

Sharing Mental Imagery in Collaborative Design

A Special Project report by

Anupama Kamath
02625008

Darshan Rathod
02613801

Guide: Prof. U. A. Athavankar

March 2004

The Special Project entitled

SHARING MENTAL IMAGERY IN COLLABORATIVE DESIGN

By **Anupama Kamath** and **Darshan Rathod**

Is approved in partial fulfillment of the requirements for the
Post Graduate Degree in Visual Communication and Industrial Design

Guide:

Chairperson:

Internal Examiner:

External Examiner:

Index

Introduction	2
Hypothesis	3
The Experiment	4
Pilot Experiment I	5
Pilot Experiment II	6
Pilot Experiment III	7
Final Experiment	8
Observations	9
Session I	10
Pause I	16
Session II	19
Pause II	23
Final	24
Analysis and Conclusion	26
Bibliography	27

.....
.....
.....

And so these men of Indostan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right,
And all were in the wrong!

So oft in theologic wars,
The disputants, I ween,
Rail on in utter ignorance
Of what each other mean,
And prate about an Elephant
Not one of them has seen!

From **The Blind Men and the Elephant** *by* John Godfrey Saxe

Introduction

Nigel J. T. Thomas describes mental imagery informally as 'seeing in the minds eye', 'visualization and is a quasi-perceptual experience, it significantly resembles perceptual experience, but occurs in the absence of the appropriate perceptual stimuli.

The focus of the research started with the goal of understanding mental imagery in the field of design. What is the role of mental imagery in creativity? Several questions related to the nature and role of imagery in design have been a focus of research. Some questions asked are whether creativity depends on imagery or whether discoveries can be made in imagery. Where do creativity, discovery and imagery intersect?

Also what is the role of mental imagery in team design? Private and personal mental imagery experiences are sparked of with several words (Jalote Bhedasgaonkar et al 2000) and are affected by several aspects like personal associations, past experiences and so on. How are these communicated to the partner? Can some strategies be evolved to enhance the communication of these private experiences in the mind's eye to another?

Hypothesis

This experiment is a continuation in the studies of mental imagery in architectural design process. The earlier experiments attempted to study the nature of mental imagery in the mind of the architect during the design process and subsequent sharing of the same with a co-architect. In this experiment, the focus would be on the issues that arise in a team while sharing mental imagery

In this experiment it is primarily intended to study the **Sharing of Mental Imagery** in a collaborative design scenario.

How is mental imagery shared?

How much of personal visualizations can be communicated to the partner?

What is the response to this sharing?

What is the clarity of these experiences?

The experiment also tries to explore factors that may affect the sharing of mental imagery between architects in a collaborative design system. Finally the exploration tries to analyze whether and to what extent Mental imagery can be used in Collaborative Design projects.

Such an exploration could give insights into -

Communication strategies that evolve and

Common pitfalls to avoid miscommunication

New strategies that could be evolved to help the communication and sharing of Mental Imagery

Specifically while collaborating and designing in a restricted medium. These insights could lead to forming guidelines in communication techniques that need to be adopted in a collaborative design system.

The Experiment

In an earlier experiment (Hrishikesh Deshmukh, Neelam Gill et al, 2000), it was established that words triggered images, and sketches supported this imagery exchange. It had the two architects working from different locations. The imagery experienced each was shared by a video-link while their identity was not revealed to each other. The results of this showed that though the architects experienced rich visual imagery prompted by spoken words and phrases, most of it was not completely shared.

In the experiment going to be conducted, the focus has been to design within a shared mental model. This sharing will be restricted to a verbal medium unaided by sketches or gestures to communicate the imagery being experienced. The actual process of conducting the final experiment evolved after a series of pilot experiments were carried out and some initial observations made.



The Experiment

Pilot Experiment I

Mode

Two architects were separated spatially and are collaborating and designing. The architects were not blindfolded in this session, as the idea was to simulate an environment where they were physically separated from each other. The experiment was conducted in 3 sessions with 2 intermediate pauses. During the pauses the architects were asked to make sketches in an attempt to capture maximum imagery experienced during the discussion.

The final designs were compared for completeness of mental model shared.

Observations

The imagery experiences were rich and although initially diverse they were finally integrated to form a common language. (RB referring to Richard Meirs buildings, while SK referring to a place near the mountain)

The design process followed a strategy of zoning, floor wise demarcation, and then detailing. A grid provided on the site plan, use of proportions like $\frac{1}{4}$ $\frac{3}{4}$ etc. was used to position and size the rooms on the site. This facilitated discussion of the detailed aspects of the design. Communication strategies were the use of words like backside, right side, bottom left side and so on. The approach to the site was used as a reference for positioning on the site. The subjects placed themselves on various points on the site and built the model. They could easily move around this built model. At one point although, a misinterpretation occurred due to inattentiveness by one of the subject, resulting to a difference in orientation of the built block as a whole.

Insights

From the pilot experiment it seemed that a fairly good amount of sharing was possible. The shared space though retained for a short duration was unto most levels accurate. While detailing of the spaces varied, these could be attributed to the time constraint of the experiment.

The important factor that was noticed was that the architects were feeling conscious of the camera and also getting distracted. This led to a slight change to be followed in the next pilot experiment.

The design strategy that evolved was that of a 'combination and compromise' when things were not clear of individual ideas and imagery to evolve a common design solution.

The Experiment

Pilot Experiment II

Mode

As an improvisation of the earlier experiment, the participants were blindfolded and the experiment conducted in a similar manner with 3 session and 2 pauses in between. In addition the site plan was slightly detailed for them to get points of references while moving around in the site

Observations

The results were similar to the earlier experiment and the individual versions of the shared model when compared matched in many ways.

Insights

Blindfolding helped the participants to concentrate on the imagery and not get camera conscious.

The solution still remained on a zoning level as considerable amount of time went in interpretation of the problem statement and getting acquainted with the site features.

The architects coming from a similar background could easily share their inputs and build on the shared model without much problems.

The Experiment

Pilot Experiment III

Mode

This was conducted in the same manner as the previous pilot experiment with a slight variation. The architects chosen had different design and cultural backgrounds.

Observations

The results were unexpected as the models were different in their individual space treatment. Sharing of the space failed as the participants could not get proper orientation of individual spaces with respect to the building as a whole.

Insights

The pauses showed that problem lay not in the different background of the architects but in their verbal articulation of the spaces to each other. Problems were seen in words like left and right as both had been viewing the site from different points, one from the sea and one from the north point..



The Experiment

Final Experiment

Mode

In the final experiment the architects were to be blindfolded as in Pilot II and Pilot III. The two architects were chosen from completely different backgrounds. Bhavik Sejpal (BS) is an interior designer who has graduated two years back, while Sanjay Nandani is a practicing architect and a professor at an Architecture College in Bombay. The experiment was conducted in three sessions of team discussion and two pauses of individual recap to a third person. The identities of the two were not revealed to each other till the end of the experiment.

The design sessions

The 3 sessions of 15 minute duration each, were conducted by keeping the blindfolded participants in the same room with a partition between them to simulate different working locations. The architects initially got accustomed to voicing their ideas and then moved onto building on these shared ideas. These discussions were recorded for purposes of documentation and transcriptions. After the end of the third session the participants were asked to draw the finalized design solution reached at the end of all three design sessions

The pauses

During the pauses the participants were asked to recap their individual experiences. A prepared questionnaire was used to elicit and cover all possible areas of the discussion. The recaps were recorded and played to the participants at the end of the experiment. They were then asked to sketch these imagery experiences.

Documentation and analysis

The videos were transcribed and the description compared with sketches made. The model shared was different in some aspects. The differing features were selected and an individual study of each, from their conception to evolution in the different stages was charted to observe the points of failure. The session were analyzed individually to check for any patterns in strategies evolved or breakdowns occurred.

Observations

The Sessions were transcribed and observations documented sequentially. Broadly the sessions were observed from the following viewpoints.

Sharing of Mental Imagery

Instances of complete/incomplete sharing of ideas during discussion.

Triggering of Imagery

Instances of words or experiences triggering newer directions in discussion or imagery.

Communication Strategy Evolved

Instances of strategies evolved by the participants during the discussion which helped in the sharing process.

Communication Breakdowns

Instances indicating how sharing failed and possible causes of the same



Observations

Session I

During the first session the focus was towards zoning the areas on the site. Both the architects evolved separate strategies to zone the areas on the site.

SN propelled the discussion towards developing a character to the building while BS got into tectonic details and arriving at a conclusion. Some of the details are discussed below

Observations			
Sharing of imagery	Triggering imagery	communication strategy	communication breakdown
sharing thoughts as they occurred in the mind	few instances of triggering took place	sharing of a blurred concept simplified by explaining character	skills required for articulation of thoughts and imageries
sharing by relating as a experience while walking		explaining the visualization as a story	thoughts change faster than spoken words... so everything was not conveyed
visualised the site from the same place I.e from the sea		defining limits of spoken words	visualizing of spatial elements not in the same order as the others
		macro to micro level designing	during most parts the discussion became one sided
		sharing scenes seen	

Observations

Session I

Sharing of mental imagery

Sharing of thoughts.

Thoughts were shared in the order as they were seen to the partner to help visualize certain scenarios. The idea of 'President of India' coming to and approaching the site was used to convey the idea of an arrival.

Instance: SN effectively used such scenarios and stories that aided the visualization process (5:42 to 7:03)

Walkthroughs

In this session as the next SN tries to use walkthroughs through the site to create an experience.

Instance: In this particular session he is talking about walking from the pier to the site and creating and sharing rich imagery experiences of the atmosphere as well as the elements that come along the way (9:23 to 10:29)

Visualizations from the same point of reference

There were instances when both the subjects were viewing the site from a common place, from the seaside. Such markers around the site help visualize and get a feel of the site and can be effectively used to create and share imagery.

Communication strategy

Few instances of triggering imagery could be seen in this session. Particularly a meditation room was visualized in this session after a discussion on axes. This although not discussed here was later reported in the pause. This points out to the prowess of mental imagery in creating unassociated relations.

Observations

Session I

Communication strategy

Sharing concepts

A character build up within the storyline was used to define the lighting of the built form.

Instance: This aided an overall image of the built form, as it would look in the night (3:04 to 3:19)

Story as an aid

An overall story was built around the site to help visualize and communicate the nature, character and feel of the site. This was an immediate response as a physical image of the site was absent and needed to be created. The story proceeded to form an overall form of the building and nature of the building to define its characteristics. This kind of discussion was prevalent throughout the first session.

Defining limits of spoken words

One sequence where the exchange of imagery is very evident is where the discussion is regarding building a feminine character in the built form. As soon as SN mentions this BS responds by talking about an organic built form.

Instance: Sensing the nature of this as divergent from the theme being discussed SN defines and articulates the limits of exploring the feminine feel and emphasizes that it not be overdone. In this sequence imagery plays a direct role in the process (19:23 to 20:52)

Macro to micro level designing

Both SN and BS started observing the site from a macro level to a minor level. SN additionally started from the immediate environment, climatic factors, and generally built up an environment around the site BS on the other hand started looking at the site in a plan form first, quickly zoning it and then proceeding to the details. SN kept on going back and forth and kept on building separate elements into the site.

Observations

Session I

Communication strategy

Sharing concepts

A character build up within the storyline was used to define the lighting of the built form. **Instance:** This aided an overall image of the built form, as it would look in the night (3:04 to 3:19)

Story as an aid

An overall story was built around the site to help visualize and communicate the nature, character and feel of the site. This was an immediate response as a physical image of the site was absent and needed to be created. The story proceeded to form an overall form of the building and nature of the building to define its characteristics. This kind of discussion was prevalent throughout the first session.

Storyline to build a character and feel of the site -SN	
11.29 to 11.34	n u can see the first rays of the sun jus coming out behind those hill and u start entering this site n den I think the story has to take on from there.
	then...
11.39 to 11.50	you see again the sun sets on the west, again on the sea and that again I think becomes a very very wonderful evening time you know the sandhya time
11.51 to 11.55and
11.56 to 12.09	you know the fact that u have a wonderful sun setting here and u can take a walk down the bridge or pier when u r arriving from the sea... you can go and sit there in the middle of the sea.... You know running your feet in the water.... Sleeping on the pier..... n u can see the sun setting down.... n that u can see will be a glorious moment

Observations

Session I

Defining limits of spoken words

One sequence where the exchange of imagery is very evident is where the discussion is regarding building a feminine character in the built form. As soon as SN mentions this BS responds by talking about an organic built form.

Instance: Sensing the nature of this as divergent from the theme being discussed SN defines and articulates the limits of exploring the feminine feel and emphasizes that it not be overdone. In this sequence imagery plays a direct role in the process (19:23 to 20:52)

Macro to micro level designing

Both SN and BS started observing the site from a macro level to a minor level. SN additionally started from the immediate environment, climatic factors, and generally built up an environment around the site BS on the other hand started looking at the site in a plan form first, quickly zoning it and then proceeding to the details. SN kept on going back and forth and kept on building separate elements into the site.

Sharing scenes

Instance: Evident sharing was seen when the sunrise and sunset were being discussed. An onlooker could also get the feel of these defining qualities of the site. (10:59 to 11:55)

Site zoning-BS	
7:15 to 8:36	First I'm talking basically about the zoning first living n public area can happen there. which naturally results..... n plus u can havea outdoor exhibition area so that .can happen on the north side...people visiting to go see the work.. Could directly go onto the left side of the side . i.e. the north. n den probably we cud keep the workspace n the exhibition space next to each other.....so that becomes one whole area in itself...

Observations

Session I

Communication breakdowns

SN seemed to be more adept at defining and communicating aspects of the design. BS on the other hand had his own forte of imagining details but during the discussion some of these details were lost as they were either not described properly or were not discussed at all. Imagery experience and communication also links up to individual professional experiences.

Nature of thinking affecting communication

Speech being the only mode of communication , some of the ideas did not get across. This is seen in several examples throughout the conversation where dialogues were cut through by the other person and some thus some points remained undiscussed. This arises from the nature of thinking where the mind thinks about several unconnected things at the same time.

Markers and strategies for communication

SN used the features around the site namely the sea, the hill and the coconut groves to describe the site whereas BS uses 'from the west', 'from the north', 'left side, right side and so on. BS followed a method of using the plan and features described in the plan to communicate locations and so on. SN on the other hand built up these features as if he were seeing them while walking through it.

Observations

Pause I

Visualization

Visualizations of the spaces by BS were basically in form of plans top views and models. This may be attributed to the extent of work experience of the individual. It might also suggest that richer imagery is experienced based on the professional experience of the person. This seems to be true because SN was always walking on the site and had an overall clarity in visualization as he also corroborated in the pause. BS on the other hand was experiencing the site more in terms of details and specific parts that he needed to integrate.

Recap with BS	
	This is what I.. This is clearly what comes in front of me.. The curved walls.. The levels and the wall .. The niches in the wall.. Pathway.. Probably of some rough stone or wood or something.. Like that little bit of detailing on the material side also.. little bit of color
ok	
	But not much
but it was not very crystal clear	
	not crystal clear(pause)it was.. I wouldn't say it was crystal clear.. Though it was enough for a person to you know start designing this is the.. These are the guidelines.. I need to catch when I am designing and then you.. Then I was imagining the plan. basically after
the plan..	
	ya.. The plan .. The top view..
	ya.. The plan .. The top view.. Becoz I don't know.. Maybe it was because of the discussion. I started looking at the thing as a model

Observations

Pause I

Imagery experiences

BS reported seeing balconies jutting out everywhere from curved forms on the upper level(4:58 to 5:15)BS was also visualizing finishes like 'metallic or reflective materials on the wall'. A curved wall which became an important feature of the site also seemed to appear in this session. Details like 'lots of niches' and even colours , 'yellow', 'earth ochre' were visualized. This again goes on to illustrate the diverse nature of visual imagery experiences. While one of the subjects was imagining details the other was imagining the site as a whole. This also seemed to make the communication difficult?

Ideas that were not discussed.

BS also followed a pattern wherein he saw several disparate images that were not discussed with SN. This was detrimental to the cause of the experiment as some of these were integrated in the final design and were away for evolving a common design solution.

Some ideas on the other hand like a meditation room which was visualized in the discussion session were elaborated here and were then integrated into the design (Pause 1 part 2- 0:20)

Observations

Pause I



	Other Observations	
	SN	BS
	Was trying to build the model step by step	Had some preconceived spaces already juxtaposed and was sculpting them with SN's inputs
General Observation	extensively articulated pier, character of the built space,	zoning
Shared imagery seen in a similar way	curved wall	could not articulate organic forms
Shared imagery seen in different ways	waterbody in the site	detailing of materials, built spaces, meditation room
Imagery not shared		studios

Observations

Session II

The second session was focused to defining the flow of spaces and the separate elements on the site, which were again anchored in different ways by the two designers. Specifics of rooms as well as new peculiar elements came in. Finishes were also discussed in this session. From the discussion the visualizations seem to be rich in imagery.

Observations			
Sharing of imagery	Triggering imagery	communication strategy	communication breakdown
active acknowledgement of shared imagery	imagery triggered changed course of discussion	attempt to build on existing model	differing temperaments leads to indifference to inputs from others in turn resulting in loss of sharing
citing example of similar places		doing a walkthrough as a chklist while adding	wrong acknowledgements
		referring to established spaces	interruptions lead to unresolved issues
			inability to visualise the other persons idea while designing

Observations

Session II

Sharing of mental imagery

Active Acknowledgment of Mental Imagery

The subject's approval of each other's ideas and decisions not only helped to build the idea further and concretize it but also proved that the imagery was shared.

Instance: Typical examples were SN's description of the dining and the kitchen (Session II- 4:31 to 5:03). At the same time there were some miscommunications SN's reactions seemed to be like approvals to BS and some features that he discussed were added by him later in the final design but were not integrated by SN. An example of this is the interior of the living area with a skylight on top, with a low seating below it. (Session II 3:53 to 4:09)

Citing examples of similar places

Instance: SN's association of the site skyline with that of 'Mykonos' in Greece was registered and accepted by BS (8:25 to 8:24) Like in previous experiments the designers could not only get in references from unrelated non-rational sources but also could convey the idea to the other person and the imagery was shared.

Triggering imagery

Word-imagery relationships and sharing.

Some instances were found where words mentioned by one person triggered of an idea and an imagery response.

Instance: Most peculiar of these is the lighthouse that came about after BS mentioned 'height' (session II- 5:54 to 6:07) the same happened again when a little later BS mentioned 'high place' and SN immediately responded with a discussion of the lighthouse (Session II 9:31 to 9:37)

Observations

Session II

Communication Strategy

Attempt to build on existing model

Passage between living and dining

Walkthroughs

There were instances when the subjects seemed to be traversing the site as if they were walking through it. For instance the discussion of the journey from the entrance to the lighthouse illustrates that the subjects were walking through the site. (16:20 to 16:43)

Using established spaces as Markers

Spaces and elements created on the site were used as markers or reference points on the site. A curved wall that became a primary feature of the design was often used as a reference or starting point to develop several other details around it. (Water-body near curved wall-12: 12 to 12:18)

Observations

Session II

Communication Breakdowns

Temperament

An idea of a meditation room was proposed by BS but was finally discarded when it was not received by SN. The idea was adequately developed by BS but was probably not accepted or given adequate importance to by SN, as it was not communicated adequately. The absence of a communication medium did not register the feature the importance BS associated with it (17:57-18:03)

Wrong acknowledgments

The bedroom discussed by BS was incorporated in his final design as it was thought to be acknowledged from the response that SN gave back (7:01 to 7:21) This was typical of several other features that were incorporated by BS in his final design. This points out to the need of a system to elucidate a clear response from the partner.

Interruptions

Thought processes of the two designers worked in parallel at the same time. Due to this some information was lost and some features remained unresolved. For instance the dining room discussion was interrupted by SN and it resulted in the dining not being resolved to a common solution in the final design. This points out to the need of keeping a check on the system to measure whether goals are filled adequately.

Inability in Visualization

Some of the discussions did not yield clear visualizations of the matter being discussed as it was not descriptive enough or the parameters were not defined. The exhibition areas in the discussion were not visualized completely.(9:25)

Observations

Pause II

Some peculiar observations made in the pause.

Imagining details

BS imagined a number of details on the site as the building was being articulated. Most peculiarly he saw pots, large scale pots that were placed around the house. He also saw low level concrete seating with cushions on it. These imagery experiences though not discussed were seen when that specific part of the house was being discussed.

Very rich details like staircase construction skylight etc. were experienced

He also describes white walls as there had been a mention of the same during the discussion

BS tried to define and articulate his building through several examples. Some that he specifically mentions are Cidade-de Goa, kala bhavan and also some books that he referred to. Other important aspects that BS saw were the time of the day which he defines as '1:30 to 12 or so'

SN in the pause could describe each of the rooms and spaces as he had visualized them. Some sizes were also thought of. Materials, ambience of the space were also imagined. The descriptions show a rich mental imagery experience, some of which was communicated through the discussion while the rest was not shared, mostly due to the course of the conversation or lack of time.

From the descriptions of the individual rooms and so on, both the subjects seem to have imagined rich visual images. Most of these images were consolidated in this session. Finalization of the details etc was described in this session. The imagery experienced by both the designers was articulated more or less towards its final form in this session.

How were the bedrooms in the night? What colour was the light

they were extremely comfortable... with some velvet or makmal or something..... Some wonderful rugs on which u walk.... Or on which u sleep and some music is going on...something like that . And extremely comfortable...n one can sleep there .. N sleeping is a fantastic thing.. something that I love to do n to my mind that has been the most comfortable n the most luxurious space in the house

Observations

Final- Session III

A large part of the session was used to communicate the planning details. Directions like NW SE and other strategies were used. So also some elements like vaulted roofs were introduced. The tree canopy was articulated. Extensive part of the session was used to articulate and refine the overall plan. Few imagery experiences like the tree canopy etc. were well articulated (session3 - 13:33 15:52)

Points of differences and commonalities in the final design and their evolution

Although the final quality of design is not of importance to this experiment, it is interesting to note how certain features evolved during the course of the discussion. The intention is to check primarily the similarities and dissimilarities of the solutions.

Axis

Curved Wall

Tree

Entrance Canopy

Light House

Studios

Exhibitions area and Amphitheater

Observations

Final- Session III

Points of differences and commonalities in the final design and their evolution

Lighthouse

The lighthouse evolved as a spontaneous idea when BS mentioned heights and was discussed extensively throughout the sessions of the experiment. But in the end the lighthouse position was shifted away from the position discussed. Tracing back through the sessions BS has a different idea about the position of the lighthouse, which he uses to complete the axis that he has defined. SN on the other hand sticks to the idea of the position discussed for the lighthouse and the final solution matches with the discussion. The error thus results in different positions of the lighthouse in the final design attributed to a problem of communication

Tree and entrance canopy

During the course of the experiment SN refers to the tree as being the starting point where the entrance could be located. But in subsequent discussions he mentions the tree but does not specify the exact location BS on the other hand imagines and assumes a tree at the position of intersection of axes that he has thought of for the site. Due to this the final location of the tree is different in both the scenarios.

Axis.

The axes mentioned in several conversations were not clearly defined and led to separate visualizations of the final solution

Curved wall

The curved wall became a primary element in the design and though conceptually similar, finally ended up as different elements in the experiment. The form and detailing of the final designs of the curved wall differed to a large extent and were personal impressions of the Architects.

Sharing of imagery

Sharing imagery is extensive throughout the course of the experiment. Several examples portray the level of imagery that was shared and the factors that affect the sharing of imagery experiences. The level of the imagery shared differed due to the communication issues that were prevalent due to the course of the experiment. Personal experiences as well as shared imagery experiences go on to form solutions that have a common genesis.

Communication

Majority of the problems occur when imagery experiences are not communicated or miscommunicated as seen in the examples of the curved wall and the lighthouse.

Interestingly strategies evolved by the subjects like building up a story around the site and using simple reference points to communicate locations would be useful in determining the course of future experiments.

The observations also refer to a lack of feedback resulting into miscommunications and misinterpretations of design solutions generated by the partner. Fundamentally and conceptually the designs being the same, some amount of a feedback is necessary to evolve a common tangible, physical solution.

Bibliography

Athavankar U(1997)Mental imagery as a design tool , Cybernetics and Systems,28(1):25-42
(Initially published in Robert Trappl(eds) proceedings of the thirteenth European meeting on cybernetics

Anshuman Singh, The potential of mental imaging in the architectural design process
Proceedings of International Conference on Design and technology Educational research and curriculum development
University of Loughborough, England, 1999, pp 230,236

M. V. Bhedasgaonkar, A Jalote and U. A Athavankar, Co-Design:Sharing Mental Imagery?: Team thinking in filmmaking

Gill N, Deshmukh Hrishikesh, Collaborative Design, Eds. Stephen A. R. Scrivener, Linden J. Ball and Woodcock, Springer-Verlag, London, 2000,pp 223,232