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A Preliminary Classification of the Writing Elements of Chinese Characters

ABSTRACT: Chinese writing from 100 Asians who recently migrated to the United States was collected and intercompared to determine the frequency of handwriting characteristics. The general elements of handwriting form and execution were assessed in each sample. They include: system, style, size, slant, proportions, angularity, skill, speed, pressure, arrangement, spacing, and alignment. The basic strokes of Chinese characters are delineated, and the methods and application of foreign writing comparison are summarized.

KEYWORDS: questioned documents, handwriting, Chinese characters, classifications

In this day and age we hear a lot of talk about the global society and how advances in communication technologies expose us to a great variety of cultures. Another contributing factor is demographic change. More people are migrating to different parts of the world and making societies more diverse. With the Pacific Rim migration, the United States is witnessing an influx of Asian immigrants who bring with them cultural differences, including a different handwriting system. In many parts of the country, documents written with Chinese characters are becoming part of the social and commercial structure of society. Some of these documents are coming under dispute. It is apparent that steps to increase the data bank of reference material en the subject is necessary.

Although there are structural differences between Chinese characters and Latinized systems, the principles of identification are universally applicable. However, in the identification process, several factors affect the procedure. Gideon Epstein in his paper "Examination of the Josef Mengele Handwriting" [1] emphasizes that familiarity with the language under examination is necessary. He enumerates additional steps in the examination process as a preparatory measure to acquire a base of knowledge in the area of endeavor.[2] This base of knowledge is required to distinguish between class and individual characteristics.

Method

What distinguishes one thing from another is a set of characteristics. The set is made up of a particular combination of elements which serve to individualize. The more intricately a

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thing is divided into its elements, the more it can be individualized. Handwriting identification is based on individuality. Therefore, the first step is to divide handwriting into its elements. The logical order is to go from the general to the specific. The process of handwriting identification, in simplistic terms, is similar to how one locates his car in a parking lot. He first looks for the general characteristics such as make, model, and color. With handwriting we look at the system, style, and perhaps the overall size. When the general characteristics are insufficient to distinguish one's car from four other cars that have the same set of general characteristics, then more specific qualities must be assessed. This process of evaluating the general and specific characteristics is the process used to identify handwriting.

If we follow this analogy strictly, an additional factor must be addressed—that of familiarity. The identification process is performed more quickly when we are examining samples of our own writing or that of a friend, because the identifying features are in our memory. When we examine writing from someone whose combination of characteristics we are unfamiliar with, the process takes longer because more steps are involved. In this case we no longer depend on our memory as the sole reference source, but make notes of the distinguishing features in the known samples. When an additional factor is introduced that makes the unfamiliarity even broader, such as handwriting derived from a foreign system, then the process involves still more steps and consequently takes a greater amount of time to accomplish. When a foreign system uses an entirely different set of symbols, like Chinese characters, the process is further complicated.

The primary source for resolving the unfamiliarity factor is reference material, and the secondary source is a collection of samples from people with similar background for the purpose of distinguishing class characteristics. Shimoda [3], Crown and Shimaoka [4], and Leung et al. [5-7] have supplied reference material on the history, systems, basic strokes, classes of characters, and identification principles of Chinese characters with respect to handwriting identification. All of these papers serve as excellent reference material for anyone considering the examination of a questioned document involving Chinese writing. Since the history, systems, and character structure are discussed thoroughly in these papers, they will not be reiterated here. This study will use the secondary source as a base for classifying characteristics of Chinese writing, and by so doing, it is hoped that it will complement the work already done in this area.

Writing was collected from 100 Chinese immigrants who were educated in China, Hong Kong, or Taiwan. The majority (85%) were recent arrivals and were all students in an adult education class studying English. They were between the ages of 17 and 62 with the majority (87%) between the ages of 20 and 40 years. Their education level was 48% high school, 35% junior high, 12% elementary, and 5% college. Ninety-one percent came to this country within the past three years.

Since this sampling was initially collected for the purpose of distinguishing class characteristics for an examination of a questioned document, the selected text was comprised of specific names, words, and phrases. Professors and Asian task force investigators, all of whom were either from China or Hong Kong, and who spoke and wrote Chinese fluently, guided the selection. The text included three names, for example, Jackie Chan, Los Angeles, South China; eleven words, for example, old, acquaintance, rooster; and ten phrases, for example, dear mother, man seeks employment, fairy tales of North South. The text was dictated in Chinese.

Character Units

The basic unit of a character is the stroke. In Fig. 1 the first row shows the eight basic strokes in modern writing; the second row shows some additional strokes seen in practice. The character may be simple or compound. The compound character is two characters put together. In this composition the characters are either both radicals or a radical and a pho-
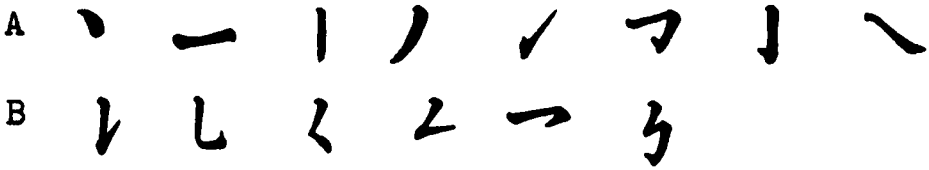
FIG. 1—*The basic strokes* (a) *and some extended strokes* (b) *of Chinese characters.*

netic. The radical gives meaning to the character and the phonetic points out the pronunciation [8]. Figure 2 shows some simple and compound characters. The composition and class of characters are explained more fully in Shimoda's and Leung's papers.

Preliminary Classification

Before the empirical data can be assessed, a formula or scheme for division of handwriting elements is required. There are several ways to divide the elements of handwriting. In the broadest terms, the elements used in handwriting identification involve form and execution. Form includes all the elements derived from the graphic pattern, and execution includes the elements derived from the manner and process of recording the form.

There are general elements and detailed features in each category. The preliminary classification involves the general elements. The elements of form are system, style, size, slant, proportions, and angularity. The elements of execution are skill, speed, pressure, arrangement, spacing, and alignment. Except for system and style, a qualitative assessment is made of each of these elements. For instance, writing is determined to be quickly executed when the line quality is smooth with tapered strokes and slowly executed when the line quality is marked with tremor and blunt termination of strokes. Hence, each of these categories are subdivided by descriptive qualities. Some of these qualities are relative, such as size, which is assessed as large when it is somewhat larger than the norm and small when somewhat smaller than the norm.

These elements and their qualities were assessed in the Chinese samples to determine the frequency of occurrence among the writers.

System

There are two basic systems used in contemporary Chinese writing: conventional and simplified. In the conventional system, the characters conform to the structures used for hundreds of years. In the simplified system, the number of strokes in thousands of characters have been reduced. For example, country or nation is written with eleven strokes in the conventional system, and only eight strokes in the simplified system (Fig. 3). Note: system for the purposes of this study should not be confused with the calligraphy systems described in
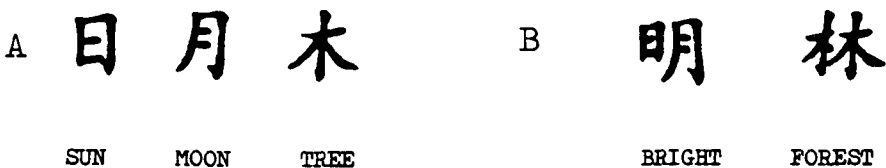

FIG. 2—*Examples of simple* (a) *and compound* (b) *characters.*

A 國   B 国   C 𠂆>

FIG. 3—*Examples of the word "nation" written in the conventional* (a), *simplified* (b), *and shorthand* (c) *systems.*

Leung's paper which are based on three calligraphers introducing their personal writing habits. Note: there is a shorthand system that was not found in any of the samples and therefore, will not be discussed in this study (example included in Fig. 3).

Style

There are three basic styles of Chinese writing: printing, cursive, or a blend of printing and cursive (Fig. 4). Printing, referred to as the regular style, is composed of separated strokes to form the characters. Cursive is composed of linked strokes some of which are slightly curved in structure to facilitate the connections. The combination of printing and cursive, referred to as the running style, has some connections between the strokes of otherwise printed characters. Table 1 depicts the combination of system and style.

Many people abbreviate the construction of characters and care must be taken not to confuse this with simplification. Abbreviation may also be a reduction of strokes, but not in the prescribed form of the simplification system. It also includes reducing the longer strokes for shorter ones and connecting strokes in the nonprescribed manner. The differences are not always clear to one who is not familiar with Chinese writing. While the abbreviation of characters may be a class characteristic, the manner and quality of that abbreviation is quite individual.
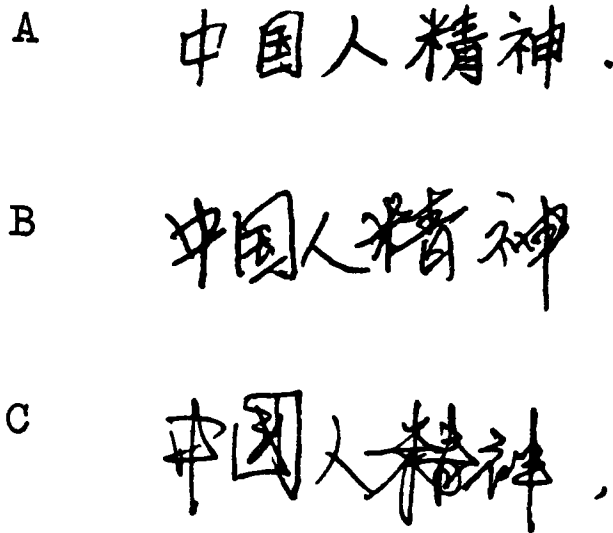
A   中国人精神 .

B   中国人精神

C   中国人精神 ,

FIG. 4—*Examples of the words "Chinese spirit" written in the printed* (a), *mixed* (b), *and cursive* (c) *styles.*

TABLE 1—*System and style.*

| | Style | | |
System	Printing, %	Running, %	Cursive, %
Conventional, 55%	20	31	4
Simplified, 45%	11	34	0

Size

The overall size of writing was measured by the ruled lines of the paper. Writing that was considered small was confined to the space allotted between the ruled lines. This accounted for nine percent of the writers. Seventy-seven percent wrote approximately fifty percent larger than the small writing or one and one half of the space alloted between the ruled lines, which was considered the norm. Fourteen percent wrote much larger than the norm—two to three line spaces.

Slant

Chinese writing is constructed as parallel blocks which are vertical; consequently, in practice the slant is minimal. Leung found that the margin of slant was narrow, ranging from the largest mean value of 3.6° to the smallest of −2.1°. He attributed this to the untidiness considered in slanting characters. There are two methods of measuring slant in any system of writing: the axis of the character or the vertical strokes. It is far easier to measure vertical strokes in Chinese characters because most characters have at least one. The pattern of slant of the vertical strokes is easily assessed and has a parallel factor that Leung addresses in his paper. This pattern is quite individual.

Perpendicular to the baseline, 51%
Backslant, 13%
Forward slant, 8%
Definite mix of slants, 28%

Proportion

There are various measurements of proportion. That which was used here is the comparative relation of character heights. The imaginary box that accommodates the strokes of each character should be the same size. In practice this is seldom the case (Fig. 5). The generally accepted rule is that multistroke characters should be written small and few-stroke characters large. The height ratios of characters were considered uniform if their range was less than one sixth of the character height.

Uniform, 29%
One half character, 32%
Three quarters character, 24%
One character, 6%
One-and-one-half character, 3%
Two characters, 6%

Angularity

Angularity is not assessed in the same way as in Latinized writing, because as Leung discusses, Chinese characters are not constructed on a circular track, even in the cursive style.
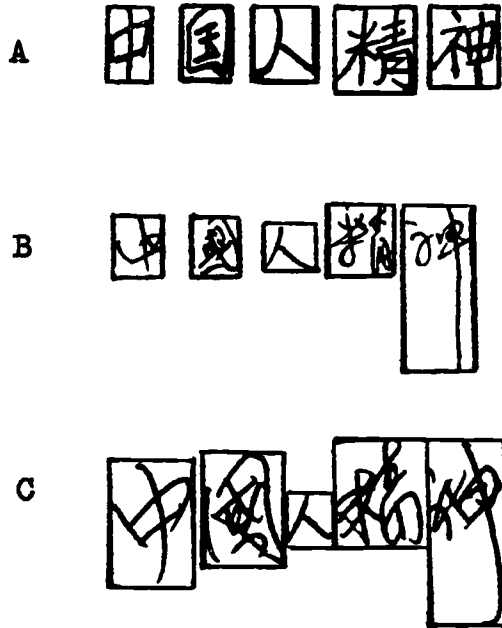
A 中国人精神

B 中国人精神

C 中国人精神

FIG. 5—*Examples of various ranges of proportional heights of characters.*

Chinese characters, by their very nature of straight or angled strokes, are angular structures. This element is more appropriately considered as an element of detail and, therefore, is not considered further in this study. Suffice it to say that the degree of angularity varies and definite patterns are established among writers.

Skill

Skill denotes the fluency of movement and certainty of execution and involves qualities such as rhythm and legibility as well as the uniformity of all the elements. The general categories of skill can be considered as good, average, or poor. If the sample was neat, legible, rhythmic, and had good form it was categorized as good. To determine this, the samples were first divided by the pictorial qualities of neatness and rhythm and then subdivided by legibility and form. Conversely, if the writing had an erratic appearance, was lacking in uniformity of its elements, or was laboriously written it was considered poor. That which did not fit clearly in these two categories was considered average. As expected, the majority of writers fell into the average category which had a very wide range of skill. Three percent wrote poorly and seven percent wrote very well. One of these was close to copybook quality and was written rapidly.

Speed

If the writing was marked with blunt endings, or a tremorous line quality, the writing was considered slow; if it was marked with tapered strokes and smooth line quality it was considered fast. Any writing that did not clearly fit into either group was considered medium.

Slowly written, 21%
Medium, 59%
Quickly, 20%

Pressure

Pressure was measured by an overall quality of heavy or light intensity of writing. Twenty percent of the samples were written with light pressure and thirty-one percent with heavy pressure. The remaining forty-nine percent were either marked with a wide range of variation (shading) or could neither be considered heavy nor light.

Arrangement

Arrangement incorporates the features of margins and spacing between lines and words. The samples were collected on standard size, ruled notebook paper. Although the paper had a left margin ruling, 12% ignored it and four of these did not use the paper right side up. Only 55% used the ruled lines to govern the written text, consequently the spacing between lines was uniform. Of the remaining 45%, only 2% had uniform spacing between lines. There were nine categories of arrangement which combined the features of left-hand margin, line spacing, and grouping of the text (Table 2).

TABLE 2—*Arrangement.*

Percent	Page	Line Spacing	Left Margin	
34	whole	double	even	
16	whole	double	even, indentations	
14	whole	double	right or left slanted	
12	whole	double	even, grouped text	
7	whole	double	no	
6	half	single	even	
4	half	single	no	
4	half	double	even	
3	whole	single	even	

Spacing

Most of the writers had disproportionate spacing between characters. Only 23% of the writers uniformly spaced the characters, 77% did not. In 22% of the samples the spacing between characters and between elements of compound characters was often the same and was subject to a wide range of natural variation between writers (Fig. 6).

Alignment

The baseline of characters was measured. Regardless of whether or not the writers used the ruled lines, the majority had varied alignment. Only 29% aligned the characters uniformly.

Discussion

The frequency of a class characteristic has some import in evaluating the combination of personal writing habits. It is axiomatic that any particular characteristic may be found in more than one writer, so the frequency of various characteristics is fundamental in the evaluation process. Usually this is determined through experience. When experience has not built a sufficient data bank in a particular area, another system is necessary. A scientific classification of empirical data can reduce the dependency on experience in making judgments of frequency.

Classification of handwriting characteristics requires definite parameters. Therefore, each division and subdivision must be clearly defined. The first division of handwriting components are the general elements such as style, slant, size, proportions, and so on. Each of these elements are then subdivided by the qualities they possess, for example, slant may be left, right, or perpendicular to the line of writing. In practical examinations these qualities are further divided, but since this study is intended to be a preliminary classification, only the primary and secondary divisions are used. The parameters of the secondary division are objective measurements, that is to say, they are defined by physical qualities perceptible by others. As a result of this broad categorization, each has a class characterization, whereby a large number of writers will fit into each subdivision.

The characteristics that are common among several writers are important in the identification process. Just because a characteristic is a class characteristic does not diminish its importance, nor do several class characteristics as a set preclude some distinction. For in-
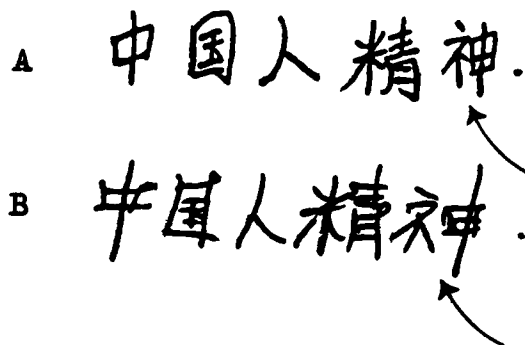

FIG. 6—*Examples of spacing between characters and between elements of compound characters. In Example a, the elements in the last character are spaced in the prescribed manner. In Example b, the elements are spaced as separate characters.*

stance, one class characteristic may belong to one group of people, another class characteristic may belong to another group of people, and so on, until the sum total or combination of class characteristics may indeed be quite individualizing. Hence, the ultimate formula for distinguishing one writer from another is the combination of all the characteristics, both individual and class.

Those characteristics that usually reflect more individuality as a rule are the detailed features of form and execution. The frequency of these should also be assessed. They include: design; shading; connections; density of structure; punctuation; internal proportions; and the position, shape, size, angle, curvature, termination, direction, and sequence of strokes. Leung describes several additional features: unique writing mistakes (structural or homonyms), tilt of horizontal strokes, pen emphasis, width-to-height ratio of characters, symmetry, and parallelism of adjacent strokes.

Should an occidental examiner undertake the examination of foreign script? The maxim "know your limitations" is the crucial factor in answering this question. This maxim is not a justification for staying limited, but rather a caveat for preventing mistakes. Examiners are not in control of which documents become questioned, only which ones they are qualified to handle. Documents are not static, nor should be the examiner. If the principles of identification and the preparatory steps necessary for an unfamiliar category of writing are followed, then an examination is possible. The situation is analogous to some of the unfamiliar conditions of English script that arise in questioned documents: writing affected by a particular illness and specialized text such as chemical formulas are both conditions that introduce unfamiliarity for most examiners. In these cases, the examiner must research the causes and affects of the condition to resolve the limitations of unfamiliarity before proceeding with the examination. However, for some examiners, developing or expanding their expertise in foreign script is not practical, because they do not have enough occasion to justify the extensive effort that is absolutely required.

There are several prerequisites to making an examination: a sufficient quantity of known samples accurately depicting the natural writing habits, similar conditions (format, instrument, text,[3] chronology, and physical conditions of the writer), random sampling to distinguish between class and individual characteristics, and background information about the language from reference material and those fluently familiar with it. A reference collection of samples is crucial for the occidental examiner who attempts a Chinese writing examination, not just for the purpose of distinguishing class characteristics, but to help tune the eye to unfamiliar symbols. Reference material should include general information on Chinese writing and studies on Chinese and foreign writing examinations.[4]

Conclusion

Many factors affect the face of a document, therefore it is incumbent on the examiner to not only keep abreast of these changes, but to prepare for them. Today's immigration patterns are in the process of altering American society and they are expanding the scope of the questioned document profession as well. It is not necessary to be able to read and write a script in a foreign language to make an examination, as long as the examiner follows the scientific principles of handwriting comparison, has a sufficient sample of known writing, has the aid of one who is knowledgeable in the language, and has a collection of samples from several people with the same general background. Research must be recognized as a mandatory prerequisite whenever an unfamiliar condition is encountered, foreign or other-

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[3]To make the radicals in a compound character approach each other, sometimes strokes are made shorter or longer. For this reason, it is important to have exact comparability to the questioned text.

[4]Several papers have been written on foreign handwriting systems that are completely different than the Latinized alphabet, for example, Arabic [9,10], Thai [11], Chinese [12-14], that aid the examiner in applying the principles of identification.

wise. Even with this background, when a fundamental element cannot be resolved in an examination, regardless of whether it involves a familiar or unfamiliar handwriting, the process cannot proceed to a definitive conclusion. Recognition of this limitation is part of professional responsibility, and examiners should be especially alert for it when examining documents written in a foreign script.

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