Decoding Strategies Used by Chinese Primary School Children

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This study explored the ways Chinese children remember and decode characters. Thirty primary school children in two cities in China reported how they recognized and remembered individual characters. Of the ten strategy categories identified from the children's responses, three that analyzed character structure dominated. These three categories, as well as several others, emphasized visual processing rather than phonetic processing and suggest emphasis on visual perception. The first-, second-, and third-grade children readily divided characters into structural components and individual strokes. The study concludes that learning written Chinese engaged these children in using semiotic systems unique to their written code and distinct from those usually emphasized in English literacy learning.

> *Interviewer:* Is [the character] right or not?
>
> *Child:* No.
>
> *Interviewer:* How do you know that?
>
> *Child:* Because the end part of it shouldn't be this horizontal bar, but four dots.
>
> *First Grade Student, China*

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When Chinese children learn to decode and comprehend characters they focus on writing system components quite different from those found in the English alphabet. Probing early literacy practices in systems that function differently than our own can provide insights about the different ways children learn and process written symbols. This study investigates the literacy practices and strategies that young Chinese children report using to remember and decode the densely

packed characters of their writing system. Using single character words with small errors in them to stimulate children's oral commentary, we interviewed first, second, and third grade children in two Chinese working-class schools about what strategies they used to remember and decode them. Using a constant comparative method of data analysis (Bogdan & Biklen, 1982; Glaser & Strauss, 1967), we determined recurring categories of strategy use. Unlike most studies of character recognition and processing reported in the West (Feldman & Siok, 1999; Ju & Jackson, 1995; Perfetti & Zhang, 1995; Shu & Anderson, 1999) and in China (Peng, Li, & Liu, 1994; Yu, Feng, Cao, & Li, 1990; Zhang & Feng, 1992), we chose to cast the net widely and elicit, to the greatest extent possible, what the children themselves had to say about the nature of their written code and how they remember its components. By verbalizing their processes during the interviews, the children in this study revealed some of the ways they weave together complex strategies and bits of knowledge that they employ as tools for recognizing and remembering visually complex written symbols.

Background

The current study grew out of a foundation of two decades of microanalytic cross-cultural investigations in U.S. and Chinese contexts (see Regan, Pine, & Stephenson, 2000 for a synthesis). One of our research strands has probed and compared the nature of literacy in China and the United States. During investigations carried out by teams that include early childhood and elementary educators, we have been continuously struck by the dissimilarity of skill emphases and perspectives required to negotiate the English and Chinese writing systems. English users speak of sounding words out, of the sounds of poetry, of invented spelling; Chinese users speak of balanced characters and stroke order, of the appearance of a character, of the visual allusions found within the characters of a poem. Our studies of young Chinese children have often uncovered, from a Western perspective, unusual visual memory skills (Pine, 1993; Regan et al., 2000; Stephenson, 1994) related to two dimensional shapes and patterns. For those of us from China, this visual acuity seemed commonplace until we saw children and adults in the United States struggle with what we consider the simplest of Chinese literacy tasks.

We therefore decided to probe the early stages of literacy behavior among Chinese primary grade children and, in the current study, what specific strategies they report using to decode and remember characters. We hypothesized that if adults using the two writing systems view literacy from such different perspectives, then this difference might manifest itself in children's early literacy learning.

Nature of the Chinese Writing System

The Chinese writing system employs a knowledge base quite different from an alphabetic system, such as English. Although some researchers dispute what cognitive mechanisms are triggered while reading Chinese (Cheng, 1992; Perfetti & Tan, 1999), Chinese[1] clearly requires some skills and strategy configurations that are quite different from English, Spanish, and other writing systems that utilize the Latin alphabet.

To be literate enough to read a Chinese newspaper, a sixth-grade child must learn approximately 2,500 characters (Hudson-Ross & Dong, 1990; People's Education Publishing House, 1993; Yin & Rohsenow, 1994). For the average adult, 7,000 to 9,000 characters are enough to read general books (Yin & Rohsenow, 1994), and 3,000 are sufficient for writing. Academic and professional literacy requires much more. Although repetition of character components often occurs, especially when simple characters appear as components of more complex characters, children's learning task for this logographic system requires them to memorize hundreds of tightly constructed characters.

The internal structure of characters requires attention to minute detail. Each character is comprised of multiple strokes–sometimes as many as 30–which have a proper order and method of writing. A character has balance and geometric beauty in and of itself and is situated within a visualized square space (Regan et al., 2000). The Chinese envision a character as black lines within a white space rather than just black lines, and when they write a character they envision a white square intersected by crossed lines into which the character is placed.

Characters sometimes have a component on the left and another on the right, sometimes one up, one down (see Figure 1). Sometimes a character has three characters embedded as components within it, and so forth. Shapes are complex and can often be confused with other shapes. Many times, for example, one dot or stroke can indicate very different meanings (e.g., zhé [bend] (折) and chāi [disassemble] (拆). Also, one pronunciation can have many meanings and is represented by different characters. For instance, in the Xinhua children's dictionary [Xīnhuá Zìdiǎn] (Xinhua, 1998) the fourth tone yàn pronunciation represents 23 different characters with meanings spread from *disgusting* to *banquet* to *learned person*.

Compared to the words and morphemes of alphabetic writing systems, Chinese characters are relatively independent from the spoken language (Taylor & Taylor, 1995; Yin & Rohsenow, 1994). Characters represent primarily the meaning of a morpheme and only indirectly its sound. In Chinese, a literate person often sketches a character in the air to clarify a meaning. For example, one man in the midst

Different Character Structures

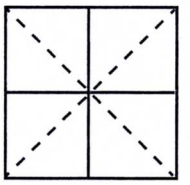
Most characters fall into one of these configurations. In addition, a left/right structure might have a top/bottom structure embedded on one side, etc. Single structure characters comprise only 3% of all characters. Percentages are from Yin and Rohsenow (1994).

Left/Right c. 65% 孙

Top/Bottom c. 23% 叠

Inside/Outside c. 9% 国

Writing Square for First Grade



In first grade practice books the squares, called tían squares, are about $^1/_2$" square. They first contain only the vertical and horizontal lines. Diagonal lines are added as characters become more complex. By third grade these practice squares are $^3/_8$" square.

Figure 1. Character structures and writing square for beginners.

of writing looked up, puzzled, and sketched a character in the air, saying, "I can almost see it, but there is a bit just there I can't see clearly," pointing at the place in his imagined space (Regan & Zhang, 1997, p. 646).

Most characters are comprised of components and can be decomposed into smaller parts. Compound characters, which make up a majority of modern characters, contain two types of components, often called the semantic radical and the phonetic component. (In Figure 2, which lists some of the characters used in this study, standard compound characters include K.2, 2.4, and 3.4.)

The semantic radical, called yīfú (衤), often on the left in a right/left character structure, carries the meaning of the character that is only evident visually. It is not realized phonologically (Taylor & Taylor, 1995). The shape directly represents meaning rather than sound, but most semantic radicals have no pictorial relation to their referents. In tǎng (躺) [lie down], for example, the left side of the character is a component for shēn (身) [body] and leads the reader towards the meaning. The phonetic component provides a hint of what the character might sound like; it "specifies aspects of a character's pronunciation, but does not reflect the meaning of the character" (Hudson-Ross & Dong, 1990, p. 19). It is often an independent character with its own meaning which is embedded in the compound character

and imparts its sound (Taylor & Taylor, 1995, p. 80). In tǎng (躺), the phonetic component is on the right side and is the character for shàng (尚) [still, yet]. Its relation to the pronunciation of tǎng is fairly opaque, and it must also be visually decoded as shàng in order to provide any phonological help. Although some linguists theorize that phonetic components may have originally been linked to pronunciation (Taylor & Taylor, 1995; Yin & Rohsenow, 1994) continuous changes in the language and the writing system in the past 3,000 years have made the vast majority of phonetic components ineffective in indicating pronunciation (Yin & Rohsenow, 1994, p. 169). Any link to pronunciation is also confounded because there are many vastly different dialects in Chinese that all share the same writing system. These dialects often sound less alike than Spanish, Portuguese or Italian but have had a common writing system for over 2,000 years (Liu, 1988).

Set #	Incorrect Character	Correct Character	Pinyin & English
K.1	电	电	diàn [electricity]
K.2	球	球	qiú [ball]
1.2	燕	燕	yàn [swallow]
1.3	出	出	chū [exit]
2.2	闷	闷	mēn [stuffy]
2.4	裤	裤	kù [trousers]
3.2	鞠	鞠	jū [bow]
3.4	躺	躺	tǎng [lie down]
All Grades	唱	唱	chàng [sing]

In the Set # column, grade is indicated first, the card number second (e.g., 1.2 = first grade, card #2).

Figure 2. Samples of card pairs used for children's interviews, incorrect and correct.

The most frequently used Chinese characters are also the least regular, and the characters taught to first graders tend to be irregular in many ways. They contain almost no phonetic clues (Shu & Anderson, 1999; Tao & Zuo, 1997).

A long tradition of Chinese literacy instruction dates back more than 2000 years, with one of the literacy primers, *The Thousand Character Classic* [Qiānzì Wén] being used for 14 centuries, from the 6th century A.D. to the early 20th century (Liu, 1988; Woodside, 1992). However, universal literacy has only been a systematically planned goal since the Communist government came to power. As a consequence, most 20th century governments had concern about the complexity of the Chinese writing system and how to teach it most efficiently (Woodside, 1992; Yin & Rohsenow, 1994).

Reading Pedagogy and Practice in Chinese Primary Grades

From a Western perspective, Chinese lessons in first, second, and third grades are fast-paced, noisy, and very much teacher-centered. The 100-plus first grade classes we observed over the last several years each contained 50 or more six-year-old students sitting in rows of fixed seating. The primary grade teachers who specialize in teaching Chinese[2] instruct from the front of the room on a raised platform, aided by a blackboard, colored chalk, small slates with characters written on them, and poster reproductions of textbook illustrations.

When teachers first introduce a character, they have the children look at it carefully as a whole and then study its details. They next introduce the small units within it, relating them to previously learned characters or components and demonstrating how to write it. But the focus is always within the context of the whole, balanced character. The teacher demonstrates how each stroke is made, in what order it is written, and where it is positioned within the character. Teachers view correct stroke writing and stroke sequence as essential to learning characters. Children are instructed to write the separate units in the air while saying the stroke names (of which there are 23). This is done aloud with great enthusiasm. The children then are asked to write the whole character on worksheets that have gridlines (see Figure 1) so that they can create balanced, well-proportioned characters.

During the first few weeks of first grade, children are introduced to Pinyin, a system of Chinese sounds written in the Roman alphabet with tone markers and used as an early decoding aid. Characters are introduced in the third month of first grade. By the end of first semester children are expected to have mastered Pinyin as well as 160 characters (People's Education Publishing House, 1993). During first grade the two systems (Pinyin and characters) work side by side. Then as children move through the grades and increase their character memory bank, Pinyin drops away.

Related Research

Although successful readers must learn to decode and comprehend continuous text, the current study focuses on just those processes and strategies children employ as they succeed at recognizing individual characters. We realize, however, that these processes cannot be wholly separated from the fuller picture of reading.

Visual perception is an important element of reading for all written languages. Coming to literacy in Chinese, however, demands more complex levels of visual perception than many written systems because of the dense structural nature of characters. Chinese appears to utilize a semiotic system dominated by visually processed signs. An overview of visual perception research follows as it relates to literacy, as well as a review of research related to recognizing and decoding characters.

Visual Perception in Literacy

One aspect of literacy development in any writing system is the complex process of passing information transmitted by arbitrary written signs through a child's visual system. Children must recognize these signs as useful for gaining information, discriminate among the various signs (e.g., letters, words, or characters), and derive meaning from them that is tailored to the expectations of their linguistic communities. The ability to accurately access visual information encoded in print provides the foundation for literacy (Clay, 2001). Perceptual learning, the search for invariants and for the permanent features that make it possible to distinguish them and to perceive the predictable (Gibson & Levin, 1975), is integral to that encoding process. Because it occurs early in the processing of information and therefore affects all subsequent processes, perceptual learning exerts a profound influence on behavior (Goldstone, 1998). Visual processing of print by the emergent reader, therefore, plays a key role in moving toward fluency (Adams, 1991; Clay, 2001).

A vast difference exists between the preliteracy tasks of perceiving objects–a spoon, a dog, a face–and perceiving the arbitrary written signs of language. In order for literacy to develop efficiently, the visual system, which has been picking up information from birth, must be adapted for this new task (Clay, 2001). Brain plasticity research (Merzenich, 2001) suggests that the learning brain of the child continuously remodels its processing machinery and is highly adapted to this type of change. It routinely handles accurate, high speed reception of multiple information streams, including visual input, and self-organizes this material, including the efficient storage of massive content compendia in richly associated forms.

Early perceptual learning in the visual field requires highly developed discrimination in order to know what to look for in a written code and what to ignore. Perception of relevant invariants and ordered relations must precede self-directed

strategic use of them (Gibson & Levin, 1975). Goldstone (1998), working from an ecological approach to perception (Gibson & Gibson, 1955), identifies four fundamental processing mechanisms: attention weighting, imprinting, differentiation, and unitization. These mechanisms aid perceptual adaptation including visual processing. Clay (2001) considers attention weighting–the increasing of attention paid to important perceptual dimensions and features and the decreasing attention paid to irrelevant ones (Goldstone, 1998)–plus differentiation and unitization, as mechanisms critical to visual perception of written signs. Goldstone sees differentiation defined as distinguishing features of a given entity, with objects or clusters of signs being decomposed into more definable/usable and detailed pieces, and unitization, whereby a task that originally required detection of several small parts can be accomplished by detecting a single unit, as complementary mechanisms. In other words, the child differentiates all the details necessary to distinguish one letter or character from another, and when sufficiently familiar with these sign components, then unifies them into one unit (e.g., the word *cat*, once seen as isolated letters, becomes a single entity). Goldstone's fourth mechanism, stimulus imprinting, appears to develop perception through either whole parts or specific features of stimuli. Clay omits this mechanism, yet it appears to be associated with Chinese character learning. Research revealing specific links between 2- and 3-year-olds' prewriting and the writing systems of their linguistic communities (Pine, 1992) strongly suggests an imprinting mechanism at work.

Although Clay (2001) emphasizes that only a few emergent readers may stumble in the visual perception demands when decoding a written system, clearly all children must successfully recognize the arbitrary visual signs and parts of signs of their writing system and later unitize that detailed visual data in functional "chunks" (Czerwinski, in Goldstone, 1998) that lead to fluent reading. Conquering the arbitrary nature of the writing system (Gibson & Levin, 1975; Nöth, 1990) requires them to engage in learning the demands of the semiotic systems related to their particular linguistic community.

Chinese Character Recognition

In recent decades, as the Chinese government has tried to bring an entire nation to literacy, emphasis has been placed on how to encourage and simplify literacy learning. Many of the suggested changes have been fruitful, while some proved unsatisfactory and were abandoned. Considerable effort in the last decades has focused on the effects of simplifying characters, with many studies conducted in areas such as frequency of character use and determining which characters are vital for beginning literacy levels (Fan, Tong, & Song, 1988; Woodside, 1992; Yin & Rohsenow, 1994). In the 1980s the study of Chinese character processing was still rare (Zhang & Feng, 1992), but during the last decade more studies have reported

on Chinese character recognition and the processes involved (Xiao & Huang, 1998). Nevertheless, only a few have looked at children's character learning, and of these, we have found only one study in which children were asked to report their views. The data for this one are still being analyzed (Olsson, Dahlgren, & Wen, 2000).

A number of recent adult studies focus on how various parts of characters affect processing, and a major subset of these look at the relative importance of the semantic and phonetic components of complex characters. Many studies have examined the variance between up/down and left/right characters (see Figure 1), horizontally balanced characters, and characters with different numbers of strokes and subunits (Shen, Li, & Zhu, 1997; Xiao & Huang, 1998; Yu et al., 1990). Zhang and Feng (1992), for instance, investigated the complex effects of number of strokes and number of subunits within a character. They looked at the effects of varying numbers and positioning of these components on processing time and accuracy, finding that "high frequency characters may use component parts as the processing unit" (p. 385). Others (Liu, Tu, & Zhang, 1998; Peng et al., 1994) have investigated the differences between processing nondividable and dividable characters as well as words comprised of two characters. Although the results of these studies are not relevant here, their number and specificity suggest the importance Chinese researchers assign to effects of stroke and component variation on the decoding process.

Many studies focus on the semantic and phonetic components of complex characters. The fact that most of these studies draw from a foundation of Western research and alphabetic language processing confounds the investigations. Some Western psycholinguists, concentrating on phonological and semantic processes in relation to the sublexical and lexical processing of print, have turned to Chinese because many characters contain both a semantic and phonological component (Feldman & Siok, 1999). Since the 1970s, detailed studies have been carried out with Chinese-speaking adults in the United States reading isolated characters under carefully designed conditions (Ju & Jackson, 1995; Perfetti & Zhang, 1991, 1995; Seidenberg, 1985; Tan, Hoosain, & Peng, 1995). One major issue they address is whether reading Chinese characters bypasses phonology. Perfetti and colleagues (Perfetti & Tan, 1999; Perfetti & Zhang, 1991, 1995) have shown evidence of semantic and phonological priming that, they argue, supports a universal principle that all printed word forms, whether alphabetic or logographic, routinely arouse phonological representations as part of their identification. Others (e.g., West, Ju, & Jackson, 1995; China, Zhou, Shu, Bi, & Shi, 1999) have found that graphic and morphological information plays an essential role in Chinese character identification and that information in the phonological components does not enhance decoding accuracy. Peng, Liu, and Wang (1999) conjecture that because of the

conflicting evidence in the studies of how sublexical units and speech elements from single Chinese words are decomposed to derive meaning, and because of the nature of the interplay between phonological and semantic accessing in Chinese, "hidden factors influence the organization of access representation" (p. 65). In discussing the conflicting research results, Zhou and Marslen-Wilson (1999) raise the question as to whether the phonological explanation is adequate for Chinese characters, which are often composed of semantic and phonetic radicals. Peng et al. (1999) argue that sublexical processing in reading Chinese words is both phonological and semantic.

Studies in China related to these issues have increased substantially in number since the late 1980s. Shu and Zhang (1987) found that adults used the phonetic component and associated analogical reasoning more often with low frequency words, while processing high frequency words semantically. Jin and Li (1995) found that the form of a character was activated before the phonetic portion. Song, Zhang, and Shu (1995), in a study of children and college students using a proofreading task, found that children in third grade relied on the phonetic components for decoding text, while sixth-grade students and adults utilized the meaning component in increasingly greater amounts by age and literacy development.

Yu et al. (1990) suggested that the whole character, rather than its separate components, is the perceptual unit in decoding and reading. And a recent series of studies conducted by Zhou et al. (1999) concluded that orthographic information for most Chinese characters "seems to play a stronger role than phonological information. Phonology by itself has a limited effect on semantic activation in reading Chinese" (p. 136). They firmly assert that in written Chinese "direct visual access is the predominant way to access information in the mental lexicon" (p. 136).

Questions are being raised in China about the overly dominant role of Western style research questions that bypass the unique traits of Chinese characters. In a review of brain language processing studies, Gao and Guo (1993), for example, noted that word processing based on Western languages leaves many questions to be answered about Chinese processing. Zhu and Gu (1992), in their extensive review of character recognition studies, argue that investigations repeating foreign experiments on alphabetic writings with Chinese characters do not fully consider the features of Chinese characters and their effect on character identification, nor do they build theory related to character identification. They urge more focus on features of Chinese characters–the relationship between morphology and pronunciation, and morphology and meaning. Such studies would help develop research methods better suited to character features.

Studies of Children Processing Components of Chinese

In the 1970s and 1980s several researchers studied preschool children's knowledge and ability to learn characters (Fan et al., 1988). Huang (1982), for example, in a six-semester research project in Nanjing, found that when character learning was connected to real experiences such as going to a zoo, kindergarten children learned and retained individual characters, including those with many strokes. Of 161 characters taught, the 30 children in the project recognized an average of 91.4% at the end of the semester.

Using a complex design that included a task appropriate for third graders through college students, Song et al. (1995) developed interesting data on the possibility of a shift from more reliance on the phonetic component in third grade to increasing reliance on the semantic component with age and fluency. This study, unlike others mentioned, embedded target characters within continuous text. Zhou, Wu, and Shu (1998) studied the responses of third- and sixth-grade students in Beijing and found that effects of phonetic and semantic priming existed at both grade levels and that both increased in strength with age, with semantic priming coming earlier than or simultaneous with phonetic priming.

Shu and Anderson (1997, 1999) explored Chinese children's utilization of metalinguistic awareness, defined as the ability "to identify and reflect on the structural features of language" (1999, p. 1) as literacy develops. They suggest that in order to attain metalinguistic awareness children must become "aware of the basic units of spoken language, the basic units of the writing system, and the mapping between the two" (1999, p. 1). They hypothesized from the role of phonemic awareness in alphabetic literacy that in Chinese, because characters map onto morphemes, morphological awareness might be the aspect of metalinguistic awareness most closely related to literacy. Because large groups of characters, sometimes up to 100, share the same semantic radical and are related in meaning, children aware of the function of radicals would have a powerful tool for literacy learning. For example, knowledge of the component for *animal* would enable them to identify a number of characters as belonging to the animal category.

A cluster of character recognition studies with first, third, and fifth graders in a working-class school (Shu & Anderson, 1997) explored children's awareness of semantic radicals in characters and whether this awareness helped them learn and remember characters. In a paper and pencil task they provided the children with series of characters with varied amounts of morphological help–helpful semantic radicals, opaque radicals unrelated to character meaning, and characters undividable into components. Each group included familiar, recently learned, and

new characters. They found that, for the 143 first through fifth graders tested, morphology was not important for familiar characters. Characters with semantically transparent help were utilized by older students, but first graders did not demonstrate "a clear ability to utilize the semantic information in radicals" (1997, p. 84). In a later discussion, they stated that the younger children understood the basic configuration of the standard compound character but seemed not to "spontaneously use what they know about morphology to process familiar characters or derive the meaning of new characters" (1999, p. 13). By third grade, however, students of "average or high ability" regularly used semantic radicals to learn and remember characters and to derive the meaning of unfamiliar characters. In another similarly structured experiment related to use of the phonetic component of characters, they provided 113 second through sixth graders with three types of characters–those in which the character as a whole is pronounced like the phonetic component, those in which the character pronunciation is different from the phonetic, and those with bound phonetics that are not freestanding characters and have no determinate pronunciation. Their results suggested that high-ability second graders made little use of phonetic information but most sixth graders used it. Shu and Anderson found that first graders and even high ability second graders did not systematically use information provided by the semantic radicals or the phonetic components in regular compound characters. This contrasts with the findings of Zhou et al. (1998).

Available research in decoding and processing Chinese characters and the unclear understanding as to how characters are processed suggest that a considerable amount can be learned from primary grade readers about how they use the semantic and phonetic character components and, more generally, what processes come into play as they interact with the complex signs of their writing system. Rather than focusing on one specific area, such as semantic radical use, we chose to keep our inquiry more open-ended.

Method

The methodology for this study was developed over a three-year period. We began our inquiry with the very broad question of what Chinese children could tell us about how they process characters. By the time we began this particular study, while maintaining the frame of a broad question, we asked what strategies Chinese children reported using to recognize and remember specific characters.

One major challenge was to devise successful ways to elicit individual responses from students who are accustomed to a highly teacher-centered environment. Our methodological goal was to find means for eliciting children's oral commentary on

their decoding and remembering process, thus having them externalize as much as possible their internalized understandings (Wertsch, 2000).

To develop an interactive investigation with open-ended questions, we conducted three pilot studies spread across three years. The first two focused on developing engaging prompts and an environment that encouraged children to talk about a sign-mediated process (recognizing and talking about specific characters). The audiotapes and fieldnotes from these two pilots were transcribed, translated by a linguist on our research team, and analyzed by researchers in both China and the United States to find the types of prompts that elicited elaborated multiple word responses from children and that appeared to encourage them to engage in a conversation about how they remember and identify specific characters. We found that the children were most willing to share their thinking when a character they knew had a mistake in it. This error was a device that stimulated them to talk about their strategies, and although it skewed their responses toward error-spotting, we decided the yield gained from their spontaneous oral commentary was worthwhile. The third pilot tested the appropriateness of the characters we selected. The characters were chosen from grade-level textbooks by those on our research team knowledgeable about young children's developmental processes in general and about what is taught in the first, second, and third grades in China. They were selected from the grade that the child was just completing. The final pilot also provided useful feedback about how to structure the research tasks while maintaining a reassuring atmosphere for children. The final prompts were sets of grade-level characters with small errors embedded in each one. Figure 2 shows a sampling of the characters used, with and without the errors.

The Research Setting and Participants

The study was conducted in two working-class schools in widely separated cities, one on the east coast and one in central China. Fifteen children were selected for interviews in each school–five from each of the first, second, and third grades. Our school contacts were asked to select children randomly, but we did not directly witness the selection process. We can vouch for the fact, however, that the children at each grade level in each school had quite varied abilities and knowledge for recognizing and remembering characters. The children spoke Standard Chinese (Pǔtōnghuà) in addition to their native dialect.

They were interviewed individually in a room separate from their classrooms with two adults present, a Chinese interviewer and a U.S., English-only researcher. We attempted to put them at ease and encourage them to think of our questions as a challenging game rather than a test. Interviewers used a standardized set of questions, but they were also sensitive to following the children's thinking and

adapting to their responses. All interviews were audiotaped. The two interviewers, native Chinese speakers familiar with the school communities, were selected for their experience with research, their ability to work with children, and their ability to communicate in English. Both were fluent Standard Chinese speakers who also understood the primary dialect of the children. The Western researcher observed from a tactful distance, recorded nonverbal interactions and kept the process organized.

Typical interviews lasted approximately 15 minutes, occasionally much longer, and, if the child was really unsure of the characters, shorter. Following are small sections from two typical interviews, each with a first grade child.

Child 2z; chàng (唱) [to sing] (See Figure 2, "All Grades"):

Interviewer: [showing child the incorrect chàng card] What's this character?

Child: It isn't a character.

Interviewer: It is wrong, isn't it? You write down a correct one.

Child: [Writing it correctly]

Interviewer: Hmm. What is it?

Child: It's chàng [sing].

Interviewer: Chàng. Hmmm. How do you remember it?

Child: It's a character of shape and sound. The left part is kǒu (口) [a component which means *mouth*]. It shows the meaning. We use our mouth to sing, so it's kǒu [mouth]. The right part is chāng[3] (昌) [another character meaning *prosperous* or *flourishing*] and it gives the sound. So it's chàng [to sing].

Child 2x; yàn (燕) [swallow (a bird)] (See Figure 2, 1.2)

Interviewer: [showing child a character for yàn with a mistake] Do you know this one?

Child: This is...

Interviewer: What?

Child: (It's) yàn [swallow].

Interviewer: Yes, the character for swallow. Is it right or wrong?

Child: It's wrong.

Interviewer: Why is it wrong?

Child: The part below should be four dots (,,,,), but not a héng (一) [a stroke].

Interviewer: Can you write it down?

Child: [writes character correctly]

Interviewer: Then how do you know that it should be four dots instead of a bar?

Child: Because we have learned this character.

Interviewer: You have learned it before. Then how do you remember that it should be four dots but not a bar?

Child: I remember all that I have learned.

Each child was shown the grade-level characters with the mistakes on 3" x 5" cards one at a time. We introduced the children to this activity by using characters from their previous school year. For example, first grade children began with kindergarten characters. Once the children seemed comfortable with this game of finding and talking about the mistake and how they remembered to write the character correctly, we proceeded to their grade level set of four characters. They were asked if each character was correct, to identify the character, to talk about how they recognized and remembered it, and to write the correct character on their paper. In a few instances, when the children were unable to identify any of their own grade level characters, we used the characters from an earlier grade in order to encourage them to talk about characters they knew. Our purpose was to elicit their thought processes and strategies, rather than to test what they did or did not know. In addition, two common characters–chàng (唱) [to sing] and bǐ (笔) [pen or pencil]–were used for all the children in order to glimpse variation by grade.

Nature of the Data

The primary data consisted of three types: audiotapes of all interviews, the children's written responses, and the observer's notes. All of the interviews with children were translated to English and verified by Chinese speakers. The children's written responses, on half sheets of unlined paper, included their correct version of each character and also whatever they chose to write while they talked about the characters. Immediately after the interviews the written responses were coded to the transcripts and the observer's notes. Supplementary information was collected through transcribed and translated interviews with a variety of primary

and preschool teachers, plus fully recorded, transcribed, and translated Chinese lessons taught in first- and second-grade classrooms. These helped us understand the teaching processes and character learning processes that students referred to in the interviews.

Data Analysis

From the beginning of the pilot studies children's responses were analyzed by both native Chinese and English-speaking researchers for categories of strategies, using a constant comparative method (Bogdan & Biklen, 1982; Glaser & Strauss, 1967). Analyses looked for themes and categories of how children chose to talk about the characters. The data from the current study of 30 children's interviews were analyzed in the same manner, identifying categories that emerged from the students' responses. A final set of defined categories were then completed by the U.S. researcher. A subset of the data, including responses to four characters by randomly selected children, was coded by two Chinese adults familiar with research techniques to check that the categories conformed to the children's responses and to verify coding judgments. They recorded their insights about the strengths and weaknesses of the categories and then discussed their coding decisions. This interactive process was chosen rather than a more controlled training such as inter-rater reliability (Borg & Gall, 1989) because we wanted to uncover information about shades of decision-making and the fit of the categories to the data (Glaser & Strauss, 1967). The auditors suggested descriptive changes for categories, but the categories themselves remained intact.

Results

Before proceeding with the results, it is important to note the limitations of the current study. First, it involved only 30 children, 10 at each grade level. The task was also limited to decoding of individual characters, not reading of continuous text, and it may be that children bring a different analytical focus to isolated characters than they do to characters within a complete text. Finally, the task itself focused the children's attention in a specific way. All the character prompts contained an error that we can assume heightened the children's error-spotting awareness. Since the point of the study was to induce children to talk about how they learn and remember characters, these small errors in familiar characters were successful at triggering this response. Future studies should, however, probe children's analytical decoding skills in a text-embedded situation and with error-free characters.

The Categories

Ten categories emerged from the 30 children's 731 responses. They are listed in Table 1 with sample phrases from the transcripts. Within these ten, four clusters of categories emerge–responses related to the structural analysis of characters, a

category of kinesthetic responses, imaginative responses, and responses not related to alphabetic learning.

Table 1. Coding categories and clusters of strategies for recognizing and remembering characters derived from children's interviews.

Category	Description	Examples
Structural Analysis		
A1. Divides into parts	Separates structure of the character into explicit parts.	How to remember qíu? "First the component. I'll remember this part first. And then this part" [pointing to the left component and then the right].
A2. Associates with other character or part	Associates the character or part of it with another known character or small units of another character.	"The up part should be the component zhú [bamboo]." Referring to qíu [ball]: "The left part of it is wáng [a component meaning *king*]. The right part is qíu [another character]."
A3. Scans for details	Scans details of the character structure–e.g., identifies what is wrong with the incorrect character by referring to specific strokes or other details.	"It [the character for qíu, ball] should have a dot." "These two pies [stroke name] are unnecessary." [in sǎn, umbrella]
A4. Scans stroke order	Recites strokes, in the order they should be written.	"Its strokes are shù, héngzhé, héng, héng and shùwāngōu." [electricity]
Kinesthetic		
B5. Uses hand motions	Uses kinesthetic means to remember or talk about a character; writing appears to activate knowledge.	Finger writes in the air while talking about the character. Cannot talk about or identify the character error, but can write the character correctly.
Imaginative		
C6. Uses narrative	Uses a brief story or narrative to explain or remember a character or part of a character.	"Shùwāngōu [a stroke name] must be out, or the electricity can't go out." "We use a hand to pat the ball. If there isn't this dot, then we can't pat the ball."
C7. Relates shape to meaning	Uses the relationship of shape to meaning.	Describes the character kǒu [mouth] as having the shape of a mouth.
Non-Alphabetic		
D8. Gives unspecific reason	"Knows it" for a very general reason, saying, for example, "I know it..." or [D8 Ø], child "hasn't learned it."	"Because we have learned this character." "The teacher taught us." [D8 Ø] "I haven't learned it. I don't know it." "The teacher hasn't taught us."
D9. Not a character	States that without a given stroke or element "it isn't a character any longer."	"With the two strokes it doesn't read sǎn." [umbrella] "Because with four dots, it reads yàn [swallow]. But with the bar we don't know how to read it."
D10. Values appearance	Refers to the appearance of the character.	"It's nice looking." [therefore it's a character] "It doesn't look like a character."

A. Structural Analysis. In the four categories of the Structural Analysis cluster–*A1*, *A2*, *A3*, *A4*–children analyze character structure by segmenting or matching characters or character parts. These categories are ordered by the increasing amount of specificity used by the children–*A1* is the least specific, *A3* and *A4* the most detailed. Category *A1* includes those strategies that merely recognize that the

character needs to be divided into explicit subunits. For instance, one child reported, "I'll remember the upper part first and then the lower part." Another said, "The inside part is not right; the other components are."

Category *A2*–associating one character or character part with another–contains those responses in which the children associated the character on the card or a part of that character with another character or character subunit. For example, in talking about the character bǐ (笔) [pen, pencil] a child said, "The upper part should be zhú (竹) [a component meaning *bamboo*]," referring to the top unit. Another child, talking about shuì (睡) [sleep] said, "The left part of this character is mù (目) [a component meaning *eye*]. The right part is the character for chuí (垂) [drooping]."

Responses that referred to specific details of a character such as the shape, correctness, or function of a particular stroke or sub-unit fall into Category *A3*. In this category children scanned for details and their descriptions were much more specific than Category *A2*. Typical Category *A3* responses were, "The bottom of the component needs four dots (灬)" and "The piě (丿) [a stroke] is too long. It shouldn't cross this shù (丨) [a stroke]."

Category *A4* includes those comments in which the children described a character or character component by reciting the stroke names in the order they should be written, usually accompanying the recitation with very firm finger writing in the air.

B. Kinesthetic. The Kinesthetic category, *B5*, involves children using writing (often with their finger in the air or on their lap, or with the pencil placed about an inch above the paper) to activate knowledge. These preliminary movements were made before the students actually tried to write the character correctly.

C. Imaginative. The Imaginative cluster includes two categories, *C6* and *C7*. Category *C6*, the use of narrative, includes comments in which children relate a brief story to explain or remember a character or a character part. A typical response for this strategy relating to how to remember the character diàn (电) [electricity] was, "I think if the shùwāngōu (乚) [a stroke] isn't out, then the electricity can't go out and we can't turn the light on." In *C7*, children's responses associate the shape of the character with its meaning–e.g., they associate the character kǒu (口) with the shape of a mouth. Chinese adults often use this category to explain how children remember characters.

D. Nonalphabetic. The Nonalphabetic cluster–*D8, D9,* and *D10*–includes categories that Westerners might call unique to Chinese writing, in part because of the clarity and definiteness with which they are asserted. In Category *D8* the children

asserted they knew the character "because the teacher taught it" or did not know it "because I haven't learned it" or "the teacher hasn't taught it." This category was expressed with a definiteness unlikely to be heard by children learning to read and write English. The children's responses that are included in *D9* declare that the character with an error is not a character because it is missing a small part. To a Westerner, the English equivalent might be if someone insisted that *jump* were not a word if the dot over the *j* were missing. Although the final category, *D10*, rarely occurred, it is unlikely to be heard in relation to English writing. The children's comments in *D10* refer directly to the appearance of a character–it is a character because it is "nice looking" or it is not a character because "it doesn't look like one." These comments appear to echo adult Chinese comments about the beauty or poignancy of a particular character or combination of characters. In contrast, when we have asked native English speakers if they like the appearance of a word or letter, they look at the questioner with considerable disbelief (Regan et al., 2000).

Table 2 shows the frequency distribution of strategy categories, arranged by clusters, that all children utilized as they responded to the character prompts. Children sometimes used only one strategy category in talking about a character, and sometimes they employed several. They were counted as responding when they talked about a character and used at least one category. If they divided a character into several parts and analyzed each part separately, the categories they used for each segment were coded separately. A child could have used, for instance, Category *A2* for several sub-units of a given character. Overall, the 30 children responded successfully to a total of 248 characters. A total of 731 category responses were elicited from the 30 children, an average of about 3 category responses per character.

Table 2. Frequency Distribution of Children's Category Responses

	Structural analysis				Kinesthetic	Imaginative		Nonalphabetic		
Category	A1	A2	A3	A4	B5	C6	C7	D8	D9	D10
Response totals	106	228	186	22	45	72	18	32	20	2

n = 731 (total number of coded categories in all children's responses)

Structural Analysis

The children used three categories in the structural analysis cluster–*A1, A2, A3*–far more often than any other category. Each of these three strategies addresses the structural analysis of whole characters and their smaller units.

The strength of usage is consistent throughout the data–across individuals, characters, and grade level. Categories *A2* and *A3* far outstrip all other categories;

A1, the weakest of the three, is used more than 100 times. On the other hand, *A4*, which used only stroke names to talk about or remember a character, was employed much less often than the others.

Chinese children in this study clearly reported turning toward visual segmentation and their visual knowledge of characters and character parts in order to decode and remember characters. They used Category *A1*, the least specific of the Structural Analysis cluster, for 106 responses. The children separated the target character into explicit parts–sometimes left/right, sometimes up/down or inside/outside (see Figure 1), and sometimes into many parts. Said one first-grade child, pointing to the left component and then the right subunit of the character yā (鸭) [duck], "First I remembered this part, and then the right part, bird." A second grade child described how she learned and remembered the character for monkey, hóu (猴) [monkey], by visually segmenting it into four parts.

> The left part is quǎn (犭) [a component standing for *animal*]; the middle part is rén (亻) [a component meaning *person*]; the strokes of the upper part of the right part are héngzhé (乛) and héng (一); the bottom part of the right part is shǐ (矢) [a character meaning *arrow*].

This tendency toward the use of visual knowledge sometimes yielded quite complex explanations from the children. In the most extensively used strategy category, *A2* (228 responses out of 731), where children associated the character or part of the character with another character or character part, they often decomposed the target character into subunits, and then associated each unit with a separate character or character-like component. The following instance shows a first grade child delineating where strokes belong in two different characters. Using the target character diàn (电) [electricity] (Figure 2, K.1), he said, "Diàn's shùwāngōu (乚) [stroke of vertical bar, dash and a hook] should be out of the tián (田) [character for *field*]. But this one isn't." The target character, diàn, was written incorrectly without the top part of the shùwāngōu stroke. The child analyzed this in relation to a different character, tián [field], that is embedded within the character for *electricity*, saying that the shùwāngōu stroke needs to extend beyond the *field* character.

A second grader, when talking about how she remembered the character yàn (燕) [swallow], divided it into multiple parts.

> *Interviewer*: ...Then how do you remember it?
>
> *Child*: I divide it into several parts. The bottom part is four points; the middle part is a kǒu (口) [mouth] and a separated běi (北) [north]; the upper part is a cǎo (艹) [a component meaning

grass] and a dash. [Hand motions accompany all 3 parts–upper, middle, lower.]

A third grade child discussing the character jū (鞠) [bow] (Figure 2, 3.2), responded:

Interviewer: Is it right?

Child: The inside maybe should be the character for *rice* (米), but it was written as *wood* (木).

Although she did not use many words, her response required that she study the whole character, jū written with an error, and separate it into parts. She then focused on the portion with the error, the inside of the right-hand component, and observed that the character for *wood* was used instead of the similar looking character for *rice*, which would have been the correct one.

The 186 responses that fall into Category *A3*, analyzing the details of character structure, are much more specific than those included in *A2* or *A1*. Although Category *A3* responses were often evoked by the specific error in the character prompt, they were used at other times as well. Some sample responses from each grade exhibit how readily the children, beginning in first grade, focus on details that require, from a Western perspective, highly developed visual discrimination. The name of the target character precedes the quote. Each quote is from a different child.

First graders

yā (鸭) [duck]:

Child: Here a dot is missing.

Interviewer: How do you know that?

Child: Because the component should be the character for bird. And bird has a dot inside, but this one hasn't.

chū (出) [exit]:

Child: ...in this character the shù (|) should be one stroke, but here it is separated.

yàn (燕) [swallow]:

Child: It's wrong. The bottom part isn't four dots (灬).

Interviewer: Ah, not four dots.

Child: It shouldn't be the héng (一) [a stroke].

Second graders

hóu (猴) [monkey]:

Child: It missed one shù (|) [a stroke] here.

yā (鸭) [duck]:

Child: Here is the piě (ノ) [a stroke]. And here should be a dot, and here [this line] shouldn't be connected [to this line].

xià (下) [down]:

Child: [pointing to the character]...it looks like xià, but this part is shifted outward.

Third graders

shài (晒) [dry under the sun]:

Child: It is shài but with an extra short bar.

tǎng (躺) [lie down]:

Child: This stroke is too long.

Interviewer: Too long?

Child: Yes, the stroke should only come to this vertical stroke.

kū (哭) [weep]:

Child: Er...Here a dot should be added beside the character for big.

Each of the characters consisted of many different strokes, and the above comments are focused on the area where the error existed.

Normalized Analysis

Some characters were used many more times than others. Thirty children, for instance, responded to chàng (one of the characters used in common across all grades), while only seven responded to dié. We completed a normalized analysis of frequencies to insure that strategy category results were not just artifacts of the varying number of children who responded to different characters.

For each category and grade level we found the average use for each character by identifying the number of responses for each category and then dividing it by the number of children who had responded to that character. This provided the average number of times a specific category was used for each character. The normalized

frequency is the probability of using that category averaged over all the children and all the characters. The mean for all grades equals the uses per child averaged over all characters and children. These results are shown in Table 3 and Figure 3. A probability of more than 1 was possible because some children used the same category for more than one component of the same character. For example, the third grade children used the *A2* category an average of 1.08 times each.

Table 3. Normalized Frequency Distribution of Children's Category Responses, by Grade Level

	Structural analysis				Kinesthetic	Imaginative		Nonalphabetic		
Grade	A1	A2	A3	A4	B5	C6	C7	D8	D9	D10
First	0.33	0.67	0.94	0.05	0.18	0.26	0.07	0.22	0.08	0.00
Second	0.31	0.78	0.68	0.17	0.22	0.20	0.08	0.09	0.12	0.04
Third	0.56	1.08	0.73	0.03	0.17	0.35	0.05	0.08	0.00	0.00
Mean/ All grades	0.43	0.92	0.75	0.09	0.18	0.29	0.07	0.13	0.08	0.01
Response total	106	228	186	22	45	72	18	32	20	2

n = 731 (total number of coded categories from all student responses)

In Table 3, the results for the normalization analysis by grade made it clear that the Structural Analysis categories *A2, A3,* and *A1* were the most frequently used response types. When totaled by grade the use of these three categories accounts for 69%, 68% and 76% of the first-, second-, and third-grade children's responses, respectively, suggesting the importance the children gave to visually segmenting whole characters into comprehensible sub-units at all three grades.

In Figure 3, the average use by category clusters does not indicate any dramatic grade level differences. In view of the sample size, most of the differences within individual categories are of doubtful significance. However, the gain in *A1* and *A2* (dividing the characters into parts and associating characters or character parts with other characters or components) from second to third grade is potentially interesting. As stated before, Category *A3* (scanning for details) was presumably affected by the research prompts which encouraged children to hunt for small errors. The children's overall interest in talk about detail, however, suggests that this might prove a valuable area for future investigation, especially in relation to visual perception.

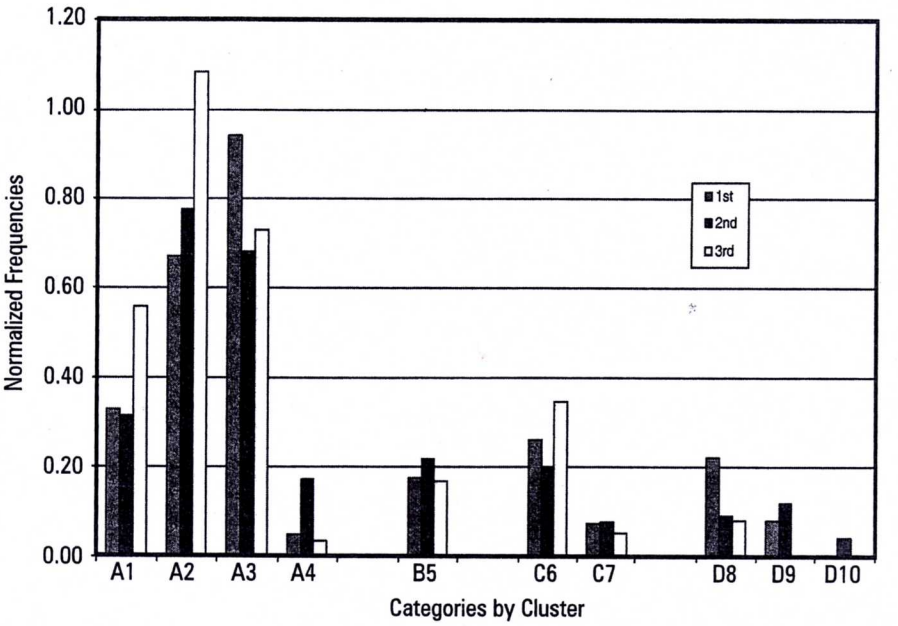


Figure 3. Normalized frequency distribution of children's category responses, by grade level.

Semantic and Phonetic Components

The children sometimes referred to a character as having both a shape and a sound component–shape referring to the semantic portion of a compound character and sound referring to the phonetic component. This terminology refers to the fact that the semantic portion can be identified by the configuration of its strokes, while the phonetic component may give a hint about a character's pronunciation. Some interesting trends emerged in relation to these two types of components. The children's responses are especially interesting in view of the numerous studies of how Chinese readers use these two components.

First, children voluntarily separated compound characters into semantic and phonetic components, and a number called them "shape-sound characters." They often demonstrated understanding and use of the semantic component, and sometimes they were able to fully employ the phonetic component as well. For example, in the following excerpt, the child identifies both the left (shape) and right (sound) portions of the character and associates this information with the meaning of the character.

kù (裤) [trousers]:

This character has left and right parts. The left part is yī (衤) [a component meaning *clothes*] and the right part is kù (库) [a different character, meaning *warehouse*], which has the same sound as the trousers.

At each grade level, nonetheless, the phonetic component frequently left children puzzled. Of the many children who employed the semantic radical as a means to remember a character, only a few knew what to do with the phonetic component. Often they referred to the meaning of the semantic portion and how that related to the meaning of the particular character, but did not talk about the phonetic component except by decomposing it into stroke names or creating elaborate stories to help them remember it. In the following example, a first grade child uses mù (目), the semantic radical that denotes something related to the eye, in the character shuì (睡), and associates it with a brief story. She is also aware of the right hand part of the character, which is the phonetic component, but seems not to know what to do with it.

shuì (睡) [to sleep]:

Interviewer: ...Then how do you remember it [shuì]?

Child: This character has right and left parts. The left part of it is mù (目) [a component meaning *eye*].

Interviewer: What does it stand for?

Child: Mù stands for eye. And people can sleep with eyes closed.

Interviewer: Right. Then the other part?

Child: [pointing to the phonetic component] This is chuí (垂) [a character meaning *hang down* or *droop*]

Interviewer: How do you remember it?...

Child: People sleep with eyes closed. So it is mù. [still referring to the semantic component]

Interviewer: And this part [pointing again to the phonetic component]?

Child: This part...It's a character of shape and sound [referring to both components].

She was unable to talk about making a phonetic connection.

One second grade child suggested that teachers may side-step the vagueness of the phonetic component and focus children on the meaning and associations of the semantic components.

shài (晒) [dry under the sun]:

Interviewer: Mm, right, right. How do you remember it?

Child: [Silence for three seconds] I divide it into ... Our teacher tells us if a character has two components, just remember the left part. So ... shài (晒) [dry under the sun] has left and right parts. The left part is a rì (日) [sun] and the right part's strokes are héng, shù, héngzhé, piě, shùwāngōu, and héng [stroke names].

Linking Shape and Semantics

The children almost never used the strategy of linking character shape directly to meaning, Category *C7*. This is an interesting development since in our experience many Chinese parents describe this as the most important way children become familiar with characters, and most Westerners assume that Chinese characters pictorially represent an object or idea. Children seldom talked about the similarity of character shape to its referent as a means for recognizing and remembering a character; they only utilized Category *C7* 18 times out of the entire 731 strategy responses. It is also notable that in the beginning first grade textbook, only 8 of the 160 beginning characters are associated with pictorial referents and then the text moves on rapidly to teach character formation by stroke order, balanced placement of strokes within their square space, and component use.

On the other hand, Category *C6*, in which the child narrates a brief story to explain or remember a character, was employed much more often (72 of 731 responses). Statements that fell into this category clustered around a few particular characters, and many of the children in both cities used some of the same stories. Our classroom observations and teacher interviews did not reveal any, but we have been told that teachers and sometimes parents use them similarly to the English expression, "When two vowels go walking, the first one does the talking." An example of one of these stories is associated with the character mēn (闷) [stuffy]. Several children refer to feeling closed in or bored by the presence of a door. A child from one city responded:

Interviewer: How do you know this is an extra piě (丿) [a stroke]?

Child: Because inside a ... door ... In one's heart, he feels bored. That ... that's why we can't put a piě here.

Interviewer: It should be a ...

Child: It should be a xīn (忄) [heart] inside the door.

Interviewer: Should be a xīn?

Child: Yes.

A child from the second city, 1500 kilometers away, responded similarly:

Interviewer: ...How do you remember it then?

Child: Mēn (闷) [stuffy] is a character of shape and sound. Mén (门) [door] has the similar sound as the character "stuffy" and the heart means that you feel bored in your heart.

These narratives, it is important to note, relate to the meaning of the two characters embedded within the character for mēn–mén (门) [door] and xīn (心) [heart], not directly to a picture of the idea.

At times the stories became elaborate, and the child seemed to have difficulty tracking its connection to the character. For instance:

kū (哭) [weep]:

Child: This is the character for weep, reading as kū. And it was written wrong.

Interviewer: Why?

Child: Because the part below should be the character for *dog* (犬). When you cry, you utter a loud voice. er...

Interviewer: So?

Child: Er...have the...

Interviewer: What is the relationship between *weep* and *dog*?

Child: [silence] [...12 seconds...]

Interviewer: How did it occur to you that *weep* is related to *dog*?

Child: I mean that it is very loud...

Interviewer: Ah, very loud.

The child appeared to lose track of his story line once he mentioned a dog. Although the interviewer tried to support him in connecting *weep* and *dog*, he wandered from his beginning connection back to the error, which he had already corrected. As one interviewer put it, "Connections made between a character and the thing it represents, though not logical or reasonable, may serve as a prompt for learning that character when one is young." He suggested that as the children get older, the connections in the story may fade and may eventually be replaced by more efficient and accurate remembering strategies.

Other stories were quite complicated and caused a chuckle when Chinese adults read them, but despite their complexity the stories stay connected to the character parts. For example, in the following several adults found the child's complex strategy both amusing and useful:

dié (叠)[pile up]:

Child: First remember sǎng (嗓) [throat], and because dié [pile up] has nothing to do with the throat, then omit the kǒu (口) [mouth]. And if you pile up the things, there are two levels, so there are two dashes.

Kinesthetic

Category *B5*, kinesthetic, which means to demonstrate knowledge of a character, was recorded 45 times. Children finger-wrote in the air or on their laps as they tried to remember how to write a character or to visualize the correct form of a character. Others practiced an inch or two above the paper several times before putting pen to paper. A number of the children also said they did not know how to write a character correctly–or did not know what the character with a mistake was supposed to be. When asked to try to write the character correctly, however, they did so–surprising themselves. It was as if their hands and muscles knew the correct details of the characters even if they could not envision them or talk about them. One first grader, talking about the character yàn (燕) [swallow (a bird)], put it this way:

Child: It's wrong.

Interviewer: Wrong? Where is the mistake?

Child: I can't think it out.

Interviewer: ...Can you try to write it?

Child: [writing the character] It is yàn (燕) [swallow].

Interviewer: But just now you didn't know. You just wrote it and got it right.

[laughter]

Child: I just couldn't find the mistake with my eyes.

Our data on this category are incomplete as it was not always captured in the children's audiotaped comments or the observer's fieldnotes. Nevertheless, even under these circumstances it was present with enough frequency to create a legitimate strategy category. It is a category that should be examined more thoroughly with systematic videotaping.

Discussion and Observations

In the vastness that is China this study investigates but one small corner of the complexities of its literacy communities. Yet the findings suggest interesting differences between strategies employed by young children learning to read in Chinese and English.

One of the most obvious areas that has emerged is the specificity with which the Chinese children talked about characters, their detailed noticing of signs within signs of their literacy system. By the end of first grade, the children in this study report a type of knowledge and way of learning that includes the ability to notice highly detailed, small nuances of the dense character structures. This appears to be very different from learning strategies employed by Western beginning readers who often focus on beginning sounds and letter/sound associations from preschool years.

Because our task focused children's attention on visual detail in a specific way, it undoubtedly weighted the frequency usage for Category *A3*–scanning for detail. In spite of this, the results are compelling. These Chinese children were not only inclined to discuss dots versus small strokes, but also to burrow into sub-units, differentiating characters or character parts in order to extract meaning from a character. The children's proclivity to rely on such detailed, complex noticing strategies startled both the Chinese and U.S. researchers among us as well as the Chinese primary school teachers associated with the study. The teachers reported that, although they focus children on the specific parts of characters, they did not expect them to attend to so *much* detail.

In our primary grade classroom observations, although teachers spent the majority of time on detailed text comprehension, attention to character structure and reinforcement of precise stroke and component formation within the balanced, whole character were embedded throughout the lessons. A rather typical teacher critique of student board work follows. (See Figure 1 for a tián square.)

> All right. Look. This stroke is quite good, but that stroke is not so good and it should be written like this, [correcting the improper stroke with red chalk] right? The two parts are too close, [correcting again] so now this character looks like a square. This stroke should be in the center of the tián square.

In addition, students are encouraged to criticize each others' character formation, as in the following first grade interchange:

Teacher: Well, let's look at xiào (校) of xué xiào. This character is of the

left-right structure. Li Ming, do you think the one on the blackboard [written by a student] is as good as what I taught you?

Student: No. This character is not good.

Teacher: Why?

Student: The left component is a little drifted.

Teacher: A little drifted. How?

Student: The vertical stroke is not straight.

Teacher: The vertical stroke is not straight.

Teacher: All right. Now everybody look at this character. As I've taught you, to write this kind of character the left component should be narrower than the right one. Is this one so?

Students [in unison]: No.

Teacher: You're right. No. The left component should be moved a little to the left, which would make this character look nicer, but on the whole, I think this character is written fairly well.

Those of us from the West found that student criticism can be quite pointed. The Chinese among us often commented, however, that this was very necessary. Mistakes had to be corrected immediately because eventually the students must write the characters perfectly. The following interchange, in another first grade class, was common:

Teacher: Then, what do you think of the next character (教)? [Students shouting responses.] Chen Jiang.

Student: It's written poorly.

Teacher: Poorly. Why?

Student: The right component is not suitable, and the jié (子) part of the left component is too small.

In interviews, time and again, teachers emphasized the importance of correcting student errors immediately, of demonstrating the writing of characters slowly and with great precision, and of having the students compare one character with another. Both the primary data of this study and the secondary data suggest the continuous perceptual learning mechanisms of differentiation and unitization (Goldstone, 1998) as the children focus back and forth between whole characters and the details of their strokes and components.

This proclivity to notice detail may also be embedded in their everyday context beyond school–learned and reinforced implicitly. We have noticed it before in different forms in China–the detailed prewriting of 75 two- and three-year-olds (Pine, 1993), and the ability of first graders to copy complex real characters and ersatz characters with virtually no mistakes (Stephenson, 1994). As we coded the data we were reminded of a previous investigation with Chinese preschoolers that we had to abandon because the children repeatedly paid attention to detail not noticed by adults. We had asked them to find "the character that's different" in a row of almost identical characters, but almost none succeeded because they kept focusing on small photocopying imperfections.

Furthermore, we have been struck by the similarities between the young children's comments in this study and college students' descriptions in a study of how they try to remember forgotten bits of complex characters (Regan & Zhang, 1997). Both the primary school children and the college students focused on the visual and spatial placement of chunks and segments of complex character configurations. An echo of the children's analytical strategies is seen in a typical monologue of one of these college students trying to envision forgotten portions of a complex character:

> I know it was composed of three separate designs within the one character rectangle. Each of these parts went into a left, upper right, and lower right position. The left part I know definitely. It is like it was a "t" with a tail and a line, I'm sure. The upper right is a simple curve with a line. But what's that under it?....(Regan & Zhang, 1997, p. 648)

As the student grasped at recalling the visually accessible configurations, we witnessed the same sets of phrases that the children use–references to left/right, upper/lower segments, to individual lines and their placements, and to the fitting together of the detailed pieces. The recall strategies of both the college students and the primary school children appear to focus on a visually dominated semiotic system.

Although in the United States, decoding focuses on sound/symbol associations and sound segmentation, the Chinese children in this study appear to focus on visual segmentation. U.S. primary grade teachers spend enormous amounts of effort and time developing children's awareness of the sound components of English–letter/sound associations, phonemes, onsets/rimes, and how these function in decoding print. In contrast, their Chinese counterparts appear to spend considerable energy and time in the early grades on visual learning, teaching stroke order, the precision and balance of character writing, and character recognition through visual and morphological decoding and encoding strategies. The phoneme seems to have little relevance to learning how to decode Chinese characters. Written characters,

unlike English, appear to transmit no specific connection to individual phonemes at the level of conscious decoding. Chinese children process written Chinese using semiotic systems distinct from those emphasized in learning English. Chinese is a system that utilizes the visual rather than sound as a medium.

Another clear difference is that once children developing literacy in English have learned to decode, even in rudimentary ways, they are able to unlock many words for themselves. On the other hand, children developing literacy in Chinese in this study either know the characters or they do not. There is no such thing as invented spelling or approximations in Chinese. Approximation does not seem to get a primary grade reader anywhere. Nonsense characters make children giggle when we have tried to use them, but there was no way they could unlock them the way an English learner could unlock a nonsense word. Being familiar with the separate components of a character may occasionally help a child gain access to it–e.g., in the case of a radical indicating a class of words such as *insect* (Shu & Anderson, 1997, 1999)–but many times the children in our study were stopped in their decoding tracks "because they hadn't learned" that specific character yet or "the teacher hadn't taught it" yet. "Sounding out" characters or constructing their meaning segment by segment was not a possibility. Gaining access to Chinese characters is markedly different from gaining access to English words.

The complementary areas between our study and the Shu and Anderson studies (1997, 1999) are interesting. Our findings parallel and support their observations (1999) that Chinese students develop an early insight into the formation of characters. With few exceptions, the children in our sample were aware of what made a character and were generally enthusiastic to point out not only the flaws of the incorrect characters, but also to talk about and dissect the characters structurally. Using sets of variously formed characters for pencil and paper morphological tasks, Shu and Anderson, on the other hand, found the children in the primary grades "have not discovered the basic morphological features of Chinese, or... have not spontaneously used what they know about morphology to process familiar characters or derive the meaning of new characters" (1999, p. 13). Our task was quite different–open-ended and designed to get primary grade children to talk about how they view their decoding and remembering strategies. We used primarily familiar characters. Within this setting we found that first graders and even the less assured second and third graders were quite willing to dissect previously learned characters into morphological subunits and describe their meaning-bearing characteristics. All but one of the ten randomly selected first-grade children in our study utilized segmentation as a means to decode characters. In the unexplored territory of unanswered questions between the Shu and Anderson studies and ours lie rich

ground for future investigation. One is to explore in much more detail how young Chinese children utilize the various structural components to decode both familiar and new characters. Another is, of course, to see how they use these strategies when reading continuous text.

This study was carried out in China. Precisely because the nature of the English and Chinese writing systems is so different, we hypothesized that children's decoding processes would be quite different from those found in English. Although it is tempting to draw parallels between the close attention children pay to words and subunits of English and Chinese, the vastly different nature of these two writing systems makes this problematic. We are not ready to identify analogous tasks in learning to decode Chinese and English; we have found at this time that it is most useful to probe deeper into young children's processing of Chinese characters. Nevertheless, we can say with confidence that these Chinese children's strategies for recognizing and remembering characters are different from English decoding skills. Children have to learn to read the arbitrary signs of their writing system in the ways that that system demands. Continued exploration of how this occurs in China will be valuable.

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Footnotes

[1] This paper discusses characters currently used in the People's Republic of China (PRC), excluding Hong Kong and Taiwan. Since the founding of the PRC, characters have been simplified to promote general literacy (Yin & Rohsenow, 1994). Hong Kong and Taiwan continue to use the earlier, more complex characters.

[2] Chinese literacy instruction is not broken into reading and writing. Rather, the two are taught as one process. Learning to read and write characters is considered an inseparable process during the elementary years.

[3] Chāng is a different character from chàng, but with a somewhat similar sound, though a different tone. The shapes and meanings of chāng and chàng are different.