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Chinese typeface with italic function

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1.1　　About Italic Type

1.1.1　　Definition

Roman type, Blackletter and italic type are three main kinds of historical typeface in Latin-script typography. The most common typeface nowadays we see and use for the main body is roman type, and the different style of typeface inside roman type text is usually italic type.

According to one of the world's most famous encyclopedias, *Encyclopædia Britannica*[1], italic type mainly has 4 features:

- Sloping;
- Light-bodied;
- Compact;
- Almost cursive letter form

  Different glyphs from roman type are usually used, like *a, f, e, w, z, C, G* and *R*. In old-style italic type, *J, K, N, T, Y, Z* can also be different[2]. Three examples of the different glyphs are shown in Figure 1:
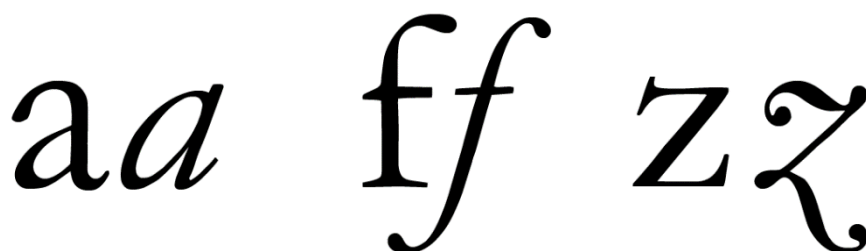
Figure 1: Some different glyphs of roman-style and italic-style from Garamond font family

Most features of italic type are owing to the influence from calligraphy.

It is worth mentioning that there is a similar form of typeface called oblique type that is usually mistaken for italic type by non-professionals[3], because oblique type is used almost in the same manner as italic type and both italic type and oblique type slant slightly to the right. However, unlike italic type, oblique type is usually geometrically distorted to be sloping. Thus, it uses the same glyphs from roman type.

1.1.2　　History

Italic type is named for its home, Italy. However, at the beginning, italic type was not designed for emphasis.

Paper was not cheap in 16th century. In order to save paper and reduce the cost of publication[2],

a narrower typeface was required by publishers. Since italic type is narrower than Blackletter and roman type, it came to use. So italic type was invented to be a text type in 16th century, which meant the whole main body of a book was printed in italic type.

In about 1560, French punchcutter *François Guyot* tried to insert italic type in roman type text. The idea of mixing italic type and roman type is considered to be *Guyot's* greatest contribution towards typography, which had not been done by any other before[4].

Since then, the use of italic type as text type waned gradually. After 17th century, using italic type inside roman type text became common[5]. The new role of italic type is to emphasize, quote, and mark special language.

Although italic type lost its independence as a typeface in 17th century and was used to mix with roman type, it was not originally designed to match roman type. Noticing this issue, type designers began to optimize italic type to match roman type suitably in 1702. Nowadays Italic type is no longer a stand-alone typeface. It turned into a sub-style of a font family. A text type is required to include at least roman style and italic style.

1.1.3 Usage

Although the use of italic type can be slightly different due to style manuals, the main usage is almost the same. According to *Interinstitutional Style Guide* by European Union[6], the use of italics is restricted to:

- Names of periodicals, ships, books, films and plays
- Words and short phrases from foreign languages
- Formulae in mathematical works
- Scientific (Latin) names of flora and fauna
- The foreword, epilogue, publisher's note
- All kinds of citations

It can also be found in other style manuals that emphasis is not included in the use of italic type, which is misunderstood by some people especially Asians who use Chinese character in their native language. While in the chapter of emphasis in *Interinstitutional Style Guide*, only bold type is mentioned. Therefore, the use of italic type and bold type are mutually different. At least the extent of emphasis they bring to readers are different: italic type is for gentle emphasis, and bold type is for heavier emphasis[7]. Italic type is supposed to distinguish special words from a text, rather than to emphasize. This difference should be made clear in typesetting.

Erica McAteer said in her research report: [8]

- *Italic face to be preferred among other options of plain, capital, and bold typeface when the intention was to provide 'contrastive' stress with a word or words within written text.*

- *Italics make it mean something else, within a context of its own set of potential meanings.*

1.2   Current Environment of Chinese Typography

However, there is no true italic type in Chinese typography.

When doing translation, the format of italic type is usually changed to:

- Bold

  sample: 意大利体**绝不是**起源于中国

The idea of changing italic type to bold may relate to the misunderstanding in China that italic type is simply an emphasis method. As mentioned in 1.3, the use of italic type and bold type should be different, therefore, in most cases it is better not to replace italic type with bold type.

- Underline / proper name mark

  sample: 意大利体<u>绝不是</u>起源于中国

Underlining is a typewriter habit for shortcomings in typewriter technology. Typewriter could not change its typeface, so its only way to emphasize text was to back up the carriage and type underscores beneath the text. In typographer's eye, underline can be ugly, and it makes a text harder to read. Underline can rarely be seen in modern publication[9].

In Chinese typography there used to be a proper name mark (专名号/短竖线号) that was very similar to underline. Proper name mark was used to mark proper names, such as the names of people and places. In 1951, Chinese government released a new standard of punctuation[10] and discarded proper name mark. Proper name mark only can be seen in some old books now.

Another potential shortcoming of underlining is that underline has other use so that readers might be confused. Underline is one of the most common way of marking text during document review, thus, readers will find it inconvenient to mark a text that was already underlined. Word processors like Microsoft Word and Apple Pages also usually use underline to track changes. Thus underline can make readers confused. What's more, hyperlinks are often underlined. Readers might confuse when they click underlined text, but nothing happened.

Therefore, it is hard to consider underline as a nice way of emphasizing text.

- Emphasis mark
  sample: 意大利体绝不是起源于中国

Emphasis mark is a dot beside the character. Like proper name mark, emphasis mark is also a relatively old mark. For word processors' bad support on emphasis mark, fewer people use it today. It can rarely be seen in today's Chinese book.

- Other typeface

sample: 意大利体绝不是起源于中国

Changing italic type to other Chinese typeface is possibly the closest way to emphasize like italic type currently. However, there is neither standard of replacement typeface nor related research. Some use Regular script, some use *Heiti* and some use Imitation *Song*[11].

- Fake italic type

sample: 意大利体*绝不是*起源于中国

This method is a direct imitation of western italic type by using italicizing function of word processors. Since most word processors can automatically generate fake italic type, and it is very convenient to use through a single click or shortcut key (Ctrl + I), a large number of people use fake italic type, especially on the web, although its legibility is usually not good. (4.2 for further) The second reason of fake italic type's popularity may due to the translation. Many non-professionals translate italic type as "slanted typeface" (斜体) in Chinese. Therefore many people can hardly realize that the central feature of italic type is handwriting style, but not simply slanting.

Unlike alphabetic language, there is no word-spacing (tracking/letter-spacing) in Chinese. The spaces between each Chinese character/word are constant. When characters geometrically slant, the unbalanced spaces between slanted characters and normal characters make the text unsuitable to read. It can be found in the given sample that the space between 体 and *绝* is relatively larger than the space between unchanged characters, and on the contrary, the space between *是* and 起 is narrower than usual. In some cases, fake italic characters can even touch the character next to it as shown in Figure 2.

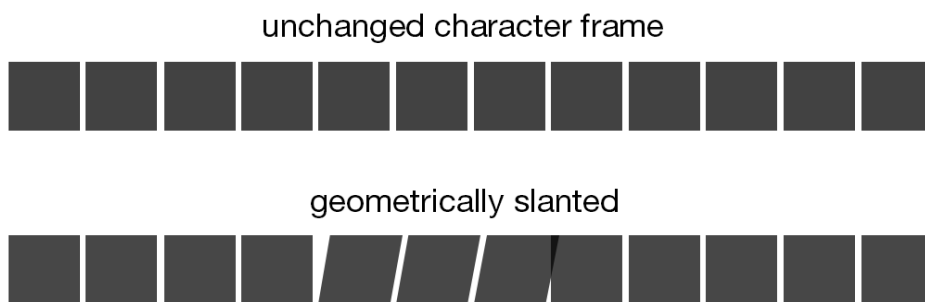unchanged character frame

geometrically slanted

Figure 2: Influence of fake italic type in Chinese text

Geometrically rightwards distortion also damages the structure of Chinese characters. It is not a natural way of writing or drawing Chinese character.

- Plain text

sample: 意大利体绝不是起源于中国

This may be the worst case because the typographical cuing is totally lost.

Despite the fact that changing the format to underline, bold type or emphasis mark is better than discarding format, these methods still can be considered to have a different effect as typographic cuing. Besides the shortcoming mentioned above, bold, underline and emphasis mark share a common problem that their effect of emphasis may be too strong for italic type. Generally, the current solutions for italic type in Chinese typography possibly change the original meaning of the text unconsciously leading to a different understanding.

In the tide of globalization, international communication will only be on the increase, so will the demand of typographically precise transition be.

1.3 Former Research

Famous type designer Stanley Morison, who designed Times New Roman used to strongly advocate sloped roman in type family as the 'true' italic in his paper *Towards an Ideal Italic*. Because of Morrison's large influence, the so-called ideal italic type emerged hoping to replace traditional handwriting italic type, but generalization was not carried out. *Akira Kobayashi,* who is an authority of Latin typeface design in Japan explaines[12] the failure of 'ideal' italic that sloped roman was hard to distinguish from upright roman. As a result, even Morison himself did not adopt sloped roman in Times New Roman several years after his paper published. This historical story suggests that simply slanted typeface is not distinguishable enough for Latin language. Famous typographer in Japan, *Takaoka Masao*（高岡昌生）also comments in his book that this situation is the same with sans-serif type[13].

Then, how is it with Chinese typeface? Unfortunately, no research of Chinese italic type has been made yet, but some Asian designers made their efforts in this field.

Jiyukubo（字游工房）is a famous type company in Japanese typography. One of its representative work *Hiragino* is the default Japanese typeface in Mac OS X and iOS. The founder of *Jiyukubo, Suzuki Tutomo*（鈴木勉）, made an experimental slanted text type called *Suusya*（スーシャ）in 1974[14]. Actually Suusya was not designed to be an italic replacement, but an innovation optimization of horizontal writing in Japanese. It won the highest award of the Second *Ishii* Creative Typeface Contest（石井賞創作タイプフェイスコンテスト）and were commercialized in 1979. However, this typeface has not been digitalized yet. It may relate to the unique environment of Japanese language[15].

コトバを書体で コトバを書体で

Figure 3: *Suusya* designed by *Suzuki Tutomo*

In 1992, *Nakamura Masahiro*（中村征宏）, a type designer of *Syaken*（写研）, released his original

font family called *Nakamin* (ナカミン) that included an italic style. It included 4 styles in all: medium, bold, bold italic and ultra. It is noteworthy that its italic style was bold italic, but not medium italic, which means this italic was not designed for text. Maybe *Nakamin* is the earliest CJK typeface that contains italic style.

Figure 4: *Nakamin* font family by *Nakamura*

In Oct.2012, Arron Bell (USA) designed a font-family called Saja. Saja introduced true italic style to CJK[16] typeface. It used Semi-cursive style Korean characters as italic style.

Figure 5: Saja family designed by Aaron Bell

In 2013, Calvin Kwok from the Hong Kong Polytechnic University designed 4 sets of Chinese equivalences for italic type as his graduation portfolio. These 4 typefaces were all sans-serif, and their text environment were also all sans-serif.

Figure 6: Experimental Chinese italic types by Calvin Kwok

The increasing international communication may be distributing to this issue. It seems the discussion of CJK italic type is becoming hot, but research and try on text italic type have not been made.

Chapter 2   Objectives & method

2.1 Motivation

It can be known from Chapter 1 that currently Chinese typefaces have no italic style and the current solutions for italic text have shortcomings. Therefore, a better solution can be demanded.

If there are Chinese typefaces corresponding with italic type, the problem of vacancy of italic type can be solved directly. Chinese italic type can be a help to two-way translation and bring much more possibility to Chinese typography.

2.2 Objectives

Generally speaking, the final purpose of this research topic is to find clues of Chinese equivalences for italic type. The main objects of this paper includes:

- How western italic type differs from roman type in impression?
- How Chinese typeface differs from western type in impression?
- Is there any existing Chinese typeface has the similar impression with western italic type?
- Does western italic type have hidden characteristic?
- What is readers' preference to typeface and font combination?
- Is geometrically transformed typeface proper when used as italic type? If not, what is their shortcoming?
- Is there any factor in traditional Chinese typeface or calligraphy that can be used in the design of Chinese italic type?
- What typeface can be a good choice to replace italic type, or to start designing Chinese italic type with?

In addition to that, a trial Chinese italic type is introduced in in Chapter 4.

Because italic type is mostly demanded in a text, this paper focuses on italic type for text. Throughout the paper, following rules are followed:

- The surrounding text type is *Ming* (宋体/明体. 3.2.2 for more detailed introduction). *Ming* is one of the most common text type in Chinese typography, especially in print work, like serif type in the west.
- Horizontal text direction.
  Vertical text direction is almost forbidden in mainland China, and even in Taiwan, government document is forced to use horizontal text direction.
- Simplified Chinese characters

These rules were selected mainly for their popularity in China.

This paper holds that the basic goals of Chinese italic type are:

- Rudimentary legibility in text size

- Matches well with *Ming*

- Weaker emphasis than bold *Ming*

  It was mentioned in 1.1.3 that italic should be used as gentle emphasis, so italic type should not be salient than bold text.

- Attack attention when being read

  This point can be considered as the least visual salience of gentle emphasis. Otherwise there is no need to change the style.

It will be better if following optional goals can be achieved:

- Easy-to-make

  Simplified Chinese typeface should contain at least 6763 Chinese characters to meet the requirement of GB2313[17]. Since it is not ease to make a Chinese font, it can be an important advantage if the font can be made efficiently.

- Features that can be applied to all font families

  Italic type may not be limited in *Ming*. Every typeface can have its own italic style, so a global transformation method can be needed.

  Besides, it was mentioned in 1.1.2 that italic style is used as a sub-style of a normal style. The common features of normal style and sub-style can be a non-negligible part. Otherwise, they can hardly be called as a font family. At this point, global transformation method is also needed.

- Do not pop-up visually when paragraphs are glimpsed

  It was mentioned in 1.1.3 that italic type is supposed to distinguish special words from text, rather than to emphasize. Important text need be emphasized so that it can be caught in a quick reading and visual search task, but the importance of italicized text usually is not that high.

2.3   Research Process

With the goals stated in 2.2, this paper carried out two experiments.

As the first stage (Chapter 3), impression of existing Chinese typefaces and English types was researched. SD method was used so that typefaces' characteristics could be known. Based on the result of factor analysis, it became easier to choose typefaces as different as possible, which would contribute in the next stage.

In the second stage (Chapter 5), overall effect was researched through practical application. Apart from typefaces used in the previous stage, some geometrically transformed typefaces and a trial typeface (Chapter 4) were also tested. The data of readers' preference and types' emphasis strength were obtained.

Chapter 3   Experiment of Existing Typefaces' Impression

3.1   Objectives

In this stage, the data of different typeface's impression was collected through questionnaire. It was mainly hoped to answer following questions:

- How western italic type differs from roman type in impression?
- How Chinese text type differs from western text type in impression?
- Is there any existing Chinese typeface has a similar impression with western italic type?
- Does western italic type have hidden characteristic?

3.2   Method

3.2.1   SD Method

SD (Semantic differential) method and factor analysis was employed in this experiment.

SD method was designed to measure people's reactions to stimulus words and concepts in terms of ratings on bipolar scales defined with contrasting adjectives at each end[18]. SD is one of the most widely used scales in the measurement of impressions.

Factor analysis is usually employed to reduce dimensions so that further analyses can be conducted.

3.2.1   SD Scales

On the basis of former researches[19] [20] [21] [22] [23] [24] and preliminary test[25], 14 pairs of bipolar adjective terms about impression were chosen to describe both Chinese typefaces and western typefaces[26]:

Heavy / Light	*Vulgar / Refined*
Simple / Gorgeous	*Hard / Soft*
Antique / Modern	*Weak / Powerful*
Fierce / Calm	*Worrisome / Sober*
Boring / Interesting	*Cold / Warm*
Dull / Sharp	*Dim / Bright*
Illegible / Legible	*Unstable / Stable*

Each subject was asked to evaluate typefaces according to these 14 adjective pairs on a scale from 1 to 5. For instance, in the case of *"heavy/light"*, 1 point meant "very heavy", 3 points meant "neither heavy nor light" and 5 points meant "very light".

3.2.2   Materials

It was mentioned in 2.2 that this research focuses on text type, therefore, ancient script styles

like Oracle bone script (甲骨文), Bronze script (金文) and Seal script (篆书/篆書) that most modern readers could not recognize were not chosen.

As a result, 4 script styles (calligraphy styles) and 4 type styles (styles for movable type and computer fonts) were chosen:

- Clerical script
  (*Lishu*/隶书/隸書, sometimes called "Official", "Chancery" or "Scribal" script)

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微风迎客，软语伴茶

Figure 7: A Clerical script typeface

Clerical script may have originated in the brush writing of the later *Zhou* and *Qin* dynasties (c. 300 – 200 BC) and remained in common use through the *Han* dynasty (206 BC – AD 220) [27]. As its name implies, clerical script was used in almost all official documents.

The most apparent feature of Clerical script is its Horizontal stroke ("一", called 横/よこ). The beginning of Horizontal stroke resembles the head of a silkworm while the finish of the stroke resembles the tail of a wild goose. Another unique feature of Clerical script is that characters usually tend to be wider than they are tall while most modern typefaces are square.

Among selected script style, Clerical script has the longest history.

- Regular script
  (*Kaishu*/楷书/楷書, sometimes called "Uniform/正书/正書", "Real/真书/真書" or "Standard" script)

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Figure 8: Most common Regular script typeface today

Regular script was developed during the period of the Three Kingdoms and Western *Jin* (220–316/317) that simplified the Clerical script into a more fluent and easily written form [28] and was perfected in the mid-*Tang* dynasty (618-907).

Because it remains the standard script in use until now and is the fundamental skill of calligraphy, up to 6 typefaces of Regular script were selected besides the typeface in Figure 8:

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Figure 9: New *Wei* Regular (新魏体)

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Figure 10: Regular script of three great calligraphers (*Yan Zhenqing*/颜真卿, *Ouyang Xun*/欧阳询 and *Liu Gongquan*/柳公权) in early *Tang*

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Figure 11: Slender Gold (瘦金体) invented by emperor *Tang Huizong*

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Figure 12: *Kodoken-seicho* (清朝体) from Japan

- Semi-cursive script

    (*Xingshu*/行书/行書, also called Running script)

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微风迎客，软语伴茶

Figure 13: A Semi-cursive script typeface

Semi-cursive script was developed out of the *Han* dynasty Clerical script at the same time that the Regular script was evolving (1st-3rd century AD). It moderates between Regular script and Cursive script. The strokes of Semi-cursive scripts often run together in unrestrained manner[29].

Generally, educated Chinese and Japanese can read Semi-cursive script with relative ease with occasional difficulties. For its convenience and legibility, Semi-cursive script is one of the most popular form of Chinese freehand writing in daily use.

- Cursive script

(*Caoshu*/草书/草書, sometimes called Grass script or Draft script)

Figure 14: A relatively easy-to-read Cursive script typeface

This script developed during the *Han* dynasty (206 BC – AD 220). In Cursive script, the number of strokes in characters can be reduced to single scrawls or abstract abbreviations of curves and dots, showing a great variety of shapes[30].

Originally, Cursive script should not be bound by rules for even spacing, but unfortunately, characters of almost all digital Cursive script typefaces are constrained in width and ligature for workload and technical problem.

This script is not particularly legible to the average person. Even a person who can read Semi-cursive script may not be able to read cursive script without training. Thus, a relatively easy-to-read typeface of Cursive script was selected in the experiment.

- *Heiti*
  (黑体/黑體, sometimes called sans-serif typeface/无衬线字体 in Chinese, Gothic typeface/ゴシック体 In Japanese)

Figure 15: Microsoft *Yahei*,
Windows' default UI font for Chinese since Windows Vista

This type style is the influence result of *Heiti* style in Western typography. The first *Heiti* appeared in 1910[31]. It is the second most common style in East Asian typography. *Heiti* is used more and more frequently due to the modernization of society and the increasing popularity of display device.

- Imitation *Song*
  (*Fang Song*/仿宋体/仿宋體 in Chinese, 宋朝体 in Japanese)

Ding Brothers invented *Juzhen* Imitation *Song* (聚珍仿宋, Figure 16) in 1916. *Juzhen* Imitation *Song* absorbed both *Ouyang*'s Regular script style and *Ming*[32]. Its stroke has low contrast in width variation and is usually relatively thin.

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Figure 16: A digital version of *Juzhen* Imitation *Song*

Although up to 10 national standards stipulate using Imitation *Song* in CAD graph and textbooks, Imitation *Song* is usually not used as text type now. At this point, Imitation *Song* is akin to italic type in West typography.

Modern Imitation *Song* is quite different from traditional one (*Juzhen* Imitation *Song*). It tends to be condensed, thinner and more geometrical regularity.

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Figure 17: Most common modern Imitation *Song* typeface

- *Ming*

  (明体/明體 or *Song*/宋体/宋體 in Chinese, 明朝体 In Japanese)

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Figure 18: A modern *Ming* typeface in regular weight

Ming is currently the most common style of type in print. The most apparent characteristic of *Ming* is its thick Vertical strokes ("丨", called 竖/豎/たて) contrasted with thin Horizontal strokes and serifs at the end of Horizontal strokes (called 装饰角/钝角/字脚/字角 in Chinese, ウロコ in Japanese).

Modern *Ming* is very different from its origin. The origin of *Ming* is similar to Regular script. However, modern *Ming* has overall geometrical regularity vertically and horizontally. *Ming* was geometrically redesigned by foreign churchman William Gamble to improve lettering efficiency because it was much easier to carve a straight line than cursive line on wood and lead. The more *Ming* developed the more geometrical stroke it has (Figure 20).

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Figure 19: An "old style" *Ming* typeface

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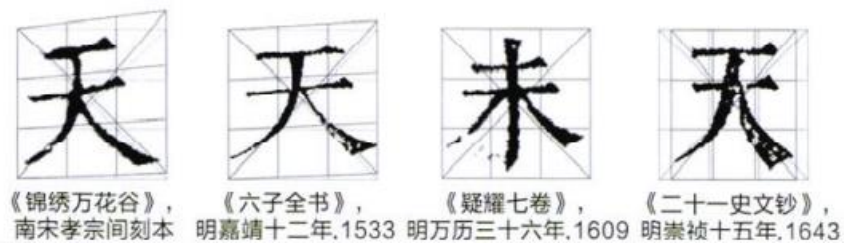
Figure 20: Evolution of *Ming*[33]

- Display type

  (美术字)

Figure 21: *Yaoti*

Yaoti was designed by *Yao Zhiliang* (姚志良) in 1958. It rose to fame soon after its release[34]. *Yaoti* is one the few display typeface that is classified in the national standard[35].

To conclude, 16 Chinese typefaces were selected in all.

The unified sample text for Chinese typefaces is from the default setting of Windows Font Viewer: 中国智造，慧及全球。微风迎客，软语伴茶. These characters contain typical types of Chinese characters structure (Table 1).

Table 1: Structure classification of the sample text for Chinese typefaces

Ideographic Description Character	Structure Description	Characters
	Single Component	中, 及
⿰	Left to Right	球, 软, 语, 伴
⿱	Above to Below	智, 全, 客
⿲	Left to Middle and Right	微
⿳	Above to Middle and Below	慧, 茶
⿴	Full Surround	国
⿵⿶⿷⿸⿹⿺	Half Surround	风, 造, 迎

In the aspect of western typeface, in order to gain the average impression of both roman type and italic type, 3 font families from different countries were chosen:

● Caslon from England

The quick brown fox jumps over the lazy dog

The quick brown fox jumps over the lazy dog

Figure 22: Roman and italic style of Caslon

● *Didot* from France

The quick brown fox jumps over the lazy dog

The quick brown fox jumps over the lazy dog

Figure 23: Roman and italic style of *Didot*

● *Palatino* from Germany.

The quick brown fox jumps over the lazy dog

The quick brown fox jumps over the lazy dog

Figure 24: Roman and italic style of *Palatino*

Including the roman and italic style of each font family, 6 typefaces were used.

The sample text for English type is a famous pangram[36]: *The quick brown fox jumps over the lazy dog.*

3.2.3   Subjects

48 Chinese subjects including 31 men and 17 women volunteered for participation in the study. Although education background was not taken into consideration, all subjects possessed a Bachelor's degree. Most subjects were 20-30 years old. Table 2 and Figure 25 present subjects' gender and age distribution.

Table 2: Cases Summary about age

	Age				
Sex	N	Mean	Minimum	Maximum	Std. Deviation
Male	31	24.39	18	35	3.030
Female	17	22.88	19	27	1.900
Total	48	23.85	18	35	2.760

Figure 25: Histogram of age
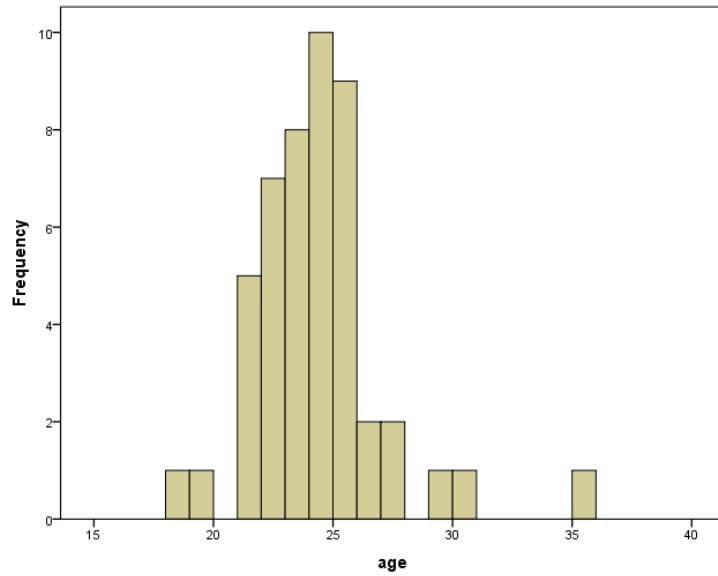
3.3 Results

The experiment was carried during January 10th, 2013 and January 20th, 2013. All subjects performed the evaluation task on their own computers and were allowed to do the evaluation at their own pace (Figure 26, Table 3 and Table 4). The Internal consistency of the data is excellent (Cronbach's alpha = 0.976)
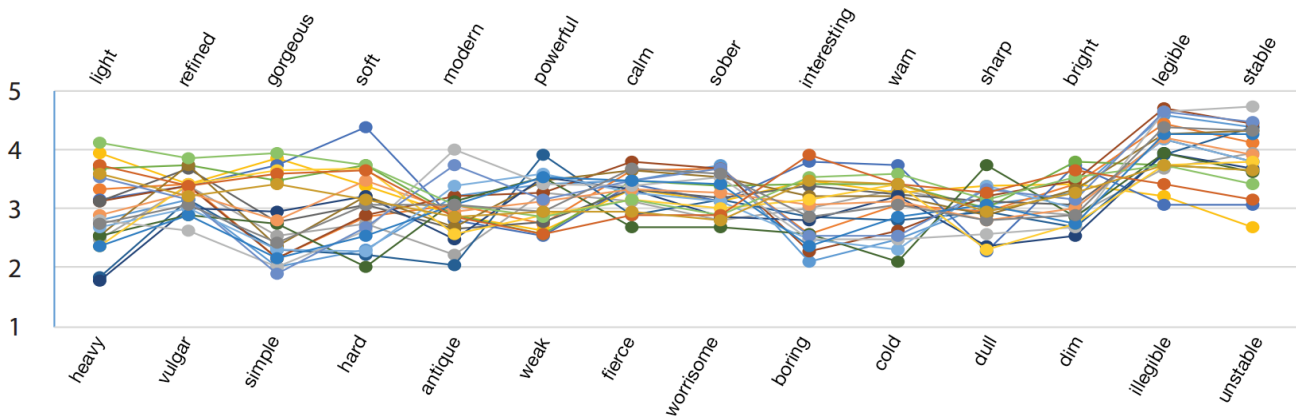

Figure 26: Schematic of typefaces' impression ratings

Table 3: Mean and standard deviation of Chinese typefaces' impression ratings

1 point / 5 points	Heavy / Light	Vulgar / Refined	Simple / Gorgeous	Hard / Soft	Antique / Modern	Weak / Powerful	Fierce / Calm	Worrisome / Sober	Boring / Interesting	Cold / Warm	Dull / Sharp	Dim / Bright	Illegible / Legible	Unstable / Stable
Ming	3 (0.92)	3.33 (0.93)	2.13 (1.27)	2.44 (1.09)	3.25 (1.16)	3.42 (0.82)	3.73 (1.07)	3.65 (1.12)	2.23 (0.97)	2.6 (1.05)	3.1 (0.93)	3.42 (0.94)	4.46 (1.05)	4.25 (0.96)
Modern Imitation *Song*	3.59 (1.06)	3.63 (0.99)	2.55 (1.1)	3.12 (0.93)	3.1 (0.8)	2.8 (0.79)	3.53 (0.92)	3.65 (0.8)	2.84 (1.05)	3.06 (0.97)	3.16 (0.94)	3.59 (0.93)	4.33 (1.13)	3.9 (1.16)
Juzhen Imitation *Song*	2.62 (1.03)	3.46 (0.97)	2.48 (0.93)	2.6 (1.01)	1.88 (1.02)	3.42 (0.97)	3.04 (0.88)	3.02 (1)	3 (1.11)	3.14 (0.83)	3.22 (1.09)	2.96 (0.92)	3.54 (1.25)	3.64 (1.31)
Slender Gold	4.18 (1.08)	3.5 (1.22)	4.06 (1)	3.26 (1.16)	3.02 (1.13)	2.72 (1.09)	2.98 (1.13)	2.8 (1.07)	3.42 (1.05)	3.14 (0.9)	3.54 (1.09)	3.56 (0.99)	3.08 (1.24)	2.68 (1.11)
Cursive	3.38 (1.14)	3.32 (1.06)	3.8 (1.12)	4.36 (0.8)	2.72 (1.2)	2.54 (0.91)	3.1 (1.09)	2.94 (0.87)	3.68 (1.04)	3.61 (0.89)	2.56 (0.99)	3.32 (0.91)	2.84 (1.23)	2.9 (1.05)
Semi-cursive	3.84 (0.84)	3.48 (0.93)	3.38 (0.95)	3.67 (0.94)	2.98 (0.99)	2.72 (0.97)	3.36 (0.96)	3.16 (0.91)	3.28 (0.88)	3.3 (0.81)	3.2 (0.79)	3.7 (0.89)	3.58 (0.99)	3.36 (1.03)
Kodoken-seicho	2.06 (1)	3.1 (1.13)	2.5 (1.05)	2.4 (1.07)	1.92 (0.85)	3.8 (1.03)	3.1 (0.95)	3.02 (0.98)	3.08 (1.08)	2.82 (1)	2.62 (1.03)	2.62 (0.88)	3.56 (1.15)	3.88 (1.24)
Regular	3.24 (0.96)	3.36 (0.83)	2.32 (0.94)	2.92 (0.75)	3.18 (1.14)	3.14 (0.86)	3.82 (1.01)	3.62 (0.99)	2.54 (0.93)	2.98 (0.77)	3.06 (0.71)	3.42 (0.86)	4.48 (0.99)	4.28 (1.03)
Liu Regular	2.88 (1.05)	3.45 (1.02)	2.86 (0.98)	2.94 (0.99)	2.37 (0.93)	3.22 (1.05)	3.16 (0.92)	3.12 (0.93)	3.27 (0.81)	3.12 (0.99)	3.06 (1.09)	3.12 (0.97)	3.92 (1.02)	3.39 (1.17)
Ou Regular	2.72 (1.01)	3.68 (1.06)	2.54 (0.97)	2.86 (1.13)	2.52 (0.99)	3.38 (0.85)	3.66 (0.94)	3.44 (0.88)	3.26 (0.96)	3.34 (0.98)	2.98 (1)	3.24 (1.04)	4.04 (1.03)	4.2 (1.03)
Yan Regular	2.06 (1.11)	2.9 (1.05)	3.02 (0.98)	3.12 (1.19)	2.2 (1.01)	3.4 (1.21)	3.34 (1.14)	2.88 (0.94)	3.02 (1.08)	3.24 (1)	2.18 (1.08)	2.58 (1.07)	3.44 (1.2)	3.34 (1.15)
Old style *Ming*	2.88 (1.06)	2.92 (1.03)	2.94 (1.06)	1.98 (0.82)	2.86 (1.23)	3.48 (1.09)	2.68 (1)	2.94 (1.06)	2.78 (1.15)	2.5 (1.07)	3.5 (1.16)	3.02 (0.94)	3.84 (1.28)	3.24 (1.55)
Yaoti	3.02 (1.07)	2.94 (1.05)	2.61 (0.93)	2.53 (0.98)	3.39 (0.91)	3.37 (1.05)	3.1 (0.96)	3.14 (1.19)	2.61 (1)	2.57 (0.84)	3.33 (1.05)	3.13 (0.98)	3.9 (1.16)	3.73 (1.19)
Wei Regular	2.84 (0.98)	3.14 (0.99)	2.88 (0.82)	3.12 (0.98)	2.94 (1.1)	3.38 (0.88)	3.22 (1)	3.16 (0.79)	3.06 (0.91)	3.16 (0.96)	2.9 (0.95)	2.98 (1)	3.84 (1.11)	3.7 (1.11)
Heiti	2.92 (1.12)	3.1 (0.91)	2.2 (1.01)	2.66 (1.06)	4.06 (1.02)	3.38 (0.88)	3.52 (0.93)	3.62 (1.07)	2.78 (1.15)	2.62 (1.12)	2.78 (1.07)	3.04 (0.99)	4.46 (1.03)	4.5 (0.81)
Clerical	2.4 (1.05)	3.24 (0.96)	3.12 (1.19)	3.4 (1.01)	2.46 (1.2)	2.98 (0.98)	3.2 (0.95)	3.08 (0.92)	3.12 (1)	3.32 (0.96)	2.42 (0.91)	2.66 (0.98)	3.38 (1.26)	3.62 (1.18)

Table 4: Mean and standard deviation of western typefaces' impression ratings

1 point / 5 points	Caslon	Caslon italic	Didot	Didot italic	Palatino	Palatino italic
Heavy / Light	3.38 (0.9)	4.08 (0.85)	2.6 (0.97)	3.92 (0.88)	2.76 (0.98)	3.72 (0.9)
Vulgar / Refined	3.22 (0.89)	3.74 (0.96)	2.98 (0.65)	3.4 (0.86)	3.2 (0.83)	3.2 (0.9)
Simple / Gorgeous	2.26 (0.83)	3.92 (1.01)	2.74 (1.12)	3.7 (1.04)	2.52 (0.93)	3.48 (0.86)
Hard / Soft	2.74 (0.8)	3.66 (0.94)	2.48 (0.84)	3.7 (0.81)	2.64 (0.94)	3.14 (0.9)
Antique / Modern	3.32 (1.02)	2.96 (1.03)	3.38 (1.16)	3.2 (1.07)	3.1 (0.95)	2.94 (1.02)
Weak / Powerful	3.26 (0.63)	2.74 (0.78)	3.5 (0.81)	2.76 (0.74)	3.36 (0.9)	3.06 (0.79)
Fierce / Calm	3.44 (0.73)	2.96 (0.86)	3.34 (0.85)	2.88 (0.85)	3.42 (0.86)	3.12 (0.8)
Worrisome / Sober	3.6 (0.95)	2.64 (0.8)	3.34 (0.94)	2.86 (0.81)	3.54 (0.97)	2.9 (0.81)
Boring / Interesting	2.78 (0.91)	3.64 (0.88)	2.72 (0.99)	3.62 (0.75)	2.88 (0.92)	3.3 (0.86)
Cold / Warm	2.62 (0.75)	3.42 (0.73)	2.62 (0.78)	3.2 (0.78)	3.14 (0.86)	3.26 (0.72)
Dull / Sharp	3.24 (0.85)	3.3 (0.86)	3.16 (0.96)	3.24 (0.82)	2.76 (0.96)	3.2 (0.81)
Dim / Bright	3.34 (0.87)	3.5 (0.86)	3.1 (0.81)	3.54 (0.79)	3.08 (0.78)	3.26 (0.8)
Illegible / Legible	4.42 (0.93)	3.5 (1.16)	3.96 (1.14)	3.38 (1.18)	4.34 (0.87)	3.74 (1.05)
Unstable / Stable	4.3 (0.93)	3.38 (1.03)	3.96 (1.05)	3.22 (1.04)	4.32 (0.89)	3.58 (0.99)

In the aspect of impression term, following points are found:

- *"vulgar/refined"* had the smallest range (0.840) among all 14 adjective pairs. While *"heavy/light"* (2.120), *"hard/soft"* (2.380) and *"antique / modern"* (2.180) had relatively larger range. (Figure 27)

  Only Yan Regular (2.90), old style *Ming* (2.90), *Yaoti* (2.94) and *Didot* (2.98) scored lower than 3 points in *"vulgar/refined"*, and their scores were actually very close to 3.

- the standard deviation of *"heavy/light"* was the highest (0.61), followed by *"simple/gorgeous"* (0.58) and *"hard/soft"* (0.54)

- Some interesting relations between impressions are found (cells with outside black borders in Table 5. To see full data, please go to Appendix 2): *soft* and *gorgeous*, *interesting* and *gorgeous*, *interesting* and *soft*, *warm* and *soft*, *warm* and *interesting*, *bright* and *light*

Table 5: Pearson Correlation of impressions

	Light	Refined	Gorgeous	Soft	Modern	Powerful	Calm	Sober	Interesting	Warm	Sharp	Bright	Legible	Stable
Light	1	.560**	.586**	.525*	.449*	-.795**	-0.176	-0.191	0.415	0.257	.646**	.897**	-0.152	-0.370
Refined	.560**	1	0.272	.470*	-0.117	-.581**	0.152	-0.002	.443*	.556**	0.295	.637**	-0.078	-0.114
Gorgeous	.586**	0.272	1	.732**	-0.118	-.735**	-.636**	-.817**	.838**	.634**	0.141	0.306	-.824**	-.870**
Soft	.525*	.470*	.732**	1	-0.049	-.870**	-0.133	-0.401	.762**	.826**	-0.206	0.389	-.608**	-.542**
Modern	.449*	-0.117	-0.118	-0.049	1	-0.171	0.286	.459*	-0.325	-.437*	0.351	.493*	.495*	0.348
Powerful	-.795**	-.581**	-.735**	-.870**	-0.171	1	0.170	0.304	-.623**	-.633**	-0.177	-.675**	.460*	.561**
Calm	-0.176	0.152	-.636**	-0.133	0.286	0.170	1	.847**	-.542**	-0.118	-0.266	0.140	.692**	.748**
Sober	-0.191	-0.002	-.817**	-0.401	.459*	0.304	.847**	1	-.718**	-.450*	-0.051	0.137	.873**	.853**
Interesting	0.415	.443*	.838**	.762**	-0.325	-.623**	-.542**	-.718**	1	.791**	-0.051	0.177	-.770**	-.691**
Warm	0.257	.556**	.634**	.826**	-.437*	-.633**	-0.118	-.450*	.791**	1	-0.322	0.139	-.599**	-.477*
Sharp	.646**	0.295	0.141	-0.206	0.351	-0.177	-0.266	-0.051	-0.051	-0.322	1	.659**	0.146	-0.142
Bright	.897**	.637**	0.306	0.389	.493*	-.675**	0.140	0.137	0.177	0.139	.659**	1	0.101	-0.130
Legible	-0.152	-0.078	-.824**	-.608**	.495*	.460*	.692**	.873**	-.770**	-.599**	0.146	0.101	1	.883**
Stable	-0.370	-0.114	-.870**	-.542**	0.348	.561**	.748**	.853**	-.691**	-.477*	-0.142	-0.130	.883**	1

**. Correlation is significant at the 0.01 level (2-tailed).

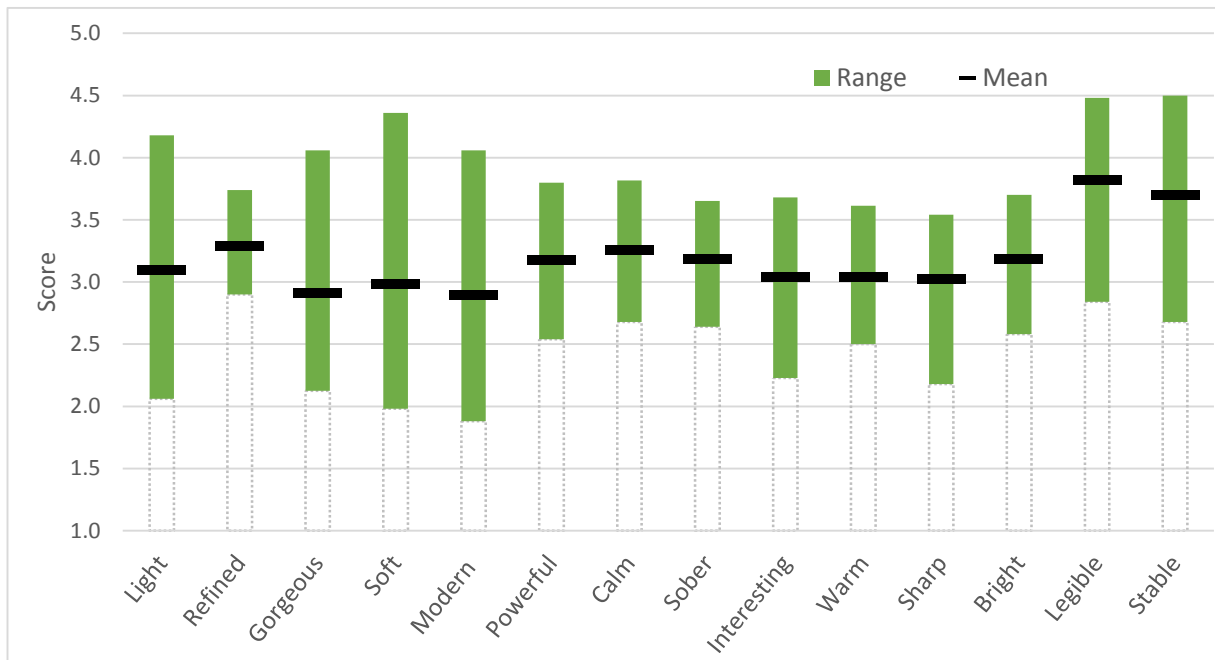*. Correlation is significant at the 0.05 level (2-tailed).

Figure 27: Rating result of adjective pairs

In the aspect of typefaces, following points are found:

- Cursive script got particularly high score in "*soft*" at 4.36 while the second most soft typeface group included *Didot* italic (3.70), Semi-cursive script (3.67) and Caslon italic (3.66)

- Old style *Ming* scored particularly low in "*soft*" at 1.98, followed by *Kodoken-seicho* (2.40) and modern *Ming* (2.44).

- *Heiti* stood out in "*modern*" at 4.06, and its score was 0.68 point higher than the second most modern typeface *Yaoti* (3.39).

- *Kodoken-seicho* was nearly the most "*antique*", "*heavy*", "*powerful*" and "*dim*" typeface.

Table 6: Significant difference of male and female (p<0.05)

Mean difference by paired sample t-test ("Male" minus "Female")	Cursive	Kodoken-Seicho	Liu Regular	Yan Regular	Wei Regular	Heiti	Clerical	caslon	Didot	Palatino
Vulgar / Refined						0.64				
Simple / Gorgeous							-0.84	0.56	0.89	
Hard / Soft										-0.68
Weak / Powerful			0.69		0.56					0.74
Worrisome / Sober										-0.55
Cold / Warm									-0.47	
Dull / Sharp	0.61									
Dim / Bright	-0.57									
Illegible / Legible				-0.79						
Unstable / Stable		-0.94								

Following point about italic type were found:

- Compared with roman types, western italic types scored 1.19 point higher in "*gorgeous*", 0.99 point higher in "*light*", 0.77 point higher in "*soft*", 0.73 point higher in "*interesting*", but 0.79 point lower in "*stable*", 0.68 point lower in "*legible*" and 0.63 point lower in "*sober*". More details can be seen in Table 7.

Table 7: Mean scores and standard deviations of Roman types and their corresponding italic types

1 point / 5 points	Roman type	italic type	difference
Heavy / Light	2.91 (0.95)	3.91 (0.88)	0.99 (-0.07)
Vulgar / Refined	3.13 (0.79)	3.45 (0.91)	0.31 (0.12)
Simple / Gorgeous	2.51 (0.96)	3.7 (0.97)	1.19 (0.01)
Hard / Soft	2.62 (0.86)	3.5 (0.89)	0.88 (0.02)
Antique / Modern	3.27 (1.04)	3.03 (1.04)	-0.23 (0)
Weak / Powerful	3.37 (0.78)	2.85 (0.77)	-0.52 (-0.01)
Fierce / Calm	3.4 (0.81)	2.99 (0.83)	-0.41 (0.02)
Worrisome / Sober	3.49 (0.95)	2.8 (0.81)	-0.69 (-0.15)
Boring / Interesting	2.79 (0.94)	3.52 (0.83)	0.73 (-0.11)
Cold / Warm	2.79 (0.8)	3.29 (0.75)	0.5 (-0.05)
Dull / Sharp	3.05 (0.92)	3.25 (0.83)	0.19 (-0.09)

Dim / **Bright**	3.17 (0.82)	3.43 (0.82)	0.26 (0)
Illegible / **Legible**	4.24 (0.98)	3.54 (1.13)	-0.7 (0.15)
Unstable / **Stable**	4.19 (0.96)	3.39 (1.02)	-0.8 (0.06)

3.4 Discussion

Before factor analysis, 3 tendencies can be concluded:

- The result of "*vulgar/refined*" may imply that it is hard to differentiate common typeface[37] in "*vulgar/refined*".

- *Kodoken-seicho* has its unique impression.

- Most of the serif types had *antique* impression.

- Top 6 "*gorgeous*" typefaces (scored higher than 3 points in "*simple/ gorgeous*") all have apparently curved strokes and the tendency of connecting successive strokes: Slender Gold (4.06), Caslon italic (3.92), Cursive script (3.80), *Didot* italic (3.70), *Palatino* italic (3.48), Semi-cursive script (3.38). This tendency may suggest that curved strokes and connection between successive strokes play an important role in the impression of "*gorgeous*"

- Both italic type and roman type have their own impression pattern according to Figure 28. It can be seen from Figure 28 that italic types' impression pattern tends to be rounder.
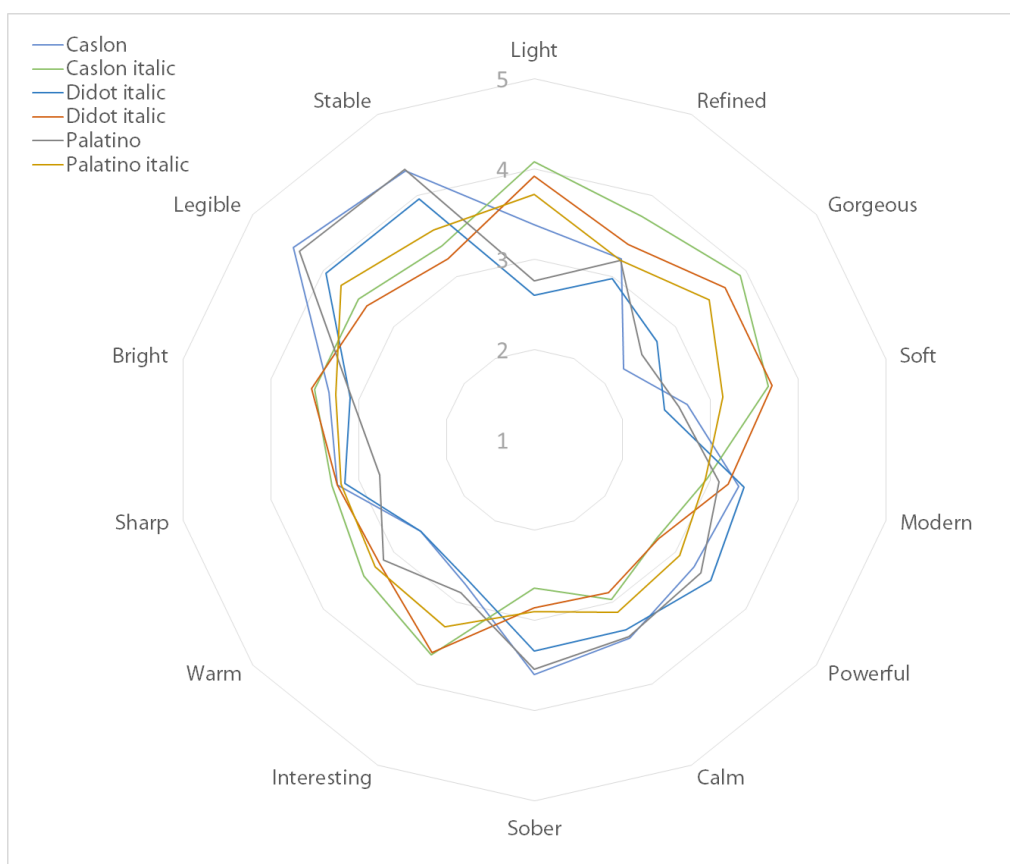

Figure 28: Impression patters of roman types and italic types

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- 4 modern Chinese text typefaces (Regular script, modern Imitation *Song*, *Ming* and *Heiti*) have the similar impression. This impression pattern is also similar to the pattern of roman text type (Figure 29).

  Therefore, this paper suspect that the universal impression pattern of text types may exist.
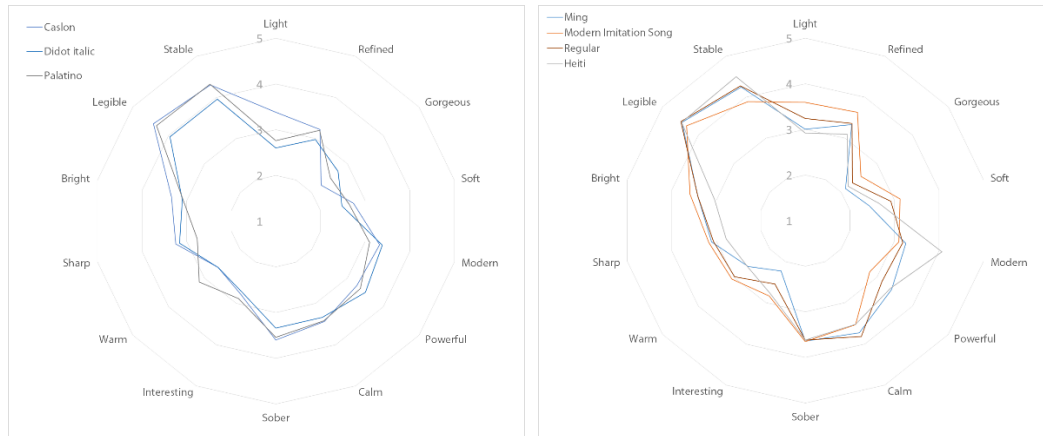

Figure 29: Impression patterns of western text type (left) and Chinese text type (right)

- Among tested Chinese typefaces, Semi-cursive script resembles western italic type most, followed by Slender Gold and *Wei* regular (Figure 30).

**Figure 30: Impression comparison of Slender Gold, Semi-cursive, *Wei* Regular (left)
and western italic types (right)**

Factor analysis was conducted. 86% cumulative contribution ratio was reached with 3 factors. (Table 8) This paper interprets the 3 factors as "simplicity and legibility" (32% contribution ratio), "tender movement" (27% contribution ratio) and "sharp thin stroke" (26% contribution ratio).

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Table 8: Impression in the process of factor analysis

	Factor 1	Factor 2	Factor 3
Calm	.881	-.270	-.160
Legible	.837	-.455	.086
Gorgeous	-.794	.439	.346
Interesting	-.602	.653	.189
Warm	-.219	.963	.089
Soft	-.239	.125	.942
Bright	.084	.084	.975
Modern	.316	-.551	-.685
Refined	.118	.499	.551

Table 9: Factor score

Typeface	Factor 1	Factor 2	Factor 3
	Simplicity and Legibility	Tender Movement	Sharp Thin Stroke
Ming	1.184	-1.304	0.395
Modern Imitation *Song*	1.164	0.256	1.181
Juzhen Imitation *Song*	0.033	0.406	-0.837
Slender Gold	-1.971	-0.305	1.397
Cursive script	-0.906	1.991	0.312
Semi-cursive script	0.067	0.912	1.449
Kodoken-seicho	-0.484	-0.680	-1.820
Regular script	1.673	0.143	0.637
Liu Regular	-0.186	-0.072	-0.342
Ou Regular	1.382	1.264	-0.255
Yan Regular	-0.486	0.642	-1.937
Old *Ming*	-1.273	-1.994	-0.340
Yaoti	-0.301	-1.406	-0.018
Wei Regular	-0.044	0.183	-0.665
Heiti	0.928	-1.011	-0.157
Clerical script	-0.477	1.051	-1.622
Caslon	0.874	-1.111	0.726
Caslon italic	-1.110	0.528	0.971
Didot	-0.013	-1.147	-0.463
Didot italic	-1.062	0.272	1.157
Palatino	1.372	0.812	-0.370
Palatino italic	-0.365	0.571	0.602

With this result typefaces could be located in 3D coordinate graphs (Figure 31).
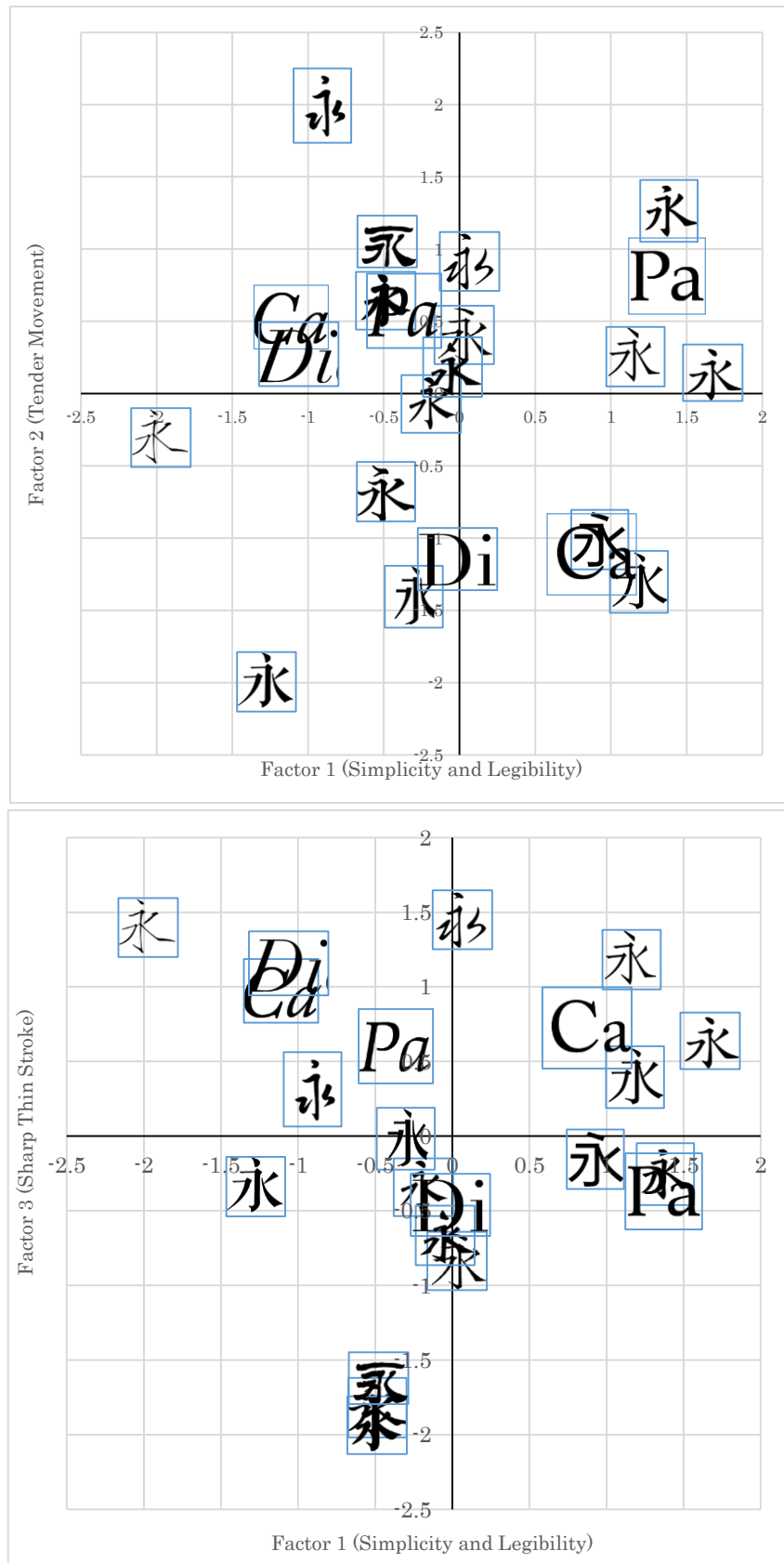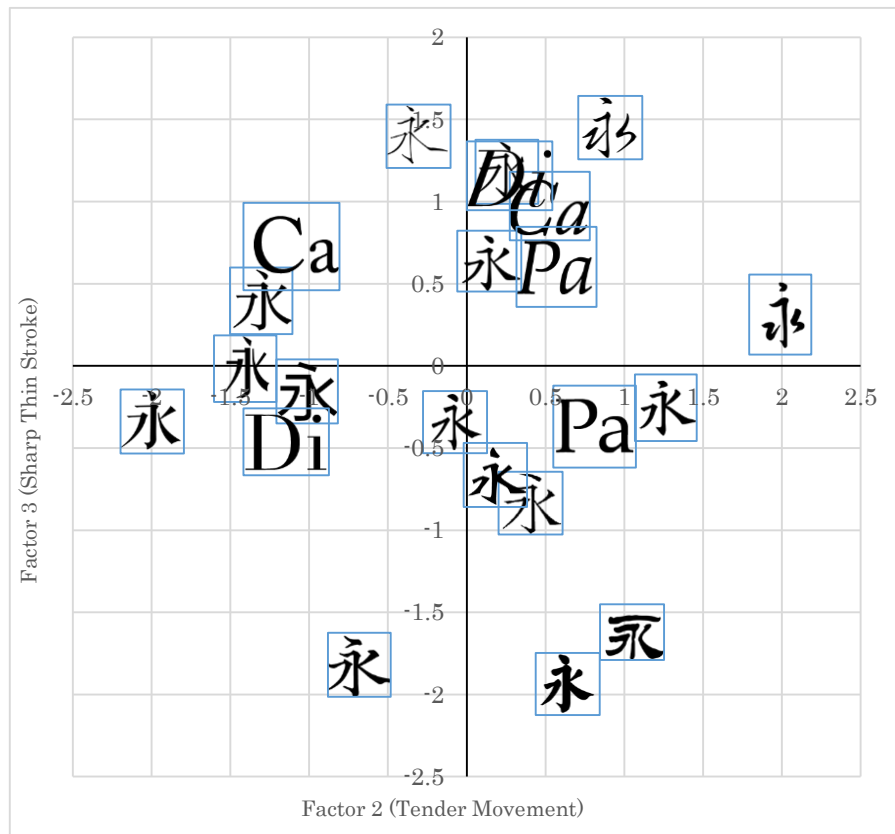
Figure 31: Typefaces' distribution based on factor scores

Following main tendencies were found:

- The distribution area of western italic types is narrower than their corresponding roman type. The roman style of *Palatino*, *Didot* and Caslon relatively separate from each on every map while the italic styles of those font families are much closer to each other on every map.

  This tendency implies that western italic style has a strong characteristic of its own so that italicization may be considered as a process of assimilation. In other words, western italic type lacks large variation.

- Chinese typefaces which are close to western italic types on the maps, tend to have slanted *Horizontal* strokes. The end of Horizontal stroke is higher than the start.

  As we know, western italic type usually slants rightwards. The upwards slanting style may be considered as Chinese way of slanting character, and it may play an important role in the development of Chinese italic type.

Chapter 4   Making of Trial Chinese Italic Type

4.1   Concept

Today's *Ming* is considered to be a modernized type style for its overall geometrical regularity vertically and horizontally, and the result of Chapter 3 supports this point of view: *Ming* was ranked fourth out of 16 typefaces, and the second modernist typeface only scored 0.14 point higher than *Ming*.

Nowadays almost all typefaces are made digitally. The advantage of geometrical design in producing typeface is not as enormous as before. However, *Ming* remains the most common text type especially in print work.

In 3.3, the other most popular typeface, *Heiti* was revealed to be the most modern type style. It seems that today's typefaces are just being modernized. The beauty of Chinese calligraphy is getting farther from youth so that more and more youth cannot write Chinese character beautifully. What's more, with the development of digital devices, people write less but type on keyboard more. People are losing their handwriting skills unconsciously.

Therefore besides the basic requirement mentioned in 2.1, humanity and Chinese characteristics are added to the concept of the trial typeface.

Besides modernity, *Ming* was also the most boring and simplest typeface according to the data in 3.3. Since *Ming*'s characteristic was known, it became easier to make its contrastive typeface.

4.2   Design Approach

4.2.1   About Slanting

It was mentioned in 3.4 that slanting Horizontal stroke upwards may be considered as an element of Chinese italic type. The author decided to make the best of this result in the trial typeface. Both Vertical and Horizontal are the fundamental strokes that construct Chinese character[38]. Is it true that slanting Horizontal is better than slanting Vertical? In this section, this paper tries to explain it.

In order to investigate the influence of slanting stroke, first of all, stroke's direction was studied.
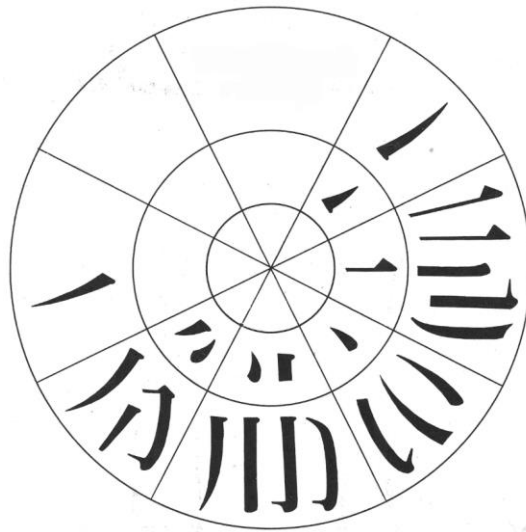
Figure 32: Directions of Chinese strokes[39]

Figure 32 shows that Rise stroke ("╱", 提 in Chinese, はね in Japanese) and Horizontal stroke are the only strokes whose direction is in the range of 0~180°. So when Horizontal stroke slants upwards, Rise stroke is the only stroke that will possibly confuse readers. In fact, in the history of Chinese character, Rise came from the short Horizontal on the lower left of a character (e.g. the last stroke of the left radical of 珏). If Rise appears on the lower left of a character, there must be some other stroke (usually Dot) on its right side to combine with it[40]. Rise was mostly independent from Horizontal since *Song* dynasty[41].

A key differentiator between Rise and Horizontal is that Rise's head end is always bolder than its tail end and became lighter smoothly while Horizontal usually have sudden serif on its tail end (in *Ming* type). Therefore in this trial typeface, Horizontal was designed to have light serif on its head end and exaggerated serif on its tail end so that readers will not mistake each stroke.

Figure 33: Horizontal and Rise of the trial typeface

However, when Vertical stroke slants, it may be mistaken for many other strokes.

Next, the frequencies of strokes[42][43] were investigated to know the extent of influence on legibility (Table 10). Fortunately, Rise's frequency is only about 1/8 of Horizontal's, therefore, not many confusing cases are expected to occur when Horizontal are slanted. However, slanting Vertical may affect the legibility more than slanting Horizontal because the frequency difference of Vertical group and the group near Vertical group is much lower.

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Table 10: Frequencies of Chinese strokes in 5 ranges of angle

Direction (angle)	Frequency	Strokes included
0 ~ 90	3625	ノ乚丨乛
0	29224	一乛乛乛乛乚乚 乛乛乀乙乁乛乚 乚乛
0 ~ -90	12773	丶乀乚く乀乙乛
-90	20671	丨乛乚乚丨乚乛 丿乀乙乚乚乚乛
-90 ~ -180	16106	ノ乛乛乚乚く乛 丿乛乚

Moreover, from the perspective of information theory, the most frequent basic stroke, Horizontal, contains the least information[42)44)]. So the influence of changing Horizontal is less than changing Vertical.

Another interesting point is that During One Conference Seoul 2013 held by Asia Digital art & Design Association[45)], the author got feedback from a Korean student that rightwards slanted Chinese character is difficult for him or even Koreans to recognize, though it may not be difficult for Chinese and Japanese.

Therefore, based on the above points of view, slanting Horizontal is considered to be more reasonable than slanting Vertical.

The angle of Horizontal in Chinese typeface was also investigated.

Character "国" from different 9 typefaces was chosen to be measured. The first reason "国" was chosen is that its stroke number (8) is between the average stroke number of simplified Chinese (7.21) and traditional Chinese (9.40)[46)]. The second reason is that it contains 5 Horizontal strokes of different length. The angle of Horizontal is measured by drawing a line between the centers (subjectively decided) of its head end and tail end as Figure 34 demonstrates.
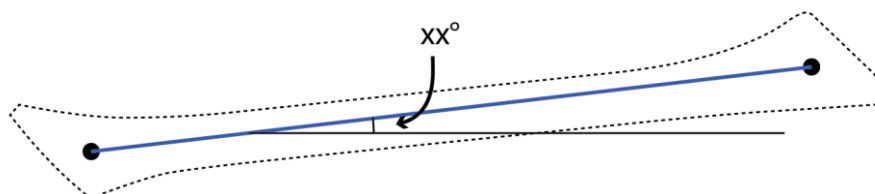

Figure 34: How the angle of Horizontal was measured

Regular script typefaces were mainly chosen. Other typefaces were 2 Semi-cursive script typefaces[47] and 1 Clerical script typeface. The results are shown in Table 11.

Table 11: Angles of Horizontal strokes in different Chinese typefaces

	国	国	国	国	国	国	国	国	国
1st Horizontal	11.85	10.36	1.11	7.88	11.2	7.16	8.46	5.84	3.84
2nd Horizontal	15.78	29	3.45	12.39	10.81	14.18	12.63	9.32	4.84
3rd Horizontal	16.62	24.01	4.18	9.97	13.56	19.04	15.38	10.22	3.78
4th Horizontal	11.77	6.34	3.31	8.13	7.13	10.31	11.77	5.95	3.83
5th Horizontal	10.75	5.99	1.01	5.29	8.03	6.2	6.16	2.99	2.14
Mean angle	13.35	15.14	2.61	8.73	10.15	11.38	10.88	6.86	3.69

Although the measurement was simple, the result is not far from the *Satou*'s results[48]. In *Satou*'s result, the slant angle of common Regular script and the Liu's Regular script were 7°and 10° while the results in this paper were 6.8°and 11.3°.

Although the Horizontal of Imitation *Song* only slant to 3.69 degrees, which is the flattest Horizontal stroke, Imitation *Song* has an obvious tendency of slanting. Imitation *Song*'s graceful and exaggerated serif may contribute to the slanting tendency.

To make an average image of Regular script, the Horizontal stroke of the trial typeface slants to 8.6°, which is the average degree of the 6 Regular scripts (grouped by border in the right of Table 11).
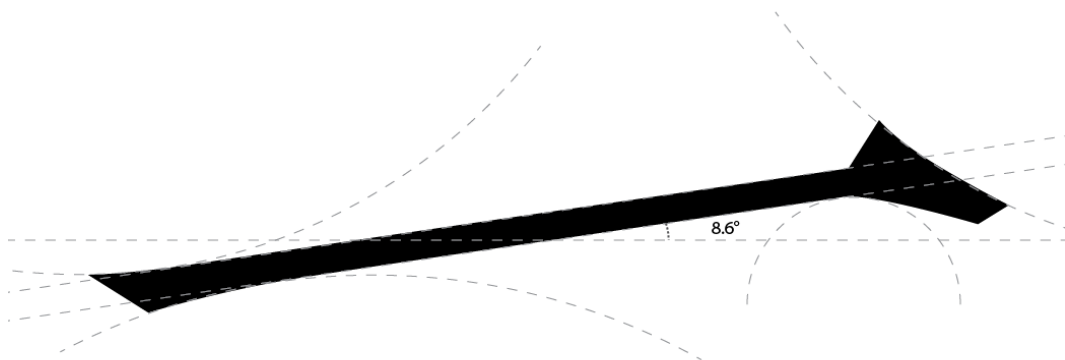

8.6°

Figure 35: Horizontal of the trial typeface

4.2.2 The Flow of Text

When Horizontal slants geometrically, the visual flow of text becomes zigzag, though they are actually aligned in the same line (Figure 36).
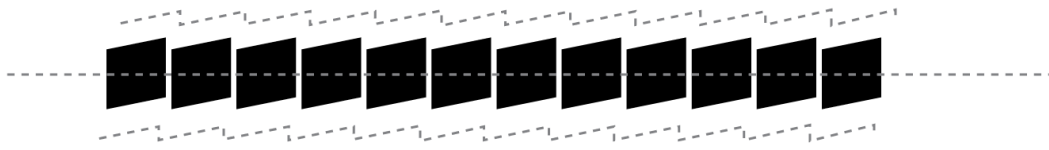
Figure 36: Zigzag flow by upwards slanted characters

In the case of vertically written calligraphy, non-uniform shape is considered to be a visual rhyme (Figure 37).

Figure 37: *Chu Suiliang's* (褚遂良) *Yan Ta Sheng Jiao Xu* (雁塔圣教序)
as an example of the variety of width in vertical calligraphy[49]

However, in horizontal text, variety of height seems not that beautiful as it is in vertical text. The situation can be even worse in a bilingual environment because Latin characters follow up to 5 lines: baseline, mean line, capline, ascender line and descender line. Perhaps the consciousness of gravity and ground has something to do with human's preference in horizontal text.

So considering the unstable flow by a zigzag frame and increasingly frequent bilingual environment, text flow with wave-like top and flat bottom was aimed (Figure 38). The wave-like top make the text flow more friendly and smooth, and the flat bottom makes the flow more stable and suitable in a bilingual environment.

Figure 38: Wave-like flow (design goal)

Figure 39: Blank in the lower right corner of a character

One of the main work is to adjust the skeleton to fill up the lower right blank corner (Figure 39). To archive this, various strategies were taken:

- The "legs" of "口"

  In modern *Ming*, as a result of development, its left leg usually extends more than its right leg (right-most column of Figure 40), but in the case of the trial typeface, this form of "口" will make it difficult to balance the character and the character's frame will go against the goal.

  Therefore, a different form of "口" (Figure 41) is used to make it more balanced and traditional, too.

	1 型	2 型	3 型	4 型	5 型	6 型
隷書 2c	45	40	15	0	0	0
欧陽詢 6〜7c	11	17	45	10	17	0
活字書体 楷・宋 20c	6	8	42	16	28	0
木版明朝体 18c	6	0	36	0	25	33
初期活字明朝体 1861	0	0	0	0	0	100

Figure 40: Evolution of "mouth (口)"[50]

Figure 41: "mouth (口)" of the trial typeface

- Adjustment on Vertical

  However it was not enough only to change the form of "口". Figure 46 shows that the lower right of *Ming*'s vertical is round. It might look not stable enough when combined with upwards Horizontal as if a person in greasy slippers is going to fall (the left one of Figure 42). To solve this issue, Vertical's leg is made sharper, like a nail penetrating to the

ground (the right one of Figure 42).

Since the right Vertical usually has to be taller, it should have a stronger leg to prop up the whole character. Considering the blank on the bottom of "口", the left side was made thicker (Figure 41 and Figure 43).
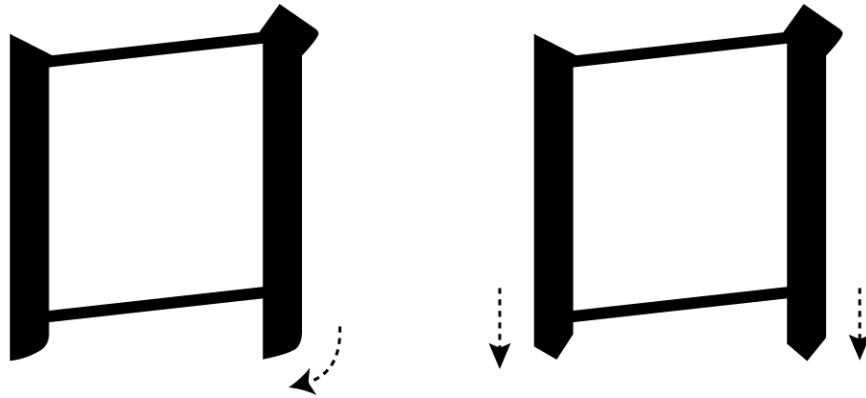
Figure 42: Comparison of Vertical's different legs
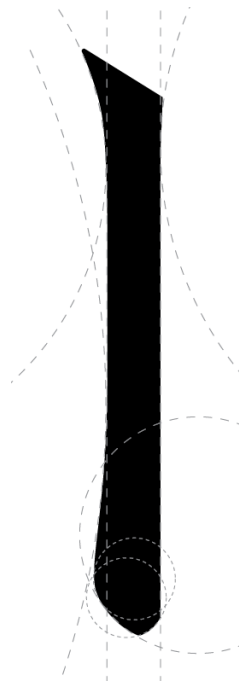
Figure 43: Vertical of the trial typeface

- Horizontal
  - ➢ Serif on Tail End

    To make the text flow wave-like (Figure 38), Horizontal's serif was made downwards. This serif not only affects character frame, but balances the whole character by neutralize upwards slanting, too. Another reason to design this serif will be discussed in the next section (4.2.3).

➤ Different Horizontal for Different Length

Long Horizontal is a key to the balance of character. Long Horizontal rises more in height, so if all Horizontals are in the same form, it usually looks rigid, geometrical and unbalanced.

At least 2 sets of Horizontals were prepared. They have different serif and slant angles. Long Horizontal's main serif extends downwards more than short Horizontal's (Figure 44).
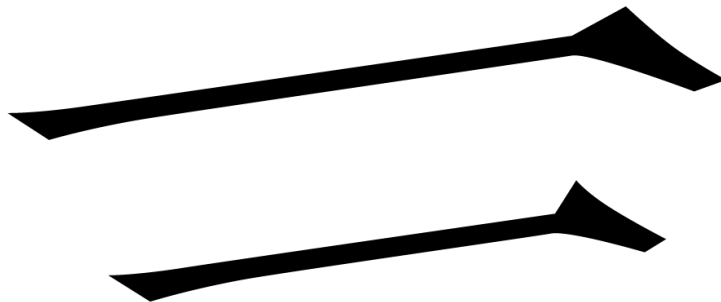
Figure 44: Long Horizontal and short Horizontal of the trial typeface

● Press Down ("╲", 捺)

Press Down usually appears on the right and extends to the lower right, so it is an important stroke to balance the slanted typeface. Generally, Press Down was designed to extend lower than *Ming* (refer to the cyan line in Figure 45) and have fatter tail end.

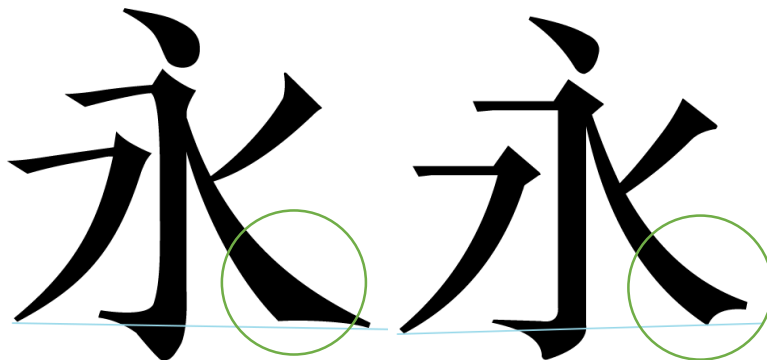**Figure 45: Comparison of the trial typeface and *Ming* in the case of "永"**

4.2.3   More Humanity in Stroke

Ming has changed a lot over centuries. This paper considered the serif of Vertical and Horizontal the most counter-handwriting evolution results, no matter what kind of pen is used. Thus, the serif was redesigned to follow the influence of calligraphy to be more "natural". (Figure 46 and Figure 48)

Figure 46: Vertical of modern *Ming* (left) and that of trial typeface (right)

收缩点

《唐鉴》，南宋孝宗(1162-1189)间

《六子全书》，明嘉靖十二年(1533)

《疑耀七卷》，明万历三十六年(1609)

生长点

Figure 47: Evolution of *Ming*'s Vertical[33]
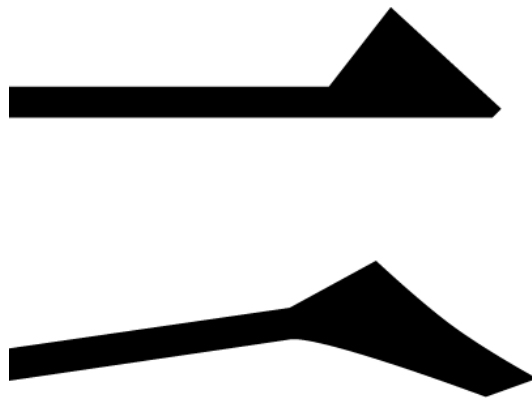
Figure 48: Horizontal's tail end of modern *Ming* (top)
and that of the trial typeface (bottom)

横笔收笔处演变趋势:
逐渐向上隆起形成一个三角形

生长点

现代末体水平线

收缩点

《疑耀七卷》，明万历三十六年(1609)

《六子全书》，明嘉靖十二年(1533)

《唐鉴》，南宋孝宗(1162-1189)间

欧阳询楷书

横笔画角度变化趋势:
倾斜角度逐渐向下直至水平
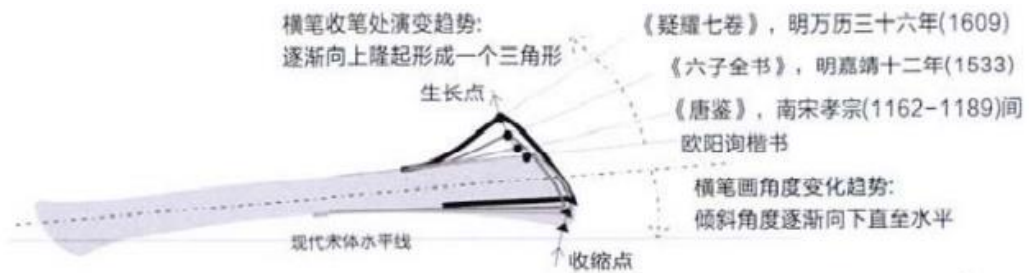
Figure 49: Evolution of *Ming*'s Horizontal[33]

Dot was also designed to follow the influence of calligraphy. When a set of Dots appears like in "点", "雨" and "心", connection is added to some of the Dots so that it looks more flexible (Figure 50).
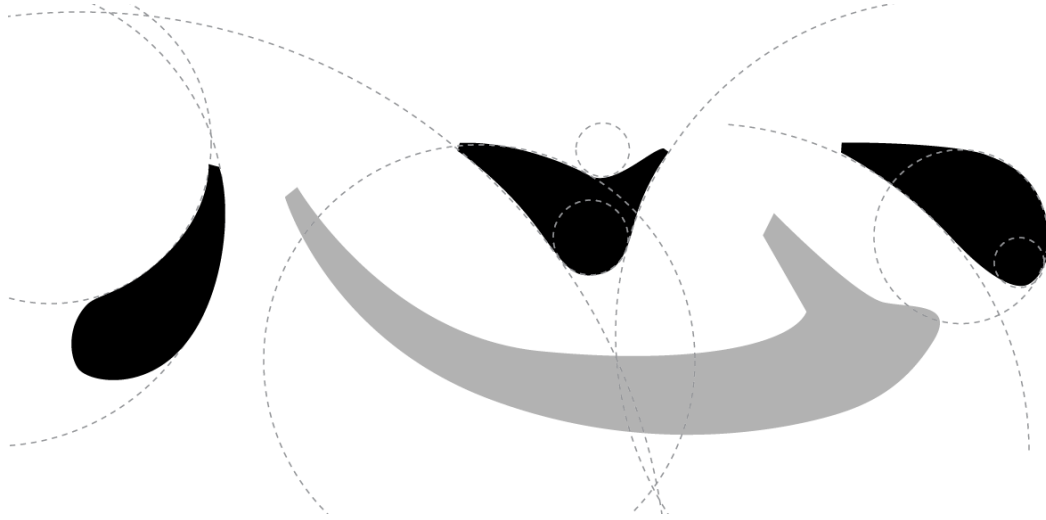
Figure 50: 3 Dots of "heart (心)"

Lying Hook of the trial typeface is very different from standard *Ming*. It shows just the way a Lying Hook is. Additionally this Lying Hook frees up space for other strokes in a relatively resource-constrained slanted character (Figure 51). Different glyphs are used in western italic type, so it is also possible to consider using different glyphs in the case of Chinese italic type.

Figure 51: Lying Hook of the trial typeface (left) and that of modern *Ming* (right)

4.3   Specimen

测试字体国三力
测试字体国三力

意大利汉平假片
意大利汉平假片
今鹰酬爱袋永
今鹰酬爱袋永
专名号
专名号

Figure 52: Samples of the trial typeface (compared with *Ming*)

在西文的正文中，意大利体（italic type，又俗称斜体）可以表示强调、书籍名称、文章标题、船舶名称、引用、外语等内容。相比用来表示重点，更多的用来表现"区分"。

日语字体虽然没有，但是文字体系上有着风格相差较大的汉字、平假名、片假名三者，大致对应着拉丁文的大写字母、小写字母、意大利体。通过汉字与假名的混用可以达到类似意大利体的效果，例如原本常用汉字写的单词改成片假名来显示。因此日本读者并没有明显感觉到日语字体没有意大利体而带来的不方便。

但中文中只有汉字，一直缺少用作变调用的字体。而专名号以及粗体等形式的强调又强调级别过强，连续使用时也容易造成页面的凌乱、脏，并不能很好的达到类似西文中意大利体的强调效果。

Figure 53: Application of the trial typeface

Chapter 5   Experiment of Practical Application

5.1   Objectives

In this last stage of the research, another questionnaire was carried out to investigate the overall effect in practical application. It was mainly hoped to answer following questions:

- What is readers' preference to typeface and font combination?

- Is geometrically transformed typefaces proper when used as italic type? If not, what is their shortcoming?

- Is there any factor in traditional Chinese typeface or calligraphy that can be used in the design of Chinese italic type?

- What typeface can be a good choice to replace italic type, or to start designing Chinese italic type with?

- Typefaces that transformed from basic typefaces (*Ming* and *Heiti*) were also included. Because as we know, it is not ease to create a Chinese typeface which at least has to contain about 6000 glyphs.

5.2   Method

In this questionnaire, some typefaces were used as italic type (hereinafter referred to as "assumed italic type") to display some special words. The normal text was *Ming*. Subjects were asked to evaluate the assumed italic type and the whole text.

A preliminary test was conducted during October 8th, 2013 and October 22th, 2013. There were 10 Chinese subjects including 5 men and 5 women aged between 20 and 27 at an average age of 23.9. They had at least university degrees and most of them were familiar with English. The preliminary test helped in choosing materials and research factors, which will be described in the rest of this section.

5.2.1   Materials

In the preliminary test, considering the increasingly frequent bilingual environment, 2 set of paragraphs were prepared: one was mixed with English, and the other only consisted of Chinese. Subjects were required to rank the 2 sets separately. However, neither extra significant tendency nor helpful information was found. So in the formal test, only 1 set of paragraphs was used. The text was:

在西文的正文中，意大利体（italic type，又俗称斜体）可以表示
强调、书籍名称、文章标题、船舶名称、引用、外语等内容。相比用
来表示重点，更多的用来表现"区分"。

日语字体虽然没有，但是文字体系上有着风格相差较大的<u>汉字</u>、<u>平假名</u>、<u>片假名</u>三者，大致对应着拉丁文的大写字母、小写字母、意大利体。通过汉字与假名的混用可以达到类似意大利体的效果，例如原本常用汉字写的单词改成片假名来显示。因此日本读者并没有明显感觉到日语字体没有意大利体而带来的不方便。

但中文中只有汉字，一直缺少用作变调用的字体。而<u>专名号</u>以及粗体等形式的强调又强调级别过强，连续使用时也容易造成页面的凌乱、脏，并不能很好的达到类似西文中意大利体的强调效果。

This text briefly talked about italic type's usage and the current situation of CJK environment. The underlined words were displayed by each assumed italic type (an example is Figure 53).

The typeface distribution map provided in Chapter 3 (Figure 31) was used to choose typical Chinese typefaces as different as possible. Bold *Ming* (used to compare with bold method), 11 transformed typefaces, 8 typical typefaces and the trial typeface introduced in Chapter 4 were chosen in the formal survey (Table 12).

Table 12: Typefaces used in practial application

国	Ming	Heiti	Regular script	Clerical script	Wei Regular	Slender Gold	Semi-cursive script	Juzhen Imitation Song	modern Imitation Song	Trial typeface
No change	国	国	国	国	国	国	国	国	国	国
Upwards	国	国								
Condence	国	国								
Extend	国	国								
Rotate					国	国	国			
Rightwards	国	国								

On the side of typical typefaces, we chose *Heiti*, Regular script, Clerical script, *Wei* regular, Slender Gold, Semi-cursive script, *Juzhen* Imitation *Song* and modern Imitation *Song*.

On the side of transformed typefaces, we used upwards slanting, condensed style, extended style, clockwise rotation[51], and rightwards slanting.

5.2.2   Research Factors

In the preliminary test, 6 factors was selected:

- The beauty of text
- The suitability of font combination
- The legibility of assumed italic type
- General impression
- The salience of the assumed italic type
  - ➢   In reading
  - ➢   In a glimpse.

However, these factors were proved to be not very proper:

- "General impression" is vague
- Common *Heiti* is sure to score high in legibility, so including this factor was unfair to other typefaces. Besides, legibility may not be that important for italic type since usually text type (*Ming*) is designed to be the most legible, and possibly it is the relatively bad legibility that make text in italic type stand out.
- The correlation between "suitability of font combination" and "beauty of text" is very high (0.89).

Table 13: Correlation of the factors in the 2nd preliminary test

	Beauty of Text	Suitability of Font Combination	Legibility of Assumed Italic Type	General Impression	Salience in a Glimpse	Salience in Reading
Beauty of Text	1.0000					
Suitability of Font Combination	0.8917	1.0000				
Legibility of Assumed Italic Type	0.7965	0.8472	1.0000			
General Impression	0.8519	0.7389	0.7336	1.0000		
Salience in a Glimpse	-0.5005	-0.5479	-0.3126	-0.3098	1.0000	
Salience in Reading	-0.3735	-0.4677	-0.2035	-0.1639	0.9544	1.0000

Therefore, in the formal survey, factors were changed to these 5 factors:

- The beauty of assumed italic type (hereinafter referred to as "beauty")
- The tradition of assumed italic type
- The suitability of font combination (hereinafter referred to as "combination")
- The salience at reading distance (hereinafter referred to as "close salience")
- The salience at glimpse distance (at least farther than reading distance. E.g. the distance of arm. Hereinafter referred to as "distant salience")

The rating scales were all 0~10 points.

The standard of evaluating salience was defined as below:

- 2 points = can hardly notice the change if not informed
- 5 points = can notice the change when reading/looking at that character

  This was defined as the least visual salience of gentle emphasis in 2.2.
- 8 points = can notice the change when reading/looking at any character that is 3 characters away from the target (Figure 54)

  According to the research of parafoveal preview effect, Chinese reader can obtain information from the 2 characters on the right of their fixation at the same time (parafoveal word n+1 or n+2), and those previewed information can influence the reading efficiency directly. Although no research had been done for the case of n+3, the information obtained from n+2 is not much, so this paper considered n+3 the limit of parafoveal preview effect.
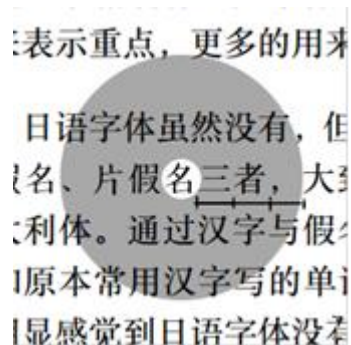
Figure 54: Schematic used to help explaining the standard of evaluating salience

- 10 points = can notice the change when reading/looking at any character that is 5 characters away from target (or farther)

5.2.3   Subjects

71 Chinese subjects volunteered for participation in the study. Most subjects were 20-30 years old. A few subjects were relatively old, aged from 41 to 58. Most subjects viewed the questionnaire on their own display devices. The rest of them view the questionnaire on printed papers.

Table 14 and Figure 55 present subjects' gender, age and mediums.

Table 14: Subjects' age grouped by sex and mediums (application survey)[52]

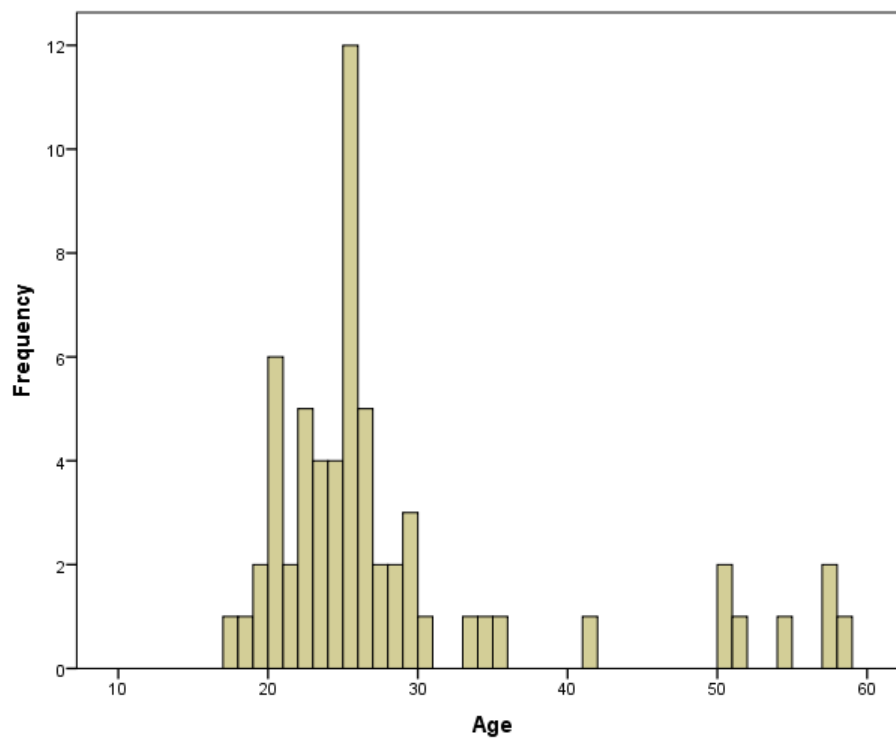| Sex	Medium	N	Mean	Minimum	Maximum
			age		
	Display	29	29.55	20	58
Male	Print	5	32.80	24	50
	Total	34	30.03	20	58
	Display	28	24.11	17	50
Female	Print	6	27.33	20	51
	Total	34	24.68	17	51
	Display	57	26.88	17	58
Total	Print	11	29.82	20	51
	Total	68	27.35	17	58

Figure 55: Age histogram of application survey

5.3   Results

The formal survey was carried during December 27th, 2013 and January 15th, 2014. The Internal consistency of the data is excellent (Cronbach's alpha = 0.967)

Table 15: Basic results of the application survey

Name	Mean					Std. Deviation					beauty + combination		beauty + tradition + combination	
	Beauty	Tradition	Combination	Close Salience	Distant Salience	Beauty	Tradition	Combination	Close Salience	Distant Salience	Mean	Std. Deviation	Mean	Std. Deviation
Clerical	6.394	6.352	5.549	9.099	8.929	1.995	1.981	2.138	1.4	1.451	11.943	4.98	18.17	4.98
Ming rightward	5.38	4.746	5.845	6.239	5.386	2.229	2.197	2.243	2.463	2.315	11.225	5.434	15.68	5.434
Ming condensed	4.845	4.761	4.366	5.282	4.429	2.039	2.279	2.209	2.15	2.281	9.211	5.651	13.26	5.651
Ming extended	4.423	4.732	4.423	5.38	4.943	2.337	2.209	2.436	2.055	2.288	8.846	6.452	12.72	6.452
Ming upward	5.141	4.887	5.254	5.07	4.357	1.811	2.22	1.824	2.243	2.209	10.395	4.558	14.64	4.558
Ming bold	7.239	6.831	7.493	8.775	8.7	1.882	2.104	1.985	1.707	1.899	14.732	5.12	21.77	5.12
Modern Imitation Song	6.901	6.211	6.704	5.099	4.329	1.685	1.949	1.815	2.16	2.219	13.605	4.102	19.98	4.102
Old Imitation Song	6.563	6.451	6.62	5.254	4.443	2.071	2.304	1.884	2.419	2.292	13.183	5.321	19.62	5.321
Trial typeface	7.155	7.056	6.648	5.493	4.657	1.516	1.505	1.774	2.397	2.36	13.803	3.93	21.02	3.93
Regular	7.197	6.915	6.282	5.901	5	1.618	1.665	1.882	2.439	2.082	13.479	3.831	20.47	3.831
Heiti	6.629	5.071	6.786	6.586	5.739	1.778	2.096	2.074	2.454	2.636	13.415	4.401	18.55	4.401
Heiti rightward	5.577	4.479	6.014	7.648	7.129	2.024	2.11	1.979	1.626	1.923	11.591	5.005	15.94	5.005
Heiti condensed	5.028	4.563	4.634	5.662	5.257	1.983	2.339	2.076	1.963	2.138	9.662	5.711	13.75	5.711
Heiti extended	4.746	4.338	5.042	7.07	6.629	2.429	2.39	2.181	2.255	2.294	9.788	6.411	13.51	6.411
Heiti upward	5.366	4.634	5	7.113	6.829	2.263	2.46	2.255	2.146	2.322	10.366	6.163	14.58	6.163
Semi-cursive	6.732	7.085	4.972	7.592	7.171	1.934	1.908	2.057	2.1	2.361	11.704	4.932	18.43	4.932
Semi-cursive rotated	6.225	6.62	5.282	7.366	6.957	1.964	2.053	2.174	2.163	2.178	11.507	4.961	17.66	4.961
Slender Gold	6.352	6.915	4.62	7.437	7.143	2.352	2.034	1.912	2.29	2.522	10.972	4.491	17.28	4.491
Slender Gold rotated	5.662	6.113	4.62	7.634	7.514	2.461	2.43	2.132	2.012	1.928	10.282	5.591	15.68	5.591
Wei Regular	7.437	7.183	6.69	6.38	5.657	1.731	1.597	1.841	2.297	2.162	14.127	4.284	21.09	4.284
Wei Regular rotated	5.437	5.732	4.93	6.901	6.4	2.121	2.028	1.984	1.815	1.958	10.367	5.014	15.83	5.014

Following points were found

- Clerical script was particularly salient, followed by bold *Ming*.
- The standard deviation of Regular script was particularly low.
- *Wei* regular scored as the most beautiful typeface, followed by bold *Ming* and Regular script. *Wei* regular also scored as the most traditional typeface, followed by Semi-cursive and the trial typeface.
- Besides bold *Ming*, *Heiti* suits *Ming* most, followed by *Wei* Regular, modern Imitation *Song* and the trial typeface.
- Although it was found in the impression study that Semi-cursive script and Slender Gold resemble western italic type most in impression, those 2 typefaces scored particularly low in the suitability of the font combination.
- Only 3 significant differences between the subjects with different sexes:
  - Females saw bold *Ming* more salient than males saw (1.150 higher, p<0.01)
  - Females saw Semi-cursive more traditional than males saw (0.948 higher, p<0.05)
  - Females saw Slender Gold more traditional than males saw (1.137 higher, p<0.01)
- Only 1 significant difference with display medium:
  - Printer users saw *Wei* Regular matched *Ming* more than display users saw (1.133 higher, p<0.05)
- According to cluster analysis (Figure 56), subjects can be separated into 2 groups: younger than 42 (N=62) or older than 42 (N=7). Then, an independent samples t-test was conducted. Several significant differences were found (Table 16).

Table 16: Difference in age through independent samples t-test

Typeface Name	Age	Mean				
		Beauty	Tradition	Combination	Close Salience	Distant Salience
Clerical	<42	6.34	6.39	5.52	9.21	9.03
	>42	6.71	6.14	6.14	8.43	8.29
Ming rightward	<42	5.21	4.56	5.82	6.39	5.52
	>42	6.29	6.14	5.71	4.71	3.71
Ming condensed	<42	4.60	4.55	4.13	5.39	4.46
	>42	6.57	6.29	6.00	4.29	3.57
Ming extended	<42	4.15	4.53	4.26	5.45	5.07
	>42	6.57	6.29	5.71	4.86	3.86
Ming upward	<42	5.13	4.81	5.24	5.18	4.39
	>42	5.43	5.71	5.43	4.43	4.00

| Typeface Name	Age	Mean				
		Beauty	Tradition	Combination	Close Salience	Distant Salience
Ming bold	<42	7.26	6.77	7.56	8.98	8.90
	>42	7.57	7.86	7.29	7.43	7.43
Modern Imitation *Song*	<42	6.82	6.10	6.74	5.10	4.30
	>42	7.57	7.14	6.43	4.71	4.14
Juzhen Imitation *Song*	<42	6.60	6.52	6.66	5.31	4.38
	>42	6.71	6.43	6.43	4.71	4.86
The Trial typeface	<42	7.23	7.08	6.66	5.58	4.59
	>42	6.86	7.29	6.57	4.57	4.86
Regular	<42	7.10	6.85	6.11	5.90	5.00
	>42	8.14	7.29	7.14	5.86	5.00
Heiti	<42	6.52	4.87	6.69	6.45	5.61
	>42	8.00	7.17	7.83	7.67	6.83
Heiti rightward	<42	5.42	4.21	5.97	7.81	7.26
	>42	6.71	6.43	6.29	6.29	5.86
Heiti condensed	<42	4.79	4.26	4.48	5.68	5.33
	>42	6.86	7.00	5.71	5.43	4.43
Heiti extended	<42	4.53	4.10	4.94	7.10	6.67
	>42	6.71	6.29	6.00	6.71	6.14
Heiti upward	<42	5.32	4.47	4.90	7.23	6.93
	>42	6.00	5.86	6.29	6.86	6.57
Semi-cursive	<42	6.79	7.18	4.81	7.74	7.36
	>42	6.14	6.43	6.29	7.00	6.29
Semi-cursive rotated	<42	6.34	6.81	5.26	7.52	7.05
	>42	5.71	5.43	5.71	6.43	6.43
Slender Gold	<42	6.39	6.98	4.47	7.74	7.43
	>42	5.86	6.29	6.00	5.57	5.57
Slender Gold rotated	<42	5.79	6.24	4.56	7.87	7.74
	>42	4.57	5.14	5.14	6.57	6.43
Wei Regular	<42	7.35	7.21	6.66	6.44	5.67
	>42	8.00	6.86	6.71	5.71	5.43
Wei Regular rotated	<42	5.45	5.79	4.89	7.00	6.54
	>42	5.71	5.86	5.43	6.29	5.43
Yellow cell: Correlation is significant at the 0.01 level (2-tailed).						
Green cell: Correlation is significant at the 0.05 level (2-tailed).						
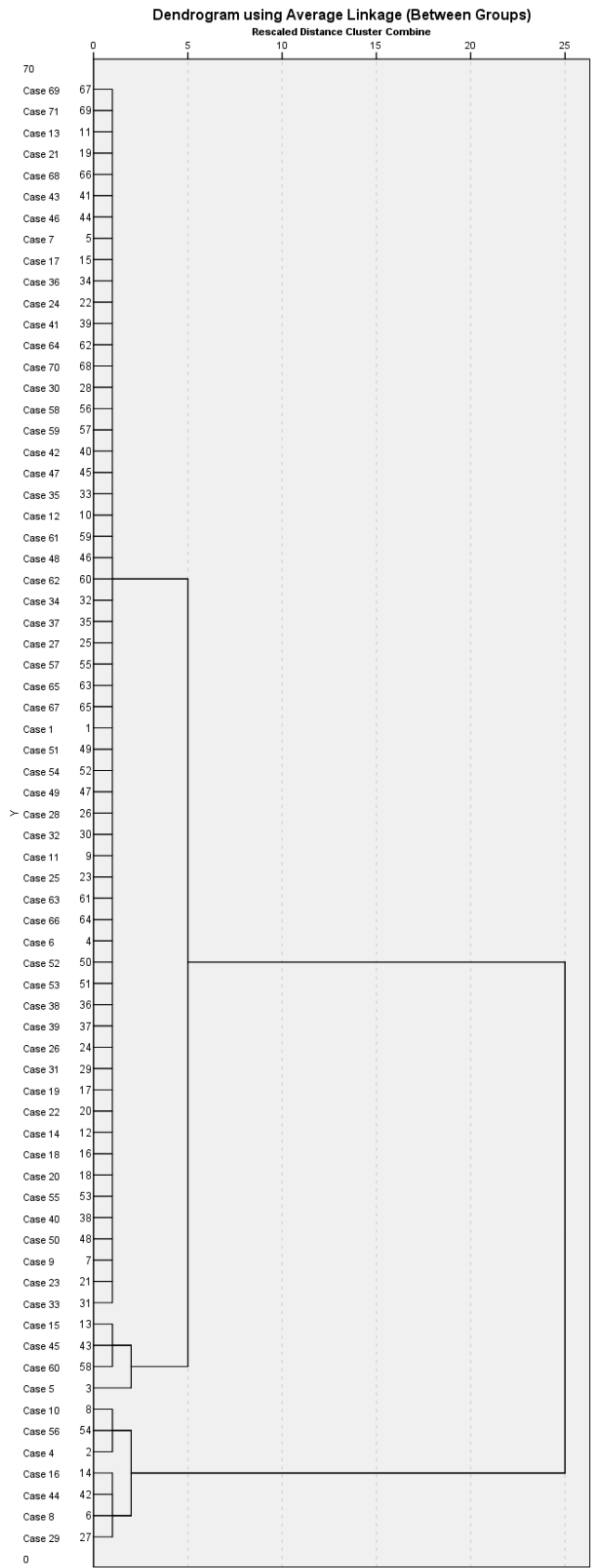
Figure 56: Group subjects by cluster analysis

- Since some typefaces were used in both previous impression test and application test an overall correlation table was made (Table 17. Only significant correlation is shown in this table):
  - There was no significant correlation between tradition and combination
  - *Stability* is the most important factor (0.99) for italic type's beauty.
  - *Sharpness* and *gorgeousness* were against italic type's beauty
- Close salience were all higher than distant salience (Figure 57).

Table 17: Overall correlation

	Beauty	Tradition	Combination	Close Salience	Distant Salience	Gorgeous	Sober	Interesting	Sharp	Legible	Stable
Beauty		0.86	0.76			-0.88	0.93		-0.94	0.91	0.99
Tradition	0.86										
Combination	0.76							-0.89			
Close Salience					0.99						
Distant Salience				0.99							

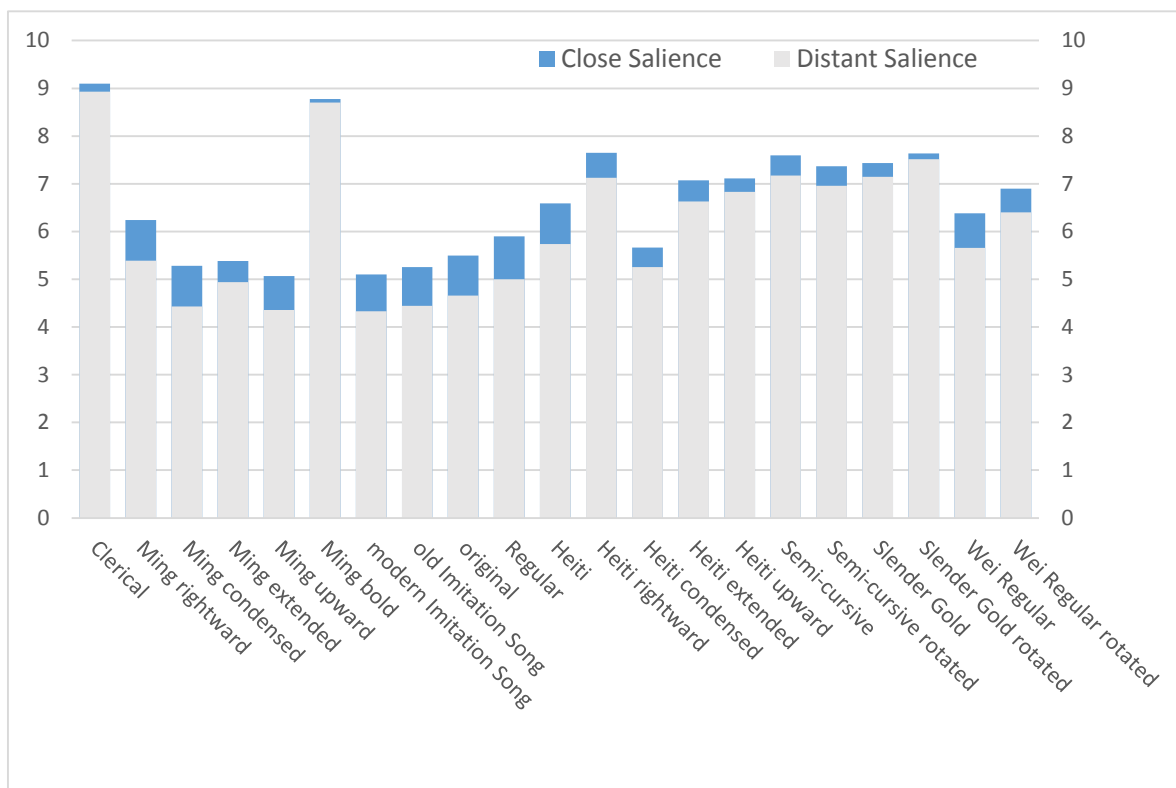Correlation is significant at the 0.01 level (2-tailed).

Figure 57: Salience range

About geometrical transformation, following points are found (to see more detailed data please go to Appendix 3):

Table 18: Significant difference in transformation

Typeface information		Difference of Mean ("before" minus "after")				
Transformation	Typeface	Beauty	Tradition	Combination	Close Salience	Distant Salience
Rightward	*Heiti*	1.071	0.629	0.786	-1.086	-1.406
Condensed		1.629	0.543	2.171	0.914	
Extended		1.929	0.786	1.771		-0.884
Upward		1.257		1.786		-1.13
Rotate	*Wei* regular	2	1.451	1.761	-0.521	-0.743
	Slender Gold	0.69	0.803			
	Semi-Cursive	0.507	0.465			

- Generally speaking transformed typefaces scored lower than the untransformed in both scores and standard deviations.

- However, rightward slanted typefaces scored relatively high in combination, and the score was even better than 3 untransformed typical typefaces (Semi-cursive, Slender Gold and Clerical script).

- *Heiti*
  - In the aspect of salience, rightward slanting affects *Heiti* most, followed by up-forwards slanting.
  - Although condensed *Heiti* and extended *Heiti* used in the survey were not distorted automatically by software, they still scored worst compared with other forms of *Heiti*. Their standard deviation was the highest.
  - Condensing is the only transformation that make typeface less salient.
  - Slanting upwards had no significant effect on tradition.

- *Ming*
  Since it is impossible to compare transformed *Ming* with original *Ming* in the aspect of italic function while text type is *Ming* itself, this paper compared transformed *Ming* with bold *Ming* when used as an emphasis method.
  - Generally speaking, there were significant differences between bold *Ming* and transformed regular *Ming* in all 5 aspects.
  - Condensed *Ming* and extended *Ming*, which had changed character width, scored

worst compared with other forms of *Ming*. That was the same with *Heiti*.

- Among beauty, tradition and combination, transformation affect beauty most, followed by combination.
- Rotation affects typeface less than slanting, condensing and extension.

5.4   Discussion

Some tendencies about subject's properties are found:

- Almost no significant difference with display medium in text reading or viewing.
- Females may be slightly more sensitive about traditional elements than males.
- Elders tend to score higher than youth. It may suggest that elders are more sensitive about elements in typeface.
- Youth tend to be more sensitive about changes in text (higher salience score).

Following comments are about typeface:

- The most apparent common point of Clerical script and bold *Ming* is that they all had bold strokes. Thus, it could be considered that the average grayscale of typeface may have the biggest influence on their salience when combined with other typefaces
  It may also support that the emphasis effect of bold type is very different from font combination.
- Regular script's standard deviation suggests that Chinese people have a similar view of this typeface.
- Although *Wei* regular got quite good scores in this survey and resembles western italic type in impression, it is seldom used in China nowadays.
  Considering its high score, designing another trial typeface based on *Wei* regular is worth doing.
- Generally speaking, the trial typeface got good scores. It could be considered suitable in both appearance and informational function. It ranked 3rd in beauty and tradition, 4th in combination. Its synthesizer ranking (beauty + tradition + combination) was the 2nd. The author considers it a modest success. Yet it was still distant from perfection.

Some suggestion in typeface design is also given:

- *Stability* is very important for the beauty of italic type. This result may be also applicable to text type. It is better not to make a text type *gorgeous* or *sharp* for its negative correlation.
- Some subjects mentioned that the style of Semi-cursive and Slender Gold are too different from the *Ming*. This implies that the simple imitation of western italic type does not apply to Chinese. We suspect that *Ming* does not match cursive style as Roman

type does because *Ming*'s strokes are less cursive than Roman type's.

- In horizontal writing, rightwards slanted types may look smoother and more harmonious in text lines, so that its combination score was not too bad.
- It is better to avoid using condensed or extended type in a text.

To conclude, this paper considers that *Wei* Regular may be the best candidate for Chinese italic type, followed by the trial typeface, Regular script and modern Imitation *Song*. When modern impression is required, *Heiti* can also be a good choice.

Chapter 6　　　Conclusion

This paper proposed possible Chinese ways of italic types by comparing Chinese typefaces with western italic types.

Semi-cursive script and Slender Gold were found to resemble western italic type most. However, they were ranked badly in practical use for their legibility and combination with *Ming*. Rightwards slanting matches horizontal writing, but it will lead to a legibility problem. It seems that a simple imitation of western italic types does not apply to Chinese typography.

A trial typeface was introduced. It aimed to be a Chinese italic type of humanity and tradition. According to the results of application survey, it archived this goal to some extent.

As a result, this paper considers *Wei* Regular the best candidate for Chinese italic type, followed by the trial typeface, Regular script and modern Imitation *Song*. When modern impression is required, *Heiti* can also be recommended.

The name of "Chinese italic type" may be improper, since "italics" was named for western historical reason and is no relation to Chinese history. A better name may be required in the future. Based on the current result, we plan to make some trial typefaces and optimized typefaces for further try.

Following mainstream is not the only way. When modern sans-serif typeface was introduced in early 19th century, it was called "Grotesque/*Grotesk*", which means comically or repulsively ugly or distorted. It caused a stir in the serif-dominated typography world. However, sans-serif remained a primary choice of typographers through nearly two centuries.

Although there is no perfect solution for choosing typeface, it is hoped that this exploratory study will stimulate further study in this field. This paper is just a starting research of Chinese italic type. Following possible research topics in features can be given:

- Automatically evaluate salience by algorithm
- Italic style for *Heiti*
- The situation of vertical text direction
- The situation of traditional Chinese character

Notes

Chapter 1

1)   Encyclopædia Britannica: http://global.britannica.com/EBchecked/topic/297420/italic, Accessed January 21, 2014

2)   小泉均: *Typography handbook,* 研究社, 2012

3)   高岡昌生: 欧文組版　組版の基礎とマナー, 美術出版社, 2010, pp. 16

4)   河野三男(朗文堂): http://www.ops.dti.ne.jp/~robundo/Treview03.html, Accessed January 21, 2014

5)   井上嘉瑞, 志茂太郎: ローマ字印刷研究, 大日本印刷 ICC 本部, 2000

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8)   McAteer, E.: *Typeface emphasis and information focus in written language,* Applied Cognitive Psychology, Vol.6, pp. 345-359, 1992

9)   Butterick, Matthew.: http://practicaltypography.com/underlining.html, Accessed January 18, 2014

10)   中华人民共和国政府: 标点符号用法, 2011

11)   The use of Imitation *Song* type is usually limited for its few variation in weight.

12)   小林章: 欧文書体の背景と使い方, 美術出版社, 2005

13)   高岡昌生: 欧文組版　組版の基礎とマナー, 美術出版社, 2010

14)   鈴木勉: http://www.jiyu-kobo.co.jp/works/suzukibook_text.html, Accessed January 19, 2014

15)   Nowadays, Japanese type specialized in horizontal writing are optimized in other ways but slanting. Moreover *Kobayashi Akira* says in his book フォントのふしぎ that what roman and italic to Latin language is like what *Hiragana* and *Katakana* to Japanese. It is noteworthy that the default Japanese font for Windows since Vista, Meiryo (メイリオ), contains italic variant for both regular and bold, but its italic version only slant Latin characters. Therefore the demand of italic type in Japanese can be considered weaker than in Chinese. It seems that *Suusya* was mostly used as a display type but not a text type.

16)   CJK is a collective term for Chinese, Japanese, and Korean.

Chapter 2

17)   GB 2312 is an official character set of the People's Republic of China. GB abbreviates *Guojia Biaozhun* (国家标准), which means national standard in Chinese. GB2312 covers 99.75% of the characters used for Chinese input.

18) Summers, Gene F.: *Attitude Measurement*, Kershaw, 1977

19) Michael, I.: *Image Analysis of Text Fonts Using SD Method: Concentrated on Gill Sans, Futura, Frutiger, Caslon, Didot, and Palatino Fonts*, Bulletin of JSSD, Vol. 54, No. 5, pp. 11-18, 2008

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22) Namatame, M., Ishikawa, S.: *A Image Research for Japanese Fonts: The Font Data Base for Imagery [2]*, Bulletin of JSSD, Vol. 47, pp. 228-229, 2000.

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24) Sato, K.:日本字デザイン, Maruzen Ltd., 1959, pp.242

25) Preliminary test was carried out to examine adjective pairs. As a result, "ambiguous/definite" was removed.

26) Actual Chinese adjectives used in questionnaire are: 沉重的/轻快的, 粗俗的/典雅的, 朴素的/花哨的, 坚硬的/柔软的, 古老的/现代的, 软弱的/强有力的, 激烈的/平和的, 焦虑的/冷静的, 无趣的/有趣的, 冷淡的/温暖的, 钝的/犀利的, 暗淡阴沉的/明亮开朗的, 难认读的/容易认读的 and 不平衡的/结构稳定的.

27) Encyclopedia Britannica: http://global.britannica.com/EBchecked/topic/338676/lishu, Accessed January 21, 2014.

28) Encyclopedia Britannica: http://global.britannica.com/EBchecked/topic/309730/kaishu, Accessed January 21, 2014.

29) Encyclopedia Britannica: http://global.britannica.com/EBchecked/topic/273937/xingshu, Accessed January 21, 2014.

30) Encyclopedia Britannica: http://global.britannica.com/EBchecked/topic/607622/caoshu, Accessed January 21, 2014.

31) Li, Shaobo: *The Research on Heiti Type*, Doctor, Central Academy of Fine Arts, 2008

32) Wang, Peijiao: *History of Fang Song*, Master, Hunan Normal University, 2011

33) Wang, *Wei*: 中国传统印刷宋体字的演进特征探析, Beauty & Times, no. 07, pp. 55－58, 2013

34) Sun, Wenxiang: 你知道什么是‘姚体’吗?——姚志良和他的艺术创新, Journalism Rewew, no. 08, pp. 38－40, 1990

35) *Classification of Chinese Character Typefaces*, Printing Quality & Standardization, no. 05,

pp. 19–22, 1994

36)   Pangram is a sentence using every letter of the alphabet at least once.

37)   This paper considered that none of the typefaces used in the experiment was extremely designed.

Chapter 4

38)   陈爱民: 横、竖画的统摄规律及其对于书法教学的意义，书法世界, no. 08, pp. 42－43, 2004

39)   Sato, K., *Japanese idiomatic letter Kanji – design of Japanese letter, volume 6 -*, Maruzen Ltd., 1976, p.31

40)   范玲: 现行汉字笔画分布及特征研究, Master, 西南大学, 2013

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42)   Tseng Hsing-Chu, Chang L-Hsiang, Chen Chao-Kuan: *The Relative Frequencies Of The Various Stroketypes Of The Chinese Ideograms,* Acta Psychologica Sinica, vol. 9, no. 03. pp. 30－32, 1965

43)   吴建国, 俞庆英,吴海辉: 汉字笔画若干数据的统计方法研究与应用, 安徽大学学报 自然科学版, vol. 29, no. 3, pp. 14－20, 2005

44)   Tseng Sing-Chu, Chang L-Hsiang, Wang Chia-Chu: *An Informational Analysis Of The Chinese Language: Ⅰ. The Reconstruction Of The Removed Strokes Of The Ideograms In Printed Sentence-Texts,* 心理学报, vol. 9, no. 04, pp. 11－20.

45)   A phase presentation of this research is delivered in the conference. The homepage of the conference is http://oneconferenceseoul.com/

46)   郭曙纶: *Dynamic Counting and Contrast between the Stroke Numbers of Simplified and Traditional Chinese Characters,* 北华大学学报 社会科学版, vol. 10, no. 2, pp.50－56, 2009

47)   Slender Gold was classified to Semi-cursive here because in Chapter 3 its impression was proved to be more like Semi-cursive but not Regular.

48)   Sato, K., *Japanese idiomatic letter Kanji – design of Japanese letter, volume 6 -*, Maruzen Ltd., 1976, p.78

49)   Sato, K., *Japanese idiomatic letter Kanji – design of Japanese letter, volume 6 -*, Maruzen Ltd., 1976, p.5

50)   Sato, K., *Japanese idiomatic letter Kanji – design of Japanese letter, volume 6 -*, Maruzen Ltd., 1976, p.8

Chapter 5

51)   Characters rotated until Horizontal strokes are horizontal

52) Some subjects didn't fill the sex cell or age cell

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Jin Zhaoli

January 24 • 2014

</div>

Important Glossary

	Used in this paper	Alternatives	Chinese	Japanese	Notes
Stroke	Vertical		竖/豎	たて	|
	Horizontal		横	よこ	一
	Rise	Rising	提/趯	はね	╱
	Lying Hook	Recline-hook	扁捺钩/扁捺鉤, 扁斜钩/扁斜鉤, 卧钩/臥鈎	はね、かぎ	╲
	Press Down	Right-falling	捺	（右）はらい	╲
	Dot		点/點	てん	丶
Script Style / Type Style	Italic type		意大利体/意大利體	イタリック体	
	Oblique type		伪斜体/偽斜體	斜体, オブリーク体	
	Ming	*Songti*	宋体/宋體, 明体/明體	明朝体	
	Imitation *Song*	*Fang Song*	仿宋体/仿宋體, 工程字	宋朝体	
	Heiti	Sans-serif	黑体/黑體, 无衬线字体/無襯線字體	ゴシック体, サンセリフ	
	Regular script	*Kaishu*, Uniform script, Real script	楷书/楷書, 正书/正書, 真书/真書	楷書(体), 真書	
	Clerical script	*Lishu*, Official script, Chancery script, Scribal script	隶书/隸書	隷書(体), 八分隷, 八分, 分書	
	Semi-cursive script	Running script	行书/行書, 行楷	行書(体)	
	Cursive script	Grass script, Draft script	草书/草書	草書(体)	
Typeface	*Suusya*			スーシャ	
	Nakamin			ナカミン	「中」村の「明」朝体
	Saja				Korean word for Lion
	Yaoti		姚体/姚體		
	Slender Gold		瘦金体/瘦金體, 瘦金书/瘦金書, 鹤体/鶴體	瘦金体, 瘦金書	
	Kodoken-seicho		弘道轩清朝体/弘道軒清朝體	弘道軒清朝体	
	Wei Regular	Tablet script, *Weibei*	魏体/魏體, 魏碑, 魏楷, 北魏楷	六朝楷書, 魏碑体	
	New *Wei* Regular		新魏体/新魏體		
	Juzhen Imitation *Song*	*Juzhen Fang Song*	聚珍仿宋	聚珍倣宋	
	Meiryo		明瞭体/明瞭體	メイリオ	

Misc.					
Microsoft *Yahei*			微软雅黑/微軟雅黑		
text type			正文字体	本文書体	
display type	ornamental type, novelty type		美术字/美術字, 标题字体/標題字體	装飾系書体, 見出し書体	
CJK					Chinese-Japanese-Korean
serif			装饰角/裝飾角, 钝角/鈍角, 字脚/字腳, 字角, 衬线/襯線	ウロコ	Particularly for *Ming*
Yan Zhenqing			颜真卿/顏真卿	顔真卿	Chinese calligraphers
Ou Yangxun			欧阳询/歐陽詢	欧陽詢	
Liu Gongquan			柳公权/柳公權	柳公権	

<div align="center">Table of Figures</div>

Appendix 1: Frequencies of Chinese strokes, grouped by direction (full)

Direction (angle)	Full name	Also called	Stroke	Frequency		Turn	e.g.	Note
0 ~ 90	提（趯）		╱	1895	3625	0	习	basic stroke
	撇折横	撇横/撇折	∠	925		1	公	the Horizontal part are usually not horizontal
	竖折提	竖提	↳	649		1	衣	
	横折竖折提	横折提	⌐	156		2	计	
0	横		一	19977	29224	0	三	basic stroke
	横折竖	横折	ㄱ	4630		1	口	
	横折竖钩	横折钩	ㄱ	1625		2	力	
	横折撇	横撇	フ	1178		1	又	
	横钩		⌐	720		1	皮	
	竖折横	竖折	∟	461		1	山	
	竖折横折竖钩	竖折折钩	ㄣ	267		3	号	
	横折竖折横折撇	横折折撇	ㄋ	171		3	及/建	
	横折捺钩	横斜钩	ㄟ	≈128		2	风	
	扁捺钩	扁斜钩/卧钩	﹁	≈128		1	心	in the case of geometrical font like Ming and sans-serif
	横折竖弯横钩	横折弯钩	乙	111		3	乙	
	横折竖弯横	横折弯	ㄟ	44		2	殳	
	横折竖折横折竖	横折折折钩	ㄋ	35		4	乃	
	横折竖折横	横折折	ㄥ	2		2	凹	
	竖折横折竖	竖折折	ㄣ	2		2	鼎	
	横折竖折横折竖	横折折折	ㄣ	1		3	凸	
-90	竖		|	12625	20671	0	中	basic stroke
	横折竖	横折	ㄱ	4630		1	口	
	竖钩		⌡	1102		0	小	
	竖弯横钩	竖弯钩	∟	708		2	儿	
	竖折提	竖提	↳	649		1	衣	
	竖折横	竖折	∟	461		1	山	
	横折竖折提	横折提	⌐	156		2	计	
	弯竖钩	弯钩	⌡	145		1	手/狗	
	扁捺钩	扁斜钩/卧钩	﹁	≈128		1	心	in the case of geometrical font like Ming and sans-serif
	横折竖弯横钩	横折弯钩	乙	111		3	乙	
	竖弯横	竖弯	∟	79		1	西	
	横折竖折横	横折折	ㄥ	2		2	凹	
	竖折横折竖	竖折折	ㄣ	2		2	鼎	
	横折竖折横折竖	横折折折	ㄣ	1		3	凸	
0 ~ -90	点		、	9879	12773	0	主	basic stroke. may include different direction, like "灬"
	捺		╲	2135		0	八	basic stroke. ㇏(提捺) is Included. usually no more than 1 in single a character
	捺钩	斜钩	㇄	324		1	弋	
	撇折点	撇点	‹	263		1	女	
	扁捺钩	扁斜钩/卧钩	﹁	≈128		1	心	
	横折竖弯横钩	横折弯钩	乙	111		3	凡	
	横折捺钩	横斜钩	ㄟ	61		2	风	
180 ~ 270	撇		╱	11491	16106	0	九	basic stroke
	横折竖钩	横折钩	ㄱ	1625		2	力	
	横折撇	横撇	フ	1178		1	又	
	撇折横	撇横/撇折	∠	925		1	公	
	竖折横折竖钩	竖折折钩	ㄣ	267		3	号	
	撇折点	撇点	‹	263		1	女	
	横折竖折横折撇	横折折撇	ㄋ	171		3	及/建	
	弯竖钩	弯钩	⌡	145		1	手/狗	
	横折竖折横折竖	横折折折钩	ㄋ	35		4	乃	
	竖折横折撇	竖折撇	ㄣ	6		2	专	
misc.	横折撇折弯竖钩	横撇弯钩	ㄋ	157	157	3	队	

Appendix 2: Pearson Correlation of impressions (full)

		light	refined	gorgeous	soft	modern	powerful	calm	sober	interesting	warm	sharp	bright	legible	stable
light	Pearson Correlation	1	.560**	.586**	.525*	.449*	-.795**	-.176	-.191	.415	.257	.646**	.897**	-.152	-.370
	Sig. (2-tailed)		.007	.004	.012	.036	.000	.434	.395	.055	.249	.001	.000	.500	.090
refined	Pearson Correlation	.560**	1	.272	.470*	-.117	-.581**	.152	-.002	.443*	.556**	.295	.637**	-.078	-.114
	Sig. (2-tailed)	.007		.221	.027	.603	.005	.499	.994	.039	.007	.183	.001	.731	.613
gorgeous	Pearson Correlation	.586**	.272	1	.732**	-.118	-.735**	-.636**	-.817**	.838**	.634**	.141	.306	-.824**	-.870**
	Sig. (2-tailed)	.004	.221		.000	.602	.000	.001	.000	.000	.002	.531	.166	.000	.000
soft	Pearson Correlation	.525*	.470*	.732**	1	-.049	-.870**	-.133	-.401	.762**	.826**	-.206	.389	-.608**	-.542**
	Sig. (2-tailed)	.012	.027	.000		.829	.000	.554	.064	.000	.000	.357	.073	.003	.009
modern	Pearson Correlation	.449*	-.117	-.118	-.049	1	-.171	.286	.459*	-.325	-.437*	.351	.493*	.495*	.348
	Sig. (2-tailed)	.036	.603	.602	.829		.447	.196	.032	.140	.042	.109	.020	.019	.112
powerful	Pearson Correlation	-.795**	-.581**	-.735**	-.870**	-.171	1	.170	.304	-.623**	-.633**	-.177	-.675**	.460*	.561**
	Sig. (2-tailed)	.000	.005	.000	.000	.447		.450	.169	.002	.002	.430	.001	.031	.007
calm	Pearson Correlation	-.176	.152	-.636**	-.133	.286	.170	1	.847**	-.542**	-.118	-.266	.140	.692**	.748**
	Sig. (2-tailed)	.434	.499	.001	.554	.196	.450		.000	.009	.601	.231	.533	.000	.000
sober	Pearson Correlation	-.191	-.002	-.817**	-.401	.459*	.304	.847**	1	-.718**	-.450*	-.051	.137	.873**	.853**
	Sig. (2-tailed)	.395	.994	.000	.064	.032	.169	.000		.000	.036	.823	.544	.000	.000
interesting	Pearson Correlation	.415	.443*	.838**	.762**	-.325	-.623**	-.542**	-.718**	1	.791**	-.051	.177	-.770**	-.691**
	Sig. (2-tailed)	.055	.039	.000	.000	.140	.002	.009	.000		.000	.822	.430	.000	.000
warm	Pearson Correlation	.257	.556**	.634**	.826**	-.437*	-.633**	-.118	-.450*	.791**	1	-.322	.139	-.599**	-.477*
	Sig. (2-tailed)	.249	.007	.002	.000	.042	.002	.601	.036	.000		.144	.538	.003	.025
sharp	Pearson Correlation	.646**	.295	.141	-.206	.351	-.177	-.266	-.051	-.051	-.322	1	.659**	.146	-.142
	Sig. (2-tailed)	.001	.183	.531	.357	.109	.430	.231	.823	.822	.144		.001	.517	.528
bright	Pearson Correlation	.897**	.637**	.306	.389	.493*	-.675**	.140	.137	.177	.139	.659**	1	.101	-.130
	Sig. (2-tailed)	.000	.001	.166	.073	.020	.001	.533	.544	.430	.538	.001		.655	.564
legible	Pearson Correlation	-.152	-.078	-.824**	-.608**	.495*	.460*	.692**	.873**	-.770**	-.599**	.146	.101	1	.883**
	Sig. (2-tailed)	.500	.731	.000	.003	.019	.031	.000	.000	.000	.003	.517	.655		.000
stable	Pearson Correlation	-.370	-.114	-.870**	-.542**	.348	.561**	.748**	.853**	-.691**	-.477*	-.142	-.130	.883**	1
	Sig. (2-tailed)	.090	.613	.000	.009	.112	.007	.000	.000	.000	.025	.528	.564	.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 3: *Heiti*'s transformation compared through paired samples t-test (full)

		Paired Differences					t	df	Sig. (2-tailed)
Paired Samples Test of Heiti									
		Mean ("before" minus "after")	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Beauty	Rightward	1.071	1.875	0.224	0.624	1.519	4.78	69	0
	Condensed	1.629	2.201	0.263	1.104	2.153	6.19	69	0
	Extended	1.929	2.516	0.301	1.329	2.528	6.414	69	0
	Upward	1.257	2.412	0.288	0.682	1.832	4.361	69	0
Tradition	Rightward	0.629	2.175	0.26	0.11	1.147	2.418	69	0.018
	Condensed	0.543	2.138	0.256	0.033	1.053	2.124	69	0.037
	Extended	0.786	2.315	0.277	0.234	1.338	2.84	69	0.006
	Upward	0.443	2.363	0.282	-0.121	1.006	1.568	69	0.121
Combination	Rightward	0.786	2.34	0.28	0.228	1.344	2.809	69	0.006
	Condensed	2.171	2.502	0.299	1.575	2.768	7.261	69	0
	Extended	1.771	2.526	0.302	1.169	2.374	5.867	69	0
	Upward	1.786	2.992	0.358	1.072	2.499	4.993	69	0
Close Salience	Rightward	-1.086	2.4	0.287	-1.658	-0.513	-3.785	69	0
	Condensed	0.914	2.442	0.292	0.332	1.497	3.132	69	0.003
	Extended	-0.486	2.43	0.29	-1.065	0.094	-1.672	69	0.099
	Upward	-0.571	2.529	0.302	-1.174	0.031	-1.891	69	0.063
Distant Salience	Rightward	-1.406	2.597	0.313	-2.03	-0.782	-4.496	68	0
	Condensed	0.478	2.949	0.355	-0.23	1.187	1.347	68	0.182
	Extended	-0.884	2.715	0.327	-1.536	-0.232	-2.705	68	0.009
	Upward	-1.13	2.532	0.305	-1.739	-0.522	-3.709	68	0
Overall	Rightward	2.155	5.487	0.651	0.856	3.454	3.309	70	0.001
	Condensed	4	5.712	0.678	2.648	5.352	5.901	70	0
	Extended	4.099	6.623	0.786	2.531	5.666	5.215	70	0
	Upward	3.225	6.512	0.773	1.684	4.767	4.173	70	0