

# Research on the Modeling Features of Mongolian Characters

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## Abstract

The study of Mongolian characters' plastic arts is a new direction in the field of Mongolian characters. The Mongolian people have a history of 800 years using the Uighur Mongolian script, and they have produced a splendid and splendid writing art. Due to the reduction of the scope of modern Mongolian characters, the art of font modeling is declining day by day, and the research on the basic characteristics of characters is not in-depth enough. Therefore, analyzing the characteristics of Mongolian characters is beneficial to the protection and inheritance of characters. Therefore, analyzing the characteristics of Mongolian characters is beneficial to the protection and inheritance of characters. This article summarizes and analyzes the Mongolian characters used in the Inner Mongolia Autonomous Region of China. According to the vertical writing style of Mongolian, the composition of Mongolian has made a detailed analysis. Summarizing the modeling characteristics of Mongolian characters, it is concluded that Mongolian characters are spelled vertically and continuously from top to bottom. The same letter has different variants in the upper, middle and lower positions of the word. The animal's physical features are named. An in-depth analysis of Mongolian character modeling provides a theoretical basis for reference in the field of Mongolian font design.

## Keywords

Mongolian Script, Features of Mongolian Characters, Inner Mongolia

## 1. Introduction

Today, the scripts still in use in the world are basically evolved from 14 main scripts such as Roman script, Chinese character, Indian script, and Arabic script. Mongolian is one of these 14 main scripts (Biligebatu, 2008). Therefore, Mongolian writing has a relatively independent writing tradition and plays an impor-

tant role in the fields of philology and writing. The Mongolian script used in Inner Mongolia of China was formed on the basis of the Uighur script (Hexige, 2002). Academic circles generally believe that Mongolian language was formed in the early thirteenth century. The Mongolian script is a phonetic script that evolved from the Aramaic alphabet, the Sogdian alphabet, the Uighur alphabet, and then the Mongolian alphabet.

## 2. Vertical Continuous Spelling Feature Analysis

### 2.1. Vertical Layout

Mongolian script is the only script in the world that is arranged vertically. It is spelled in units of words, the word order is continuous from top to bottom, and the line order is arranged from left to right (Chinese Academy of Social Sciences Institute of Ethnic Studies, 1992). This is very different from other arrangements of words in the world. Due to the vertical typesetting, there are obvious differences in reading habits and text arrangement space. In general, Mongolian is wider than other texts (Figure 1). Taking the Mongolian printing font white body as an example, one is to change it in order to put more characters in a line and save space. The second is caused by the visual illusion of the literati's eyes. There are two straight lines that are equal in length and perpendicular to each other. In human vision, the illusion that the vertical line is more than the horizontal line will occur. The reason is that the eyeball moves up and down relatively compared to the left and right movements to be dull, this occurs due to the unequal amount of time and movement required by the eyes. Therefore, in order to achieve the visual effect of equal length, when the letters are arranged vertically and continuously, shortening the upper-lower ratio is beneficial to the comfortable reading of Mongolian characters. In the past, Chinese characters, Japanese and Korean characters in Asia were written vertically from top to bottom, and the line order was arranged from right to left. However, the horizontal arrangement of mainstream Western characters and the emergence of display screens have broken the existing text arrangement direction. Therefore, people have to adapt to the way of horizontal text reading, and the shape of the text has also changed, from the width ratio in the past to Narrow proportion shape. Therefore, the vertical layout of Mongolian has a great influence on the shape of the text.

### 2.2. Handwriting Feature Analysis

The shapes of many fonts in the world have evolved on the basis of writing, and

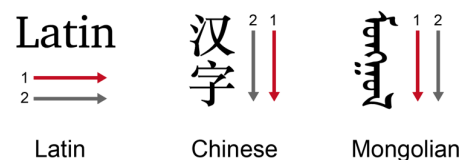


Figure 1. Text arrangement direction.

Mongolian characters are no exception. Throughout the history of the changes in the shape of Mongolian characters, the characteristics of writing have influenced the Mongolian characters from ancient times to the present. The writing tools used by ancient Mongolian scribes and writers are similar to those used by modern people, such as dipping pens and brushes. Dip pens are made from reed, bamboo, wood or stick-shaped bones (Kara, 2004). The end is like a chisel, the vertical length of the peak determines the maximum thickness of the line, and the width (thickness) of the peak determines the thinness of the pen. The outline of the characters engraved with this pen is clear and the corners of the font are crisp. 17th century woodblock fonts mostly used this type of dipping pen. Since then, the increase in the demand for reading has made the woodblock printing technology popularized, and the writing style has also been continued. From 1602-1720, it can be seen in the “Gansu Classic” (Figure 2), Woodblock prints have undergone the process of writing, wood carving, printing, etc. The characters are arranged regularly and the shape is clear. The shape strokes are sharp, the waistline is generally thick, and the single strokes extend out a large distance. It can be seen that the strokes in the woodblock printing fonts the strong contrast between thickness and thickness still has traces of writing and brushwork. In the process of woodblock printing, when the manuscript is rubbed on the wooden board, the engraver must ensure that the printed words are clear and legible, and the woodblock can be reused, so as to prevent the woodblock from cracking, character strokes and paragraphs, and the engraver appropriately thicken the text strokes to ensure the printing quality.

In modern times, the development of movable type printing technology printed a large number of newspapers and books, which changed the shape of Mongolian characters. In the early typesetting of movable type, there was a slight spacing between the letters, the glyph space was compressed as a whole, the fonts strokes gradually became 90° perpendicular to the median line, the thickness contrast between the horizontal and vertical lines became stronger, and the median line were no longer glued, and the strokes became clear, concise and lively. It is not difficult to find that the ligature character of stereotypes is slowly weakening in stereotypes. Its style is similar to the Chinese characters and Latin

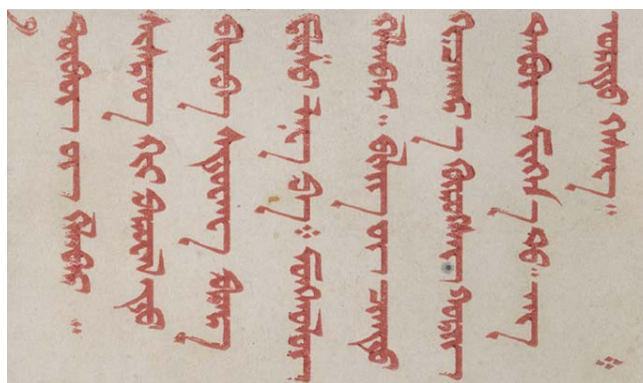


Figure 2. Mongolian characters in Gansu Sutra.

movable type printing fonts of the same stage. The stereotype font style had a great influence on the later digital font style in Inner Mongolia. It is the biggest change in Mongolian handwriting characteristics. The font with the highest usage rate in the existing Inner Mongolia Autonomous Region is the white body. Often appearing in print, TV shows, digital media. Compared with handwritten fonts, the basic shape of white body is derived from woodblock printing and metal movable type. It can be seen that the upper and lower proportions of the overall font are compressed (Figure 3).

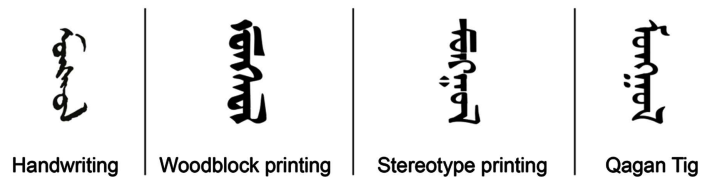


Figure 3. Mongolian writing characteristics.

### 3. Analysis of Text Composition

#### 3.1. Analysis of Word Combination Rules

The Mongolian script uses words as the basic unit of writing. There is no uppercase or lowercase letters, and it consists of vowels and consonants. Mongolian script has 34 letters, 8 vowels and 27 consonants (Figure 4). Due to the need for coherent writing, the Mongolian structure has produced many rules that constrain various letter variants. It includes the following three aspects: 1) Constraints for upper, middle, and lower positions; 2) The glyph is constrained by the shape of the letter strokes before and after it; 3) The shape of the text is constrained by the feminine and masculine letters.

1) Constraints for upper, middle, and lower positions;

Although Mongolian is a phonetic script, this attribute is the same as that of Latin and Cyrillic that we are familiar with, but it is very different from Latin and Cyrillic. When spelling Latin and Cyrillic words, there is a space between each letter, while Mongolian phrases are composed of one letter or more letters, and the letters are connected from top to bottom with the stem as the midline.

Vowels	Consonants				Numerals						
	а	а		н	ш	sh		х	h		0
	э	е		ng		т		к		1	
	и	и		б	б	д	д	ц	ts		2
	о	о		п	п	ч	ch	з	dz		3
	у	у		х	х	ж	dzh	х	h		4
	ө	ou		г	г	й	y	ж	zr		5
	ү	oo		м	м	р	r	л	lh		6
	э	ee		л	л	в	v	з	zh		7
				с	с	ф	f	а	ch		8
				ф	ф	а	а	а	а		9

Figure 4. Mongolian alphabet.

The ligature feature of Mongolian makes the same letter or grapheme have different writing forms in the upper, middle and lower positions of the word, including independent form, initial form, middle form, and final form.

2) The glyph is constrained by the shape of the letter strokes before and after it;

According to the classification of Mongolian characters in the current national standard “GB/T26226-2010 Information Technology Mongolian Deformation Display Character Set and Control Character Use Rules” document, the letters are divided into multiple characters for font design and encoding requirements, with a total of 176 characters. Among them, there are 39 nominal Mongolian characters, 56 single displayed characters, 70 mandatory combined fonts, and 11 non-mandatory combined fonts (China National Standards Administration, 2010). Due to the continuous writing characteristics of Mongolian characters, there are many combined characters that change because of their positions and strokes. Among them, the mandatory composite characters are included in the Mongolian orthographic alphabet, so there is a fixed basic combination shape. Mandatory consonants are defined as round-headed consonants [b], [p], [f], masculine [h], feminine [h], masculine [g], feminine [g], [k], etc. When spelling vowels, due to the need for ligation, a combined character is formed by changing the original glyphs of consonants and vowels (Figure 5).

	010	011	012	013	014	015	016	017	018	019	01A	01B	01C
0	ᠠ	ᠡ	ᠢ	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠦ
1	ᠡ	ᠢ	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠦ
2	ᠢ	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
3	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
4	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
5	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
6	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
7	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
8	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
9	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
A	ᠡ	ᠢ	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠦ
B	ᠢ	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
C	ᠣ	ᠤ	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
D	ᠥ	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
E	ᠦ	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ
F	ᠨ	ᠢ	ᠦ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠨ	ᠦ

Figure 5. Mandatory ligature.

In Mongolian word-forming structure, there is a kind of alphabet called chromatic alphabet, there are eleven in total, they are hard chromatic [eb eg er es ed], soft chromatic [en em el eng], and vowel chromatic [i], [ou]. Their characteristic is that they cannot appear at the beginning of a word alone, but can only be compounded into a syllable after a vowel or consonant, and have obvious differences in sound quality. Non-mandatory syllables are variations of these chromatic combinations. In the GB/T26226-2010 document, it is mentioned that the non-mandatory interpretation “The implementer of this standard can set more non-mandatory combined characters than 11 characters under the premise of not violating the relevant provisions of GB13000-2010. Non-mandatory combined characters. Mandatory composite characters may vary by typeface or may be used regardless of typeface.” (China National Standards Administration, 2010) Therefore, the non-mandatory font type varies according to the actual font type (Figure 6).

3) The shape of the text is constrained by the feminine and masculine letters;

There are seven vowels in Mongolian, which are [a, e, i, o, u, ou, oo] where [a], [o], [u] are masculine vowels, and [e], [ou], [oo] are feminine vowels, and [i] are neutral vowels. Masculine vowels are generally not mixed with feminine vowels in the same word. Neutral vowels can be used in yin and yang phrases or alone, and in rare foreign phrases, feminine letters are joined to masculine letters. The same is true for consonants. Consonants are composed of semi-consonants

	020
0	ᠰᠢ
1	ᠰᠢ
2	ᠰᠢ
3	ᠰᠢ
4	ᠰᠢ
5	ᠰᠢ
6	ᠰᠢ
7	ᠰᠢ
8	ᠰᠢ
9	ᠰᠢ
A	ᠰᠢ

Figure 6. Non-mandatory ligature.





retains the characteristics of their writing strokes. It is especially obvious in manuscripts and woodblock printing products, movable type printing fonts, the continuous writing feature in white body gradually weakens, and writing traces still remain in the strokes.

3) Influenced by the coherent writing of characters, the composition of Mongolian characters is changeable. The same Mongolian character element has different variants in the upper, middle and lower positions of the word, and the letters of the word are subject to the constraints of the stroke shape of the letters before and after it and the letters of the letters, constrained by the yin and yang of words.

4) Mongolian strokes have a unique naming method, which is derived from the animal body characteristics closely related to Mongolian traditional culture and nomadic lifestyle.

This study is a summary study based on the analysis of the basic modeling characteristics of Mongolian characters used in Inner Mongolia, China, and strives to provide a theoretical basis for reference in the field of Mongolian font design.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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