and ‘mok’ nods

3. pretends to cook on stove and puts in box using spoon
4. closes the box and opens it again
5. pretends to take some imaginary material fom different vessels and puts in box
6. closes the box

7. picks the kaddukas and copies its action poring in one bowl

8. gives to facilitator, both bowl and box

fac praises and he nods.

9. picks another bowl and pretends to put material into it

10. gives bowl to facilitator

watches facilitator and smiles

fac returns and says thank u

11. puts utensil on rack

12. pretends to mix and flip with spoon in a bowl

13. gives bowl to facilitaor

14. nods and smiles

15. facilitator returns and child puts utensil on rack

external interference - child calls for someone

16. puts material in box and closes it

17. pretends to switch on gas stove

18. gives bowl and spooon to facilitator

19. now gives him box and watches him eat with a smile (‘Mok’, Oct 9th 2014)

Memo 111: After exploration, ‘Mok’ invites facilitator to play. He pretends as a doctor using all the equipments unlike ‘Swa’ who used only few and shows connected set of meaningful actions. Overall act of treating the patient is **repeated** with some new actions during the act. Also, use of mirror, card and thermometer does not seem clear to him. He is the **leader most of the time**, while facilitator plays along. He also seems to smile and become happy when facilitator responds to his actions especially when facilitator acts as if he is afraid of injections when ‘Mok’ attempts to inject him.

Sequence of events in play session -

1. checks with stethescope
2. wears doctor glasses
3. takes scissors, facilitator pretends to be afraid, so he smiles and keeps
4. takes injection and applies
5. laughs when facilitator gives the reaction of hurting himself
6. gives thermometer to facilitator to use
7. pretends to put tube content on mirror (seeing teeth)
8. gives tube to facilitator and asks to use
9. gives mirror to facilitator
10. opens the box and pours tube content in it
11. takes scissors and pretends to cut something above box
12. puts scissors on facilitator's finger and pretends to cut something

13. again takes scissors and pretends to cut something above box
14. takes knife and mixes content in box
15. pours from thermometer and makes a sound
16. puts mirror and knife in facilitator's mouth making sound (like cleaning mouth)
17. puts thermometer in facilitator's mouth
18. pretends to give some imaginary stuff in facilitator's mouth
19. takes scissor and pretends to cut from beard and use it
20. uses injection and smiles when facilitator reacts as if he is hurt

    facilitator says, "put medicine on it"

21. puts medicine from the bottle and makes a sound
22. takes plate, pours from thermometer into it
23. fills injection
24. takes scissors and pretends to cuts card above plate
25. takes scissors and pretends to cut something above box
26. pours from tube and thermometer into plate
27. plays drum for 1 second
28. mixes the content in plate using knife
29. takes from knife and puts in facilitator's mouth and also pretends to cut something from mouth using scissor
30. applies injection with a sound

    facilitator acts as if hurt

31. puts medicine from the bottle and makes a sound
32. takes scissors and pretends to cut mirror above box

    facilitator says, "mujhe lagi yahan pe" (pointing on hand)

33. pours content of plate on hand where facilitator had asked
34. puts mirror and thermometer in mouth and makes sound
35. looks into mirror
36. uses mirror to mix content in box
37. pours tube content in plate
38. pours thermometer and mirror content in plate
39. gives plate to facilitator

    facilitator says, "I am fine now. Thank you". ('Mok', Oct 9th 2014)

Memo 114: Child learned the affordance of attaching wheel to the purple block after being modeled the first time by facilitator. 'Mok' tries to do it himself in 2nd occasion but could not find enough wheels and even seeks facilitator's help. ('Mok', Oct 9th 2014)

Memo 117: 'Mok' is seen to leave the play space and go to the adjoining rooms whenever facilitator is not with him. He picks up any toy he can find from there and brings it in the play space. It could either be that he wants to bring more toys (in 1st occasion he actually found toys hidden in drawers) or just that he does not like to sit and play alone in play space. However, it is important to note that he resumes play from where he left as soon as the facilitator sits. ('Mok', Oct 11th 2014)

Memo 121: 'Mok' started with 5-piece puzzle and had a lot of difficulty in completing. He needed a number of assistive triggers. However, he was able to complete 4-piece and 3-piece puzzle with relative ease. He did not leave play on facing difficulty however he was assisted and did not have to struggle too long.

Isn't it true for earlier cases too that cognitive difficulty was seen in puzzles esp when child tried 5 piece puzzle or more? ('Mok', Oct 11th 2014)

Memo 123: 'Mok' is seen to follow a similar strategy where he puts 2-3 beads at a time and then takes a break. Infact, there is only small amount of time he spends in challenge play but mostly he is interested in deriving other play uses from it e.g. swinging the thread with beads, wearing it like maala, etc.

He often acts naughty while swinging the thread as he keeps on doing it and enjoying even when facilitator asks him not to. Also, we have seen that communication has been largely understood between the two in most occasions.

Lastly, the child was asked to clear his nose and thus interrupted from play at the end, instead of him leaving the play. ('Mok', Oct 11th 2014)

Memo 127: 'Mok' was seen over-active while playing with blocks. He would quickly push or even beat the blocks over each other to join due to which sometimes he faced motor difficulty. He asked for facilitator's help to make car from purple block but later was seen failing to understand that purple block could not be used in the normal construction. He also asked for facilitator's approval while joining in 2-3 occasions and often glanced at facilitator while playing. ('Mok', Oct 11th 2014)

Memo 130: It has been seen in this and earlier instances that 'Mok' does not respond to gestural triggers e.g. drum, sensory balls. In this instance, he finally enacted on introductory trigger when facilitator explicitly asked him if he wanted to play with sensory balls. He probably saw playing of drum or sensory ball squeezing as facilitator is playing with it, and it did not bother him and affect his ongoing play. ('Mok', Oct 16th 2014)

Memo 132: When a child from outside starts peeping from the door which eventually disturbs the doctor-patient pretend play inside, facilitator asks him to go and pushes the door. 'Poo' also gets up and asks facilitator to lock the door showing that he wants to create a play space uninterrupted by external interference. ('Poo', Nov 10th 2014)

Memo 134:

4. Child starts enacting the PT sessions that he has (supposedly happening outside) by playing the drum and telling facilitator steps of PT while facilitator enacts role of a child following his instructions
5. Again, **child dominates** and tells facilitator to follow his commands, at times getting angry, when facilitator is not performing like he wants.
6. Here also, **child invited** fac to play
7. There is a clear **communication gap** this time as facilitator fails to understand what Poojan is trying to tell him to do.
8. It is interesting how Poojan **makes notes** in notebook (like a real teacher would). (also using environmental artefacts in social connection category)

Sequence of events in pretend play -

1. Asks fac to stand (says "upar) and shows by standing himself

2. Plays drum beat and puts his hand forward to show to fac

3. Moves his hands again with drum beat asking fac to repeat

4. Repeats step 3 (communication problem)

External interference

5. Fac says I wil doo while sitting

6. Child keeps on correcting while playing drum but not clear

7. Plays drum and asks to stand and sit

8. Takes my notebook and enacts writing

9. Asks my name and enacts to write something. (‘Poo’, Nov 10th 2014)

Memo 138: ‘Poo’ always seemed interested in what was going on in PT drill. He is seen getting exciting and shouting *Saavdhaan* (Attention) in two different occasions. It could also be seen with his pretend play session with drum where he enacted the PT drill. In the present instance also, he got up, leaving the toys and started enacting the drill listening to the drum beats coming from outside. He then briefly looked around in other room. (‘Poo’, Nov 10th 2014)

Memo 140: As seen earlier also, ‘Poo’ is seen to derive play from playdoh boxes and not playdoh itself. Infact, he verbally denies introductory triggers when play doh is introduced in play. The boxes are used for following derived play activities -

1. Opening and closing the lids of boxes (fine motor play) - in one previous occasion also, child was seen simply opening the lids of boxes and taking out the playdoh.

2. Balancing boxes one over other like a tower (constructive play)

3. Facilitator pretending to drink from each of the box. Child says he is giving tea (**imaginary** pretend play - probably trigger given by facilitator) - It is again an example of introducing play affordance in

pretend play by modeling and narrative (also seen in memo 141 in pretend play with doctor set) ('Poo', Nov 10th 2014)

Memo 141:

- Child invites facilitator to join and choses the role of patient this time initially, not repeating the previous session, the sequence still remains the same though with roles reversed. However, post this, again he took the role of doctor and **repeated** the same set of actions multiple times as in session 1 (memo 133) i.e. checking with stethescope - applying injection.
- The **balance of power** keeps shifting between the two based on who is playing the doctor and leading in pretend play.
- **Communication** has sometimes been fine when child speaks while at other times, fac fails to understand (e.g. when discussing medicine) and simply nods
- Child has been seen to learn a play affordance of filling injection after being modeled by facilitator similar to memo 140

Sequence of events in pretend play -

1. Facilitator checks child using stethescope (intentionally making sound from it)

2. Fac tells that injection will have to be taken, and child resists initially (may be copying what fac did in last session)

3. Child than tells that injection to be put on his hand

4. Child makes fac lay down and act as a patient

5. Child checks fac with stethescope

6. Child asks fac to keep his eyes closed

7. Child applies injection to fac's hand

8. Fac asks child to give him medicine (assistive trigger)

9. Child pretends to pur medicine and talks to facilitator (communication problem) as fac nods

10. Child picks up doctor badge and fac assists him in wearing it

11. Child than picks up the box & pretends to apply the content like lotion on facilitator's hand where he had put injection (**imaginary play**)

Child denies introductory triggers for jigsaw puzzles and cars

12. Child instructs fac to resume pretend play by asking him to come over and use injection

13. Fac checks child with stethescope

14. Fac prepares injection by mixing medicine content and filling injection (**modeling for toy affordance**)

15. Fac appplies injection to child

16. Child smiles and says thank you sir.

Child denies introductory triggers for blocks

17. Child asks fac to lay down again and picks up injection, plate and stethescope
18. Child takes fac help to open the injection
19. Child checks fac with stethescope
20. Child applies injection to fac (fills up the way fac had modeled earlier) (‘Poo’, Nov 10th 2014)

Memo 148:

- Play is mostly **functional symbolic** as ‘Poo’ pushes the car and hits them against each other. At times, he **arranges** the car side by side, or one after other. There does not seem to be a narrative however.
- ‘Poo’ intentionally pushes a car outside the room despite of being told to. The **need to have a segregated play space is missing**, as he is violating the physical boundary (or is it that he feels so only when an external person interferes, and otherwise physical boundary is not relevant?)
- Also, ‘Poo’ does not listen to facilitator's instructions seriously which again shows that facilitator does **not have any dominance** and is treated as equal or lesser by the child
- Child gives up playing with cars soon after **facilitator withdraws from the play** and sits at a distance. (Seen in play with doctor set also)

Again **speech when assisted with gestures** is understood by facilitator while only speech mostly fails to communicate e.g. gesturing to sit, gesturing to move car or hold it, etc. (‘Poo’, Nov 11th 2014)

Memo 155: The significance of facilitator can be seen here from the fact that as soon as facilitator left the play space, ‘Poo’ stopped playing with doctor set for pretend play. He was simply exploring, and swinging the stethescope around. He seemed distracted for some time not knowing what to do (facilitator was playing with him with doctor set before leaving). (‘Poo’, Nov 14th 2014)

Memo 157: This is one of the rare occasions where ‘Poo’ is seen seeking attention of facilitator to show that he has been able to put a block in shape sorting bucket (Sharing his success). (‘Poo’, Nov 15th 2014)

Memo 160: 1. ‘Kri’ keeps on playing with beads till the thread ends and had to be **asked to try out other toys** to make him change it.
2. However, he is seen **distracted most of the times**, often exploring other toys kept around him, to the extent that couple of times he picks up something else apart from beads because he is looking and thinking about something else.
3. ‘Kri’ shows a **little bit of motor difficulty** at times while putting beads in thread, which might have led to task not becoming too trivial.
4. ‘Kri’ seems to be **getting more interested and excited as the thread comes close to finish**, as seen from his gestures like sitting upright, increase in speed, etc.

5. In the end, ‘Kri’ could not hold the thread and some of the **beads fell out, but he again resumed** putting them and was trying hard till the end.

Points 1, 4 & 5 show that ‘Kri’ unlike many other children, likes the challenge play aspect of beads. (‘Kri’, Nov 16th 2014)

Memo 161: ‘Kri’ seemed interested and quickly started playing with stacking cups on trigger however he did not seem to understand the size variation between the cups and thus could not connect them in right sequence. He was able to complete it with the help of assistive triggers (fac correcting the sequence) given by facilitator. (‘Kri’, Nov 16th 2014)

Memo 164: ‘Kri’ again shows focused play after being given the introductory trigger for blocks. He shows meaningful play and seems to be making buildings (or may be walls of a house). When asked, he says, he is making a house. Another interesting point is that he chooses blocks of same color and size for building except at the end. (‘Kri’, Nov 16th 2014)

Memo 169: He starts play by himself without trigger, and is focused throughout the session. He finishes the thread and then seems to show it to facilitator, who appreciates it and ‘Kri’ replies with a smile. (‘Kri’, Nov 17th 2014)

Memo 171:

1. ‘Kri’ is **able to derive pretend play** with interactive phone **without any trigger**, and initiates the conversation by saying hello.
2. Facilitator has to often create conversation so his **role switches between leader and follower**.
3. ‘Kri’ also **briefly shows interest in sensory play aspect after being given an introductory trigger** for it, and smiles to hear different audio feedback by pressing buttons.
4. ‘Kri’ **likes to swipe screen** of one of the phone and is **aware of the touch phone aspect**. He tries to use it and fails, he even tries to enquire from facilitator about it.
5. This is the 1st time when ‘Kri’ **does not communicate properly** and is not understood well by facilitator, however he **seems to understand facilitator's statements and replies** everytime. Due to lack of communication, the **conversations are relatively small.** (‘Kri’, Nov 17th 2014)

Memo 175: ‘Kri’ does not show many instances where he seeks facilitator's attention and generally is focused in his play. There are only two instances where he seeks facilitator's attention (including this one) to show his final progress after he makes a fish from play doh, probably to get appreciation. (‘Kri’, Nov 19th 2014)

Memo 176: In this instance, facilitator tries to explain how to play xylophone verbally and the child does not seem to be understanding, while later in 2nd session, she is able to learn play affordance after it has been modeled by the facilitator. (‘Tan’, Jan 2nd 2015)

Memo 178: Even though beads is among the toys approached later than many other toys, ‘Tan’ takes her time, meticulously putting beads in the thread showing sustained engagement. She is not creative in terms of arrangement or using beads for deriving other play types. (‘Tan’, Sep 22nd 2014)

Memo 180: ‘par’ is seen deriving play from beads toy by swinging the thread with beads. He shows joy while swinging. (‘Par’, Jan 18th, 2015)

Publications by the candidate

- Johry, A. & Poovaiah, R. (2017). Design principles to enhance playfulness of toys for children with Intellectual Disability. *International Journal of Design* [Under review].
- Johry, A., & Poovaiah, R. (2015). Competitive Play in Children with Intellectual Disability: Informing Design. In *ICoRD'15–Research into Design Across Boundaries Volume 1* (pp. 399-409). Springer India.
- Johry, A. (2015, Oct). Reflecting on the play of children with special needs: Differences and similarities to typical children. *Design for All Institute of India, 10*(10), 49-68.
- Johry, A., & Poovaiah, R. (2014, May). Paradigms of play in a special school setting in India. Paper Presented at the *19th IPA Triennial World Conference,* Istanbul, Turkey.

Acknowledgements

I would like to express my deepest gratitude to a number of people who have supported me throughout this dissertation process. I am deeply indebted to my mentor and supervisor Pr. Ravi Poovaiah, whose balanced guidance, consistent support and calming influence helped me to keep making progress, all through the course of this PhD. Besides the useful feedback on my research, your confidence in my abilities was always a source of strength and encouragement for me.

I am also indebted to my committee member Pr. Uday Athavankar, who has always been a second mentor to me and found time for countless discussions. Your constructive criticism and critical feedback played a crucial role in shepherding my work in the right direction. I am also thankful to my second committee member Pr. Sahana Murthy for investing her time in reading, reflecting, and evaluating my research, and providing valuable suggestions at different stages of my work.

Working in a challenging domain like special needs in India would not have been possible without the generous support of the staff of Holy Cross Special school, Mumbai. I am very thankful to the principal Sister Ancy, who believed in my work and allowed me to conduct multiple research studies at the school facility. I am grateful to all the parents, school teachers and staff who were supportive of my research and helped me during my field work in numerous ways, especially teachers Rujuta, Archana, Deepa and Hinal. I will always cherish the time I spent with the children at the school, and the friends I made with these beautiful souls. I want to acknowledge Mrs. Manjiri Date, a practicing psychologist and a friend, whose expertise provided valuable perspectives on my work.

The doctoral journey would have been difficult without such amazing friends. Pr. Koumudi Patil, who was both a teacher and a friend, thank you for instilling the inspiration to pursue this PhD and then being around as a constant support. My research friends and colleagues, Sajan, Sanjay, Sudha, and Debjani, a big thanks for all the jokes we shared and stress we vented. My hostel mates and friends, Gaurav, Mahendra, Chandradeep, Srajan, and Kanika, thanks for making college more fun. I am grateful to all the caring staff at IDC, especially Vinay and Ranjana from office, Mohan sir in library, and Samarth and Kini sir from studio, who meticulously look after each of the student.

Finally to my family and loved-ones, I appreciate your belief in me as I worked to accomplish this dream. My mother and father for standing beside me in every step and making me into the person I am. My brother and my sister-in-law for ensuring that physical distance does not matter and looking after me at all difficult times.