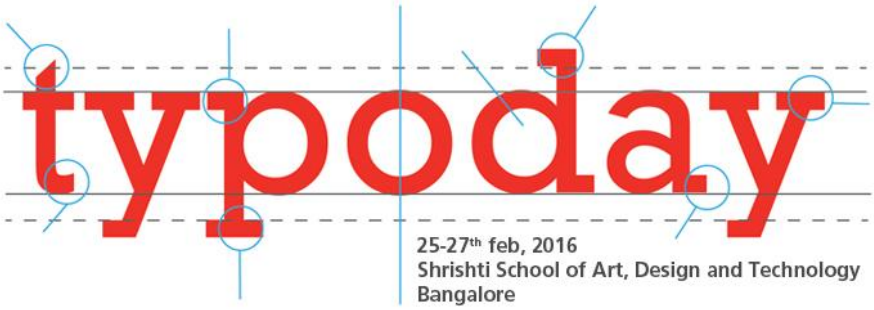

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Examining the legibility of Chinese typefaces in medicine labels for elderly people

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Abstract: Teaching Chinese typography in Hong Kong is always a challenging task. In addition to the dominance of Western typography principles in teaching and research in Hong Kong, Chinese typography in the context of Hong Kong is rarely studied. In this regard, students found cultural detachment and a neglect of socio-cultural concerns when they were introduced to both the Western and Eastern theories of typography.

In this practice-led project of redesigning medicine labels, students learned not only how to appreciate Chinese typography, but they also recognized the importance of empathy as they prioritized critical information from the user's perspective. By conducting usability tests, students verified the optimal legible Chinese typeface and confirmed final prototypes with elderly people. As a result, students understood the relationship between content (the written language) and form (the visual language), as well as related them to the local contexts in which typographic communication is presented.

Keywords: Medicine label, Chinese typography, legibility, usability test, information design, elderly.

1. Introduction

Hong Kong has long been renowned as a hybrid place of East-meets-West. Hong Kong students are grown and nurtured with a mixture of oriental values and virtues as well as Western culture. Nonetheless, teaching Chinese typography has always been challenging in our design programme. In addition to the dominance of the Western typography principles that are deeply rooted in the minds of our design students, only a few relevant teaching materials and studies of Chinese typography in the Hong Kong context are available. Although there are oriental and Chinese typography materials, these are developed in Mainland China or Taiwan while some come from Japanese typography. Due to the lack of Hong Kong-based typography references, design students in typography and related subjects felt culturally detached and disconnected when they were introduced to both Western and Eastern typography case studies.

The notion of "learning by testing" is always a good pedagogical method to elevate student's curiosity, motivation and self-discovery. In order to put Chinese typographic principles into practice in the local context, students were asked to redesign the Hong Kong Hospital Authority's medicine label and test how medicine information on a small space could be more accessible and legible to older people. Apart from appreciating the aesthetic aspects of Chinese typography, students were required to examine the legibility of common Chinese typefaces by means of a series of usability tests that would identify which Chinese typeface is more appropriate for older people. In addition, the project required students to prioritize medicine information on a label that was, following the senior's feedback, easy to understand, find, and read.

2. Background

2.1 Hong Kong medicine labels

Apart from the labels used in the private sector and clinics, there are two different types of medicine labels in public hospital, issued by the Department of Health and the Hospital Authority (HA) respectively. The latter dominates and manages over 161 public hospitals and outpatient clinics, covering 18 districts in Hong Kong. In other words, the medicine labels of the HA reach the majority of Hong Kong citizens, especially elderly people who suffer from chronic illnesses and regularly visit hospitals for medicine collection. The label of the HA was therefore selected for the project.

The current labels of the HA mainly include seven major items of medicine information for patients (Figure 1). These are the name of the hospital, the patient's name, the date of dispensing, the name of the drug, dosages, the method of administration, and precautions. Other information is displayed as well, such as the abbreviated drug name, the unit of the drug, and hospital/department codes, but these features in English and is for internal use only. Following the Pharmacy and Poisons Ordinance and the requirements of the HA, all medicine information must be shown clearly and legibly on labels for the public.

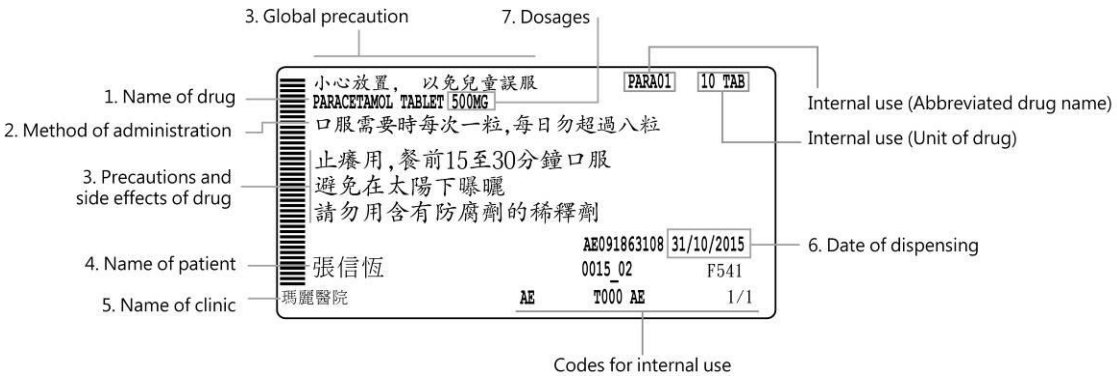

Figure 1. Medicine information on Hong Kong Hospital Authority's label

2.2 Problems of medicine labels

In the Hong Kong Medical Association's study (HKMA, 2007), it is stated that misreading labels is one of the common causes of medication errors. It emphasizes that information on labels has to be clear and legible in the process of dispensing medicines (ibid, p.7). This implies that low legibility and unclear label design can lead to medication errors such as overdosing, taking wrong drugs, and overlooking medicine side effects, which can have damaging effects on patients.

The Medication Errors Index, reported in the HA's Medication Incidents Reporting Programme Bulletin (MIRPB) in 2009, lists the category of "wrong label information" as top error at 26% whereas "wrong strength dosage" (21%) and "wrong drug" (19%) are in the top three of most common dispensing errors (MIRPB, Bulletin No.24). The 2004 issue of the MIRPB, further, indicates that there was an increase in medication incidents from 8,106 in 1994 to 18,349 reported in 2003/04. In the period of 1998 to 2003, there were 71 incidents of "mislabeling", 240 of "similar drug name/appearance" and 913 stated "failure in communication" (ibid, Bulletin No.19).

Although there is very little official data regarding medication errors that directly lead to label design, the implications of the above-listed data – illegible prescription, communication failure, wrong dosage and drugs – could be indirectly linked to, and account for, the usability and accessibility of the design of the HA's medicine label. It is also not difficult to imagine that taking medicines by mistake, or inappropriately, commonly happens among the elderly.

The above information was addressed in the first class and students realized how serious the current problems of medicine labels are. They were aware that they were not simply doing a school assignment but that their design would respond to social concerns as well as improve the way in which medicine information is presented, read, and understood.

3. Defining concepts of usability and legibility

What is meant by "usable"? Answering the question more broadly, usable means the absence of frustration. When we describe a product or service as truly usable, it refers to a scenario where the user can do what he or she attempts to do in the way he or she expects to be able to do it, without hindrance, hesitation or questions. (Rubin and Chisnell, 2008)

Rubin and Chisnell (2008) indicate that usability involves six attributes: usefulness, efficiency, effectiveness, learnability, satisfaction and accessibility. These attributes are interrelated yet can be studied individually. It depends on the entity, artifact or service one focuses on. In the project of redesigning the medicine label, four attributes were used as indicators for students to examine the current medicine label as well as to evaluate their new prototypes. The project emphasized efficiency, effectiveness, satisfaction and accessibility.

Students took Rubin and Chisnell's concept of usability as a reference. The attribute of efficiency, in the project, was related to the speed with which the elderly patient could accurately identify specific medicine information (such as dosage). The attribute of efficiency involved therefore a measure of time. Students recorded the response time of participants during the usability test in order to verify which prototype and Chinese typeface is most appropriate for elderly.

The second component was effectiveness. It refers to the extent to which the information is presented effectively for the elderly to perform medicine taking appropriately and completely. The attribute of effectiveness was evaluated through the success rate of task completion.

Third was satisfaction, which refers to the elderly patient's perceptions, feelings and opinions about the labels. Satisfaction is usually captured or measured through focus groups/group discussion, questionnaires and/or product rating. In this case, the elderly were asked to rate the scales of satisfaction of Chinese typefaces and students' prototypes.

Fourth was accessibility, which focuses on what makes information easy to access and easy to find. The idea of this attribute is quite similar to Frascara and Ruecker's (2007) idea of chunking information into related groups. Accessibility, in medicine labels, is observed when the elderly perform medicine taking with ease or difficulty. It accounts for the number of errors during medicine administration.

Apart from the attributes of Rubin and Chisnell's usability, legibility was also an important component in the students' project. It refers to the ease with which the user can recognize a Chinese letterform clearly. Legibility is related inherently to the anatomy of the type itself and its x-height in the English world. However, it could be a completely different aspect in the Chinese world where legibility considers spatial relationships between the inner and outer spaces of the block of the Chinese character. Measuring legibility means considering how difficult or easy it is for the user to recognize characters. A range of legibility variables such as font type, type size, line length, and kerning, came to play an important role in the evaluation of the quality of legibility of the students' prototypes.

4. Anatomy of Chinese typography

4.1 Three common Chinese typefaces

There are thousands of Chinese typefaces available in the market. It is impossible to study them individually in class. In order to teach students basic principles of Chinese typography, however, there are three types of commonly used Chinese typefaces for text writing that are similar to those in English. They are Songti, Heiti and Kaiti respectively (Figure 3). The Songti style is similar to the style of Roman letters in Latin typography as

it has serifs at the end of strokes. Its vertical strokes are thicker than its horizontal strokes because of which the structure of the style has a high thick-thin contrast. The Kaiti style resembles traditional Chinese calligraphy with brush strokes and is therefore comparable to that of a script in Roman characters. Both horizontal and vertical strokes possess similar weights. Each horizontal stroke of Kaiti is gently tilted upward to the right. The Heiti style, finally, is similar to San Serif typefaces in the Latin world. Mono-linear and minimal thick-thin contrasts are presented in both horizontal and vertical strokes.

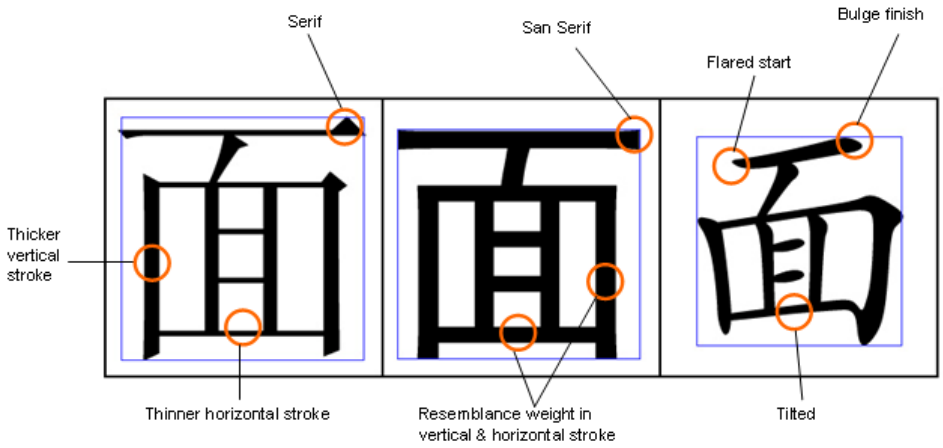

Figure 3. Three common Chinese typefaces - Songti (left), Heiti (center), and Kaiti (right) were introduced in class. Each Chinese typeface possesses some unique features that are comparable to Roman letter, San Serif and Script fonts in the typography of the Latin world.

4.2 Variations in character's white space

Apart from differences in the three Chinese typefaces' anatomies, the size of each typeface varies as well (Figure 4). It is obvious that the height of the Kaiti style is comparatively less than others albeit the fact that all typefaces are set in the same point size. The anatomy of the Kaiti character is rooted in the center and developed inward so that it leaves an amount of white space around it, in the character's area. Both Heiti and Songti are designed extensively outward and take up more space. However, if we take a closer look, we can see some differences between Heiti and Songti (Figure 5). From edge to edge, the shadow of Songti takes up even more vertical and horizontal space than Heiti. Indeed, each Chinese character is unique and involves both the stroke density and font skeleton differently. Most significantly, the Kaiti style is rather small in comparison to the other two chosen typefaces, Heiti and Songti, set in the same point size.

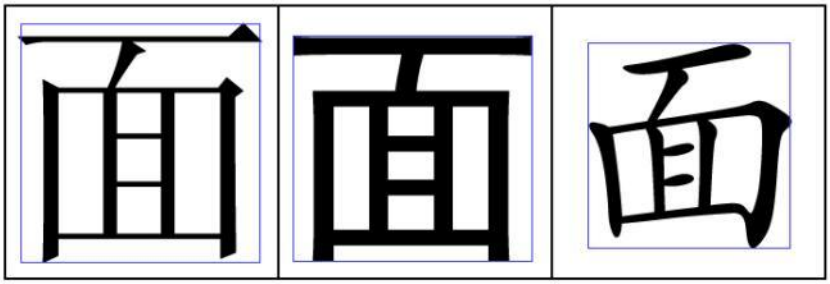

Figure 4. The anatomy of Kaiti (right) is comparatively smaller among the three typefaces set in the same point size. The Kaiti character is usually surrounded by a bit more white space.

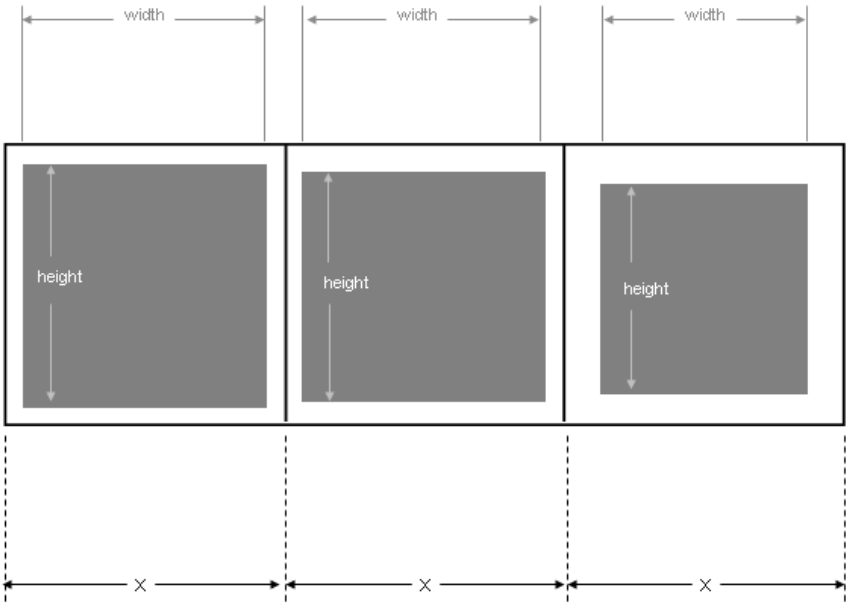

Figure 5. The shadow gives us a clue of the EM space of each Chinese typeface. Although they are set in the same point size, the amount of white space surrounding them is different for each typeface.

5. Students' prototypes and usability tests

5.1 Prototype requirements

Following the above basic principles of Chinese typography and in appreciation of the differences between the three Chinese typefaces, students were asked to redesign the Hong Kong Hospital Authority's medicine label and make medicine information more accessible and legible for older people. To begin with, students were suggested to develop three main prototypes with three different Chinese typefaces – Songti, Heiti and Kaiti. Students were not told which typeface offered optimal legibility for elderly until they found it on their own by verifying the results of the usability tests (Figure 6a and 6b).

For example, a group of students found that “they (the elderly) picked up Heiti faster than Kaiti. Heiti was easy to read after we showed them the label in the Heiti font. However, we also found that Heiti was not good for legibility when it was presented in small point size. We might probably think of applying two fonts in our next round test.” To the contrary, another group of students found that “Heiti performs comparatively weak among typefaces. Actually the seniors are not very aware of the differences between our proposed four Chinese typefaces. They find the larger sized of text would be more legibility [sic]." However, both groups drew a similar conclusion, namely that Heiti performed well in larger type sizes but less in legibility for small text.

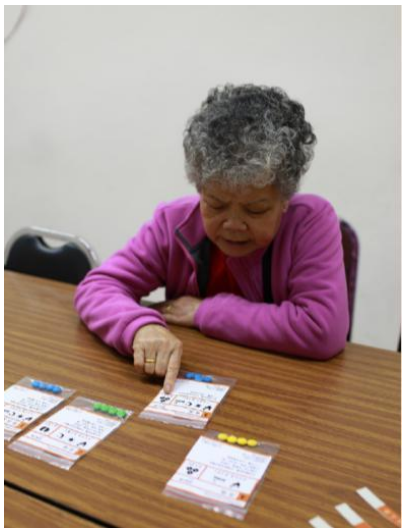

Figure 6a. Senior could find particular information easily with the student’s new label design in usability test.

Figure 6b. Senior was asked to compare and give comments on legibility and Chinese typefaces, between the original and the new design.

There were no particular design restrictions to the medication prototypes. Students could suggest different forms of medicine containers and prioritize information based on the users’ feedback and observations from the usability tests. For the design of the HA’s medicine label, the original size of the medicine label (2 x 4 inches) and white background could be changed. Students were challenged in their typographic sensibility and focused on typographic clueing instead of inserting unwanted visual ornaments. Rather, students were challenged to put more effort in considering type size, line length, kerning, bolding, spatial arrangement and visual hierarchy.

5.2 Usability tests

5.2.1 Eligible elderly group

One of the project's aims was to meet the needs of elderly people. Students were asked to present their prototypes with three Chinese typefaces to a group of elderly and collect the senior's comments. According to the information from the Hong Kong Census and Statistics Department, people aged 65 and above are classified as elderly. For our eligible participants, they were aged 60 or above and had basic literacy so that they were able to read the information on the students' labels. Eligible participants had no visual impairment but could wear glasses if needed.

5.2.2 Home visits

Students were encouraged to do home visits and on-site observation because medication errors are more likely to be made there. Home visits allowed students to observe how these older patients took medicines in familiar settings (Figure 7a and 7b). Students were able to observe where the medicines would be put - in the kitchen or on the dining table, for example. Through the on-site observations, students could understand the whole process of transforming medicine information into actions (Figure 8a and 8b). For example, they could observe which part of the labels people would usually read first. In addition, home visits brought students to realize the needs of the seniors. Each step of the process was investigated to identify hints of typographic settings and problems. In addition to home visits, students conducted their prototype tests in Centers for Senior Citizens, located in various districts of Hong Kong.

Figure 7a. In the first round of the usability test, conducted at a senior's home, a group of students tried to understand the senior's perception of the medicine label by presenting different prototypes. Students video-captured the senior's reading pattern in the process of testing.

Figure 7b. This is one of the pages of the home visit report. Students were asked to document findings through on-site observation. Students found that, for the time of medicine taking, the senior always referred to a home object as a reminder, such as a clock or a calendar.

Figure 8a. Students observed in the senior's home that medicines were rolled and tied up with a rubber band. Medicines were put in a glass container so that they would be protected from moisture in the air.

Figure 8b. Students found that the elderly tend to separate medicines according to frequency of use and methods of administration.

5.2.3 Testing materials

All students' proposed prototypes and suggested Chinese typefaces were shown on a single A4 page, individually. They were taught, step-by-step, how to conduct a usability test. Card-sorting was one of the research methods introduced in class. It enabled students to understand what group of information made sense to elderly and which information on labels is first looked at (Figure 9). After collecting card-sorting data from the seniors, students inputted it into a tabular format and analyzed it accordingly. One group of students concluded that dosage instructions and the patient name should be made prominent and other information such as hospital name and duration of dosage were of less importance to seniors (Figure 10).

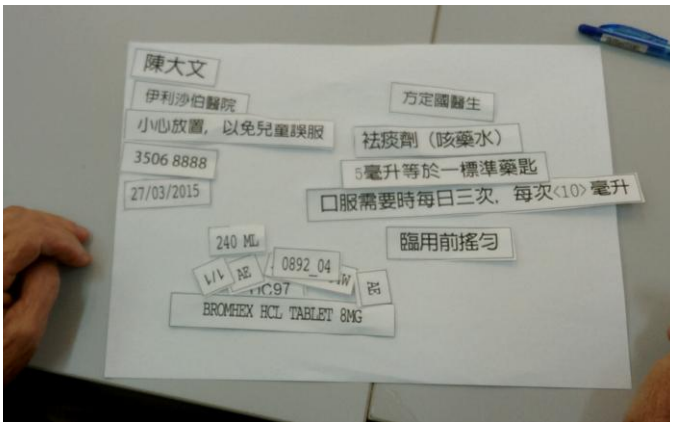

Figure 9. Card-sorting helped students to understand what medicine information seniors prioritized and classified into groups. The results of such information reorganization gave implications to students' designs.

Priority of Classification

Patient Information | Clinical Information | Medical Information | Precautions

User	1.LAW YUEN FUN	2.HO YIN LING	3.MR LAM	4.YAN YUK CHING	5.KO KIM HO
1	病人姓名	病人檔案號碼	藥物名稱	醫院名稱	醫院名稱
2	病人檔案號碼	病人姓名	藥物作用	病人姓名	醫生姓名
3	醫院名稱	醫院名稱	服藥次數	醫院電話	病人姓名
4	醫院電話	食用警告	藥物食用方法	醫院用內部資料	病人檔案號碼
5	醫生姓名	服藥次數	藥物食用份量	配藥日期	藥物名稱
6	藥物名稱	藥物作用	藥物副作用	藥物份量	藥物食用份量
7	藥物份量	藥物名稱	食用警告	藥物食用份量	藥物份量
8	服藥次數	配藥日期	藥物過期日	藥物作用	藥物食用方法
9	藥物食用份量	藥物食用份量	藥物份量	藥物副作用	藥物作用
10	藥物食用方法	藥物過期日	病人檔案號碼	藥物名稱	服藥次數
11	藥物作用	藥物副作用	病人姓名	病人檔案號碼	配藥日期
12	藥物副作用	藥物食用方法	醫院名稱	服藥次數	食用警告
13	食用警告	藥物份量	醫生姓名	藥物食用方法	藥物過期日
14	配藥日期	醫院電話	醫院電話	醫生姓名	藥物副作用
15	藥物過期日	醫院用內部資料	配藥日期	食用警告	醫院電話
16	醫院用內部資料	醫生姓名	醫院用內部資料	藥物過期日	醫院用內部資料

Figure 10. Students inputted card-sorting data into a tabular format and color-coded it according to different groups of content. It made the data easy to analyze. Four groups of related information were presented: patient, clinical, medicine, and precaution information.

Each individual elderly was presented with prototypes separately. The proposed medicine labels were aimed at probing further discussions about which Chinese typeface made information more legible and helped participants to compare different labels based on accessibility, satisfaction, efficiency and effectiveness.

Students were required to conduct at least three rounds of usability tests in which they were expected to test their prototypes with 4 to 6 participants in each test. Elderly people were asked to rate the level of difficulty of the prototypes and Chinese typefaces (Figure 11). At the end of the day, students were able to know which typeface helped to find information faster, and which typeface provided better legibility.

Figure 11. This group of students created a rating sheet that allowed seniors to rate four different Chinese typefaces in different labels, at a scale of 1 (least legible) to 5 (most legible). The four Chinese typefaces presented in the test were Heiti (top left), Songti (top right), Kaiti (bottom left), and Rounded-edged Heiti (bottom right).

In addition, all responses of participants, with regards to finding, reading, remembering and understanding the information on the re-designed medicine labels, were timed and coded for accuracy and misinformation (Figure 12).

User	1.Law Yuen Fun (age:69)	2.Ho Yin LIng (age:62)
Kaiti Label c3	7.78s	4.72s
Kaiti Label e1	8.15s	12.57s
mingti label c2	/	4.57s
mingti label d2	6.39	/
mingti label d4	4.16s	/
heiti label a3	**3.09s**	**3.17s**
heiti label C1	4.45s	6.99s
songti label b4	/	3.69s
songti label C4	/	10.71s

User	4.Yan Yuk Ching (age:80)	5.Ko Kim Ho (age:72)
label 1 Songti	33.62s	**16.31s**
label 2 heiti	4.96s	18.08s
label 3 Songti	**3.15s**	/
label 4 mingti	4.16s	22.29s
label 5 kaiti	/	67.24s

Figure 12. Seniors' response times to each Chinese typeface were recorded by students. The shorter the response time the better the performance of accessibility and legibility.

The revised prototypes were documented and used for the next round of testing, after feedback was given based on the previous prototypes. Feedback included and was drawn from reading sequences of information, medication processes, illegibility and misunderstanding, knowledge of improving medication adherence, etc. For example, students had attempted to examine which layout structures and typographic settings among the three revised prototypes were more appropriate and accessible for seniors in the second round of tests. After collecting the feedback from seniors, they documented and analyzed it following the pros and cons.

In the document, we can see that students were able to self-discover through prototype comparisons. They stated that “prototype 2 is the most preferable among all interviewees, as it has enough white space, strong highlighting effect and pictograms with notations. Prototype 1 is the least legibility among all prototypes. It is because its response time of information finding performs longer time than others. It may due to the reason of horizontal orientation and double-sided design [sic]. In addition, seniors think warning messages, purpose of the medicine and dosage methods are the most important information that should be emphasized more on the medical label” (Figure 13).

Figure 13. Students analyzed each prototype after the tests, following their pros and cons. Students jotted down feedback from seniors that helped modify prototypes for the next round of testing.

5.2.4 Final prototypes

Throughout the 13-week class, students proposed different prototypes that have all been tested. From theories of Chinese typography to daily practices, students did not just grasp abstract knowledge but applied it to a real situation as they resolved an array of legibility problems. In the project, students learned about the importance of typography as it plays a central role in making textual information easy to read and find for seniors. In addition, students considered the context in which medicine labels are read, which drove different impacts to their design prototypes and information presentation. Home visits and usability tests provided supplemental views of how seniors manage their medicine taking in their daily lives, towards a presentation of information that would reduce worries about taking medicines wrongly when administering them alone at home.

Given the real life scenario, one group of students explored the spatial arrangements on medicine containers of different sizes, for example. They extracted, highlighted and reorganized crucial information according to the varied sizes of containers. In the example of the ointment container label, the size was so limited that it was impossible to present all information. After feedback from the tests, students decided to enlarge the name of the medicine and highlight it with a yellow background, while the patient's name was

scaled down deliberately in order to draw even more attention to the medicine information (Figure 14).

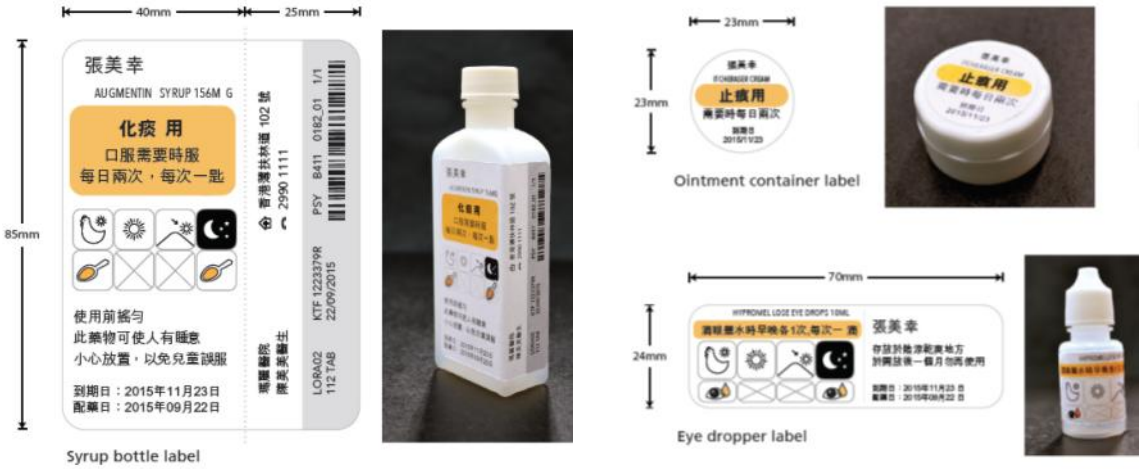

Figure 14. Students finalized and applied typographic settings and clueing across varied sizes of medicine containers. Even as small as an ointment container, the label could still be read clearly by the seniors.

Another group even developed the label design further, proposing a novel experience of medication administration for elderly people. The idea of the “Weekly Medicine Pack” was to integrate the function of a calendar in the medicine label (Figure 15). Students discovered during the home visits that seniors’ social activities were always closely tied to their calendars. Marking notes or daily or weekly activities down on a calendar, such as a doctor appointment, visits to a daughter’s home, yoga exercises at the Folk Center, or medicine taking, is a common practice in Hong Kong, particular in seniors’ homes.

Regarding the design concept of this new experience, students stated that “our design aims at solving the major problem of helping the seniors remember to take medicine every day. Wherever they go, a single pack with assigned medicines is ready for them. They do not need to worry anymore about taking medicines mistakenly. Seniors just tear off the single pack from the calendar where a certain numbers of medicines are customized and pre-packaged for them in advance. In addition, the design in a time-based format will make medicine taking more noticeable and avoidable whether seniors have or have not taken medicine. It also could help senior’s family members to keep track their daily dose in order to avoid overdose or forgotten of taking medicine [sic].”

Figure 15. The concept design of the "Weekly Medicine Pack" presents a convenient self-packed design in which seniors can easily tear off their medicine packs per calendar day (right). Each pack includes a pre-assigned medicine with dosage message and name presented on the front cover (left).

6. Conclusion

There is a common saying of "learning by doing", but I'd rather say "learning by testing". It is a good pedagogical strategy to elevate student's curiosity, motivation, self-discovery and self-learning. More importantly, students learn about the importance of empathy by engaging the views of their target audience. In his influential book *The Design of Everyday Things*, Norman (1988) states that designers should minimize the gap between the design model and the user's model in order to make a thing or information more understandable and accessible.

As previously mentioned, teaching Chinese typography is challenging for the instructor if design references do not connect with the context of students' daily lives. The project of redesigning the Hospital Authority's medicine label was a good example of a real life case that required students to work on their design together with their target audience; in this case, a group of elderly people.

In order to put Chinese typography principles into practice, students were challenged not just in understanding the basics of the anatomy of typefaces and principles. They have come to realize that typography itself has a big impact on people's everyday lives. Illegible prescription on labels causes inappropriate medicine taking, for example, which may lead to fatalities, particularly among older patients who live in solitude.

In this regard, students became highly sensitive to the legibility of Chinese typography, which is a critical attribute to the communication with certain audiences. From one-way lecturing in the classroom environment to a real life situation, students faced a lot of unexpected problems that were not described in the project brief. Through this typography project, students learned more research methods, interview skills, usability testing, documentation and data analysis. Finally, students not only appreciated the aesthetic aspects of Chinese typography but came to understand the correlations between knowing-thy-audience, contexts of use, form and content, which make information as well as design more legible and accessible to the target audience.

Acknowledgement

The author gratefully acknowledges the support for this research project provided by the School of Design, The Hong Kong Polytechnic University under Departmental General Research Funds (Project Code: G-U991).

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