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漢語學童以部件解字之傾向與相關因素

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過去研究顯示漢語學童能夠使用部件的訊息解字。但當部件所提供的訊息不一致時，漢語學童如何權衡不同部件的不同訊息解讀新字，我們則所知有限。本研究受試者爲 93 位國小四年級學童。學童聽完研究者描述一件新物品後，需從三個假字中選出一個最能代表這個新物品的假字。每個假字都由一個部首與一個聲旁構成。其中一種假字，部首提供與新物品相符的訊息，但聲旁不符；另一種假字的部首提供與新物品不符的訊息，但聲旁相符；第三種假字的部首與聲旁都與新物品不符。整體而言，四年級學童選擇第三種假字的比例很低，對部件所提供的相關訊息，並無特別的選擇傾向。但部件的選擇受到聲旁規則性與假字呈現順序的影響。此外，本研究也發現部件訊息的選擇傾向與讀字能力、詞素覺識無關。本研究結果顯示漢語學童不論其讀字能力、詞素覺識如何，似都已發展出利用不同部件解字的能力，且部件選擇的傾向相當有機動性，能隨作業需求調適，不執著於某部份的訊息。

關鍵字：聲旁、部首、中文認字、詞素覺識

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Introduction

To become literate, children must learn to realize that printed words are not arbitrary combination of graphic units that are committed to memory in a rote fashion. In order to learn to read efficiently, they have to understand that some recurring graphic units are functional and may carry cues about meaning and sound. Like English and other alphabetic orthographies, basic graphic units in Chinese, i.e., characters, also have subcomponents which are functional in representing phonological and morphological units of speech. These subcomponents are called radicals or bujian. The vast majority of Chinese characters are a fixed combination of a semantic radical that indicates semantic category and a phonetic radical that suggests pronunciation. Many studies on skilled readers of Chinese have shown that reading Chinese characters involves the processing of these subcomponents (e.g., Ding, Peng, & Taft, 2004; Feldman & Siok, 1999; Perfetti, Liu, & Tan, 2005). Awareness of these subcomponents is associated with individual differences in character reading and sentence comprehension (Ho, Ng, & Ng, 2003; Ku & Anderson, 2001; Shu & Anderson, 1997).

However, most of the previous studies investigate functional role of radicals along one dimension. Only semantic or phonetic radicals are of interest in one experimental task. For example, in Shu and Anderson (1997), children were asked to choose from 瞳撞僮潼 the one that best represented the meaning *pupil*. As these characters differed only in semantic radicals (the left parts of the characters), children's attention was naturally directed to the contrastive semantic components. However, some radicals of the Chinese characters lose their transparency over the last three millennia of development. In modern Chinese, the transparency of the functional cues of a character can vary differentially along its semantic and phonetic dimensions. A character may have both transparent semantic and phonetic radicals like 瞳, a helpful semantic radical but ambiguous phonetic radical like 抽, or an unhelpful semantic radical but relatively reliable phonetic radical like 增. Such being the case, it is not clear whether the semantic component would be appreciated to the same extent when the phonetic component of the character yields an ambiguous pronunciation. The present study was designed to investigate how Chinese children weighed semantic and phonetic information simultaneously in interpreting a new character and what factors affected their preference for semantic or phonetic

radicals.

Functional characteristics of semantic radicals

In Chinese, a character represents a morpheme and corresponds to one syllable. As there are only about 1,700 possible syllables, there are many homophonic characters in Chinese, which makes the mapping between whole characters and their pronunciations distinguishably arbitrary. However, when the characters are decomposed into smaller graphic units, some functional cues emerge at the sub-lexical level. About 80% to 90% of Chinese characters are ideophonetic characters, composed of a semantic radical and a phonetic radical. There are about 200 semantic radicals and 800 phonetic radicals in Chinese (Chan & Nunes, 1998; Hoosain, 1991). These radicals are combined and recombined to form thousands of characters in Chinese.

The semantic cuing function of Chinese is very unique when compared to alphabetic orthographies, which transcribe speech at the phonemic level. In Chinese, a semantic radical usually gives a clue to the meaning of the character, especially the information concerning the semantic category of the character. For example, the characters 材(timber), 杖(stick), 板(plank), 枝(branch), 根(root), 桌(table), and 楓(maple) are composed of the semantic radical 木(wood). All the characters have meanings related to wood. However, the semantic radical does not invariably provide reliable cues to character meanings. For example, Chinese speakers have to stretch their imagination hard to visualize the relationship between the sematnic radical 木(wood) and the meaning of the character 杯(a drinking vessel). Similarly, relationship between the character 增(increase) and its semantic radical 土(soil) is rather opaque to today’s Chinese speakers.

The prevalence of homophones in Chinese makes semantic radicals important because semantic radicals provide a way to separate and disambiguate homophonic characters (Shu & Anderson, 1997). Theoretically, awareness of semantic radicals allows children to discover relatedness among characters with an identical or related form and meaning, to decompose complex characters into familiar constituents, and to derive meanings of the characters. Empirical studies have shown that Chinese readers rely on semantic radicals in a lexical decision task (Zhang, Zhang, & Peng,

1990), in a sentence verification task (Miao & Sang, 1991), and in identifying the meanings of words and pseudowords (Chen, 1995). From age six, Chinese children begin to use semantic radicals to create characters to represent meanings (Chan & Nunes, 1998). By the third grade, good readers of Chinese use semantic radicals as an aid to select a new character that is consistent with the meaning of a bisyllabic word (Ho et al., 2003; Shu & Anderson, 1997). Learners of Chinese as a second language also develop sensitivity to the functional roles of semantic radicals (Wang, Liu, & Perfetti, 2004).

Functional characteristics of phonetic radicals

The phonetic radical conveys probabilistic information about character pronunciation. Some ideophonetic characters are regular, containing a radical that is homophonic to the pronunciation of the whole character. Some are semi-regular, with a radical that provides only partial information to character pronunciations. According to an analysis of 2570 Chinese characters explicitly taught in Chinese elementary schools, 39% of the ideophonetic characters have homophonic radicals, which provide full information about character pronunciations (Shu, Chen, Anderson, Wu, & Xuan, 2003). The predictive accuracy drops to 26% when tone is taken into consideration. In semi-regular characters, the mapping between the phonetic radical and the pronunciation of the character is generally predictable, though not fully regular (Alber, 1986, 1989). One noticeable case is the onset alternation between character and radical pronunciations, such as the alternation between the unaspirated palatal onset in 精睛菁 and their homorganic aspirated radical 青. In other cases, the onsets of the character and the radical may not be homorganic but still alternate in a regular way. For example, the retroflex /tʂ/ in 占佔站 alternates with the alveolar /d/ in 店惦點掂. It should be noted that although the phonetic radical carries probabilistic information about the pronunciation of a character, the form-sound relationship is largely arbitrary. Visually similar characters (e.g.,戊戌戎成) can have very different pronunciations and phonetically similar characters (e.g., 程承誠澄) can be visually dissimilar.

There has been misunderstanding about how a Chinese character is processed. A popular view has been the direct access hypothesis. According to this view, Chinese characters are recognized directly from their orthographic forms, without

the mediation of phonology. This view is readily accepted based on the observations that a Chinese character represents a morpheme at the syllabic level rather than at the phonemic level, that homophonic characters are pervasive in Chinese, and that a large number of Chinese characters contain a semantic radical which cues the meaning of the character. On top of that, it has been shown that semantic radicals are more reliable and more transparent than phonetic radicals in terms of the cuing function (Shu et al., 2003). The view that phonology is minimally involved in reading characters is in stark contrast with recent findings from studies using eye-movement technique and brain imaging, which reveal that phonetic radicals are invovled in reading ideophonetic characters (Lee, Tsai, Chiu, Tzeng, & Hung, 2006; Tsai, Lee, Tzeng, Hung, & Yen, 2004; Tzeng, Lin, Hung, & Lee, 1995). This new evidence confirms and extends the findings of many empirical studies, which reported skilled readers' use of phonetic radicals in predicting pronunciations of unfamiliar characters (e.g., Fang, Horng, & Tzeng, 1986; Seidenberg, 1985).

In fact, many Chinese children develop a working hypothesis about the pronunciation of an unknown character, i.e., sounding out any familiar part of a character as an approximate pronunciation for the whole character. Such phonetic overgeneralization errors were found to be the most dominant type of errors in reading Chinese among first and second graders (Ho & Bryant, 1997). Given the unreliability of the cueing function in phonetic radicals, children's attempts to overuse phonetic radicals to decode unfamiliar characters are usually discouraged by teachers and are considered to be a convenient solution used by poor readers.

However, despite the unreliability, phonetic radicals are used to predict character pronunciations as early as the frist grade (Ho et al., 2003) or the second grade (Shu, Anderson, & Wu, 2000; Anderson, Li, Ku, Shu, & Wu, 2003), whereas awareness of sematic radiclas does not develop until the third grade (Ho et al., 2003; Shu & Anderson, 1997). Knowledge of phonetic radicals has been reported to be an important correlate of reading performance in Chinese (Ho et al., 2003). Chinese dyslexic children also use phonetic radicals in learning new characters (Ho, Chan, Tsang, Lee, & Chung, 2006). It seems exploring phonetic cues in characters is a natural and parsimonious solution in decoding written codes by connecting written codes with the corresponding phonological lexicon that has already been established before learning to read (Lee, Hung, & Tzeng, 2006; Share, 2004; Ziegler & Goswami, 2005). On the other hand, children may have to take a number of years to

understand semantic regularities. This is because cues encoded in semantic radicals are specific to the written script and knowledge of the cues is not a natural consequence of oral language development. For example, characters 茶(tea), 蒜 (garlic) and 花(flower) are radically related but not morphologically related according to the spoken language experience. Though morphological awareness may facilitate the discovery of the semantic relationship specifically encoded in orthography, this discovery can hardly be cultivated until one has learned a sufficient number of characters sharing the same radical.

The present study

The aforementioned studies have generated a consensus that young learners of Chinese have developed an implicit understanding of the functions of the component radicals of characters. The question remains as to which component will take precedence when the radicals give conflict information. Most studies investigated the function of the radicals along one dimension, either semantic or phonetic. Few explored the radicals with functional cues varying in both the semantic and the phoneic dimesions. One exception is a study of incidental learning conducted by Ku and Anderson (2001). In their study, target characters were embedded in a 1500-word text. They were characters with helpful semantic and phonetic radicals, characters with helpful semantic but irregular phonetic radicals, characters with unhelpful semantic but regular phonetic radicals, and characters with no helpful radicals. It was found that the Chinese fourth graders acquired characters incidentally from reading, but radical helpfulness and phonetic regularity did not contribute to character learning. According to the researchers, children had already known about 69% of the target characters, which might have rendered the interpretation of the results inconclusive. In addition, the strength of contextual support for meaning construction of the characters might have also complicated the interpretation of the results.

In the present study, a pseudocharacter choice task was developed to reveal which radical, the semantic or the phonetic, would take precedence in interpreting a character when the radical cues were in conflict. The child was asked to choose from three pseudocharacters the one that best represented a novel object described by the test giver. Each pseudocharacter was composed of a semantic radical that was either

relevant or irrelevant to the meaning of the object and a phonetic radical that either cued the pronunciation of the object or not. None of the characters had both the semantic and the phonetic radicals that were relevant to the object.

In addition, two learner varaibles were of interest. One was children's character reading ability and the other was morphological awareness. Reseach has shown hat character reading ability is associated with knowledge of phonetic radicals and semantic radicals (Ho et al., 2003; Ku & Anderson, 2001; Shu & Anderson, 1997). Theoretically, learners who know more characters should have better functional knowledge of component characters. The second learner variable, morphological awareness, refers to the sensitivity to the morphemic structure of words and emerges first through spoken language acquisition (Chung & Hu, 2007). Morphologial awareness is closely related to character and word acquisition in Chinese (Chung & Hu, 2007; Ku & Anderson, 2003; McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; McBride-Chang, Cho, Liu, Wagner, Shu, Zhou, Cheuk, & Nuse, 2005; Wang, Cheng, & Chen, 2006). It may be a precursor to the awareness of semantic radicals, because both refer to the senstivity to the morphemic structure of Chinese, only that the latter has to be cultivated during the process of leanring to read.

Method

Participants

The study was conducted in a large middle to upper middle class elementary school (about 2,100 students) in Taipei, Taiwan. A total of 106 third graders (58 boys, 48 girls) were recruited from five classes of this school for a three-year longitudinal study, which investigated various L1 linguistic abilities in relation to the development of morphological awareness in L1 and L2. The mean age of the participants was 8;9 (range 7;11 – 9;3) when they were first tested. Prior to the implementation of the study, informed, written consent was obtained from parents of all the children who participated. The participants in the study had no known language, emotional or physical problems as reported by classroom teachers. The pseudocharacter choice task took place at the second semester of Grade 4. The morphological awareness and the character recognition tests were administered one

year prior to and one year after the pseudocharacter choice task. The participant was tested individually in a quiet room of the school. Thirteen students left the school during the three years of the study, reducing the sample to 93 participants who completed all the measures in the present study.

Measures

Pseudocharacter choice. Fourteen sets of pseudocharacters were created. Each set consisted of three pseudocharacters, from which the child had to choose one that best represented a new invented object described by the test giver. Each pseudocharacter contained a phonetic radical and a semantic radical in their legal positions. In an unpublished study of the author, the phonetic and the semantic radicals had been tested on a group of fourth graders from another school in Taipei and the fourth graders were familiar with the radicals used in the present study. One of the pseudocharacters contained a semantic radical that cued the meaning of the object but a phonetic foil that bore no relationship to the name of the object. The second pseudocharacter contained a phonetic radical that cued the pronunciation of the object's name but a semantic foil that did not cue the meaning of the object. The third pseudocharacter was a distracter, which was composed of the phonetic foil of the first pseudocharacter and the semantic foil of the second pseudocharacter. Thus, the two components of the third pseudocharacter had neither the semantic cue nor the phonetic cue to the invented object. To control visual complexity across the three pseudocharacters in each set, the components of the characters in each set, i.e., the semantic radical, the phonetic radical, the semantic radical, and the phonetic foil, had the same number of strokes.

The semantic radicals that cued the meanings of the invented objects were given meanings that corresponded to the literal (rather than figurative) meanings of the radicals. The phonetic radicals that cued the pronunciations of the invented objects were given pronunciations that were predictable but varied in regularity: regular versus semi-regular. The phonetic regularity was a within-subjects factor. For each child, half of the phonologically relevant pseudocharacters had regular phonetic radicals; half had semi-regular phonetic radicals. The regularity of the phonetic radicals was counterbalanced across the pseudocharacters and counterbalancedly presented to the participants. See Appendix A for the

pseudocharacter stimuli.

The pseudocharacter choice task began with the presentation of a pictured invented object accompanied by three pseudocharacters listed horizontally below the picture. The test giver described the invented object by referring to its semantic category and labeled it by an invented name, using the model for *fen* as an example: "Here is a tree. This type of tree is called *fen*. Which of the three characters best represents the tree *fen*?" See Appendix B for sample presentation of the exemplar. The child had to determine which pseudocharacter was the best for the object just named. The order of the three types of pseudocharacters was counterbalanced. There was no prompt to directing the child's attention to either the semantic radical or the phonetic radical.

Morphological awareness. In the task, 20 scenarios were created and presented orally to the child. Each child was asked to invent appropriate new words for the new concepts based on the clue words given by the test giver. Half of the new words were constructed through the compounding process of Chinese; the other half through the derivational process. One example of the instruction for the invention of a new word is as follows: "When we want to have more *lu* (green) plants in our environment, we say we will *lu-hua* (green+ify) our environment. If we want to have more *xiang* (fragance) in our environment, what would we say we do to our environment?" The form *-hua* is a derivational suffix in Chinese, with which a verb form derives from an adjective. In this example, the child was expected to construct a new word *xiang-hua* based on the clue word *lu-hua*. An analogous example of English was to create a new word *fragrantify* based on the clue word *beautify*. The reliability coefficient of the task (Spearman-Brown) was .73.

Phonological Awareness. There were two tests of phonological awareness, oddity and deletion. In the oddity test, the child was asked to choose from a set of three words (e.g., *bi, ban, gou*) the word that sounds differently from the others (*gou*). There were 14 test trials. The trials differed in the type of the sounds the child had to contrast. Half of the 14 test trials required the child to contrast the stimulus words according to the initial consonants of the words. The other half of the 14 trials required the child to contrast the stimulus words according to the rimes of the words. In order to avoid the confounding effect from tone on the child's awareness of the structure of spoken words, the stimulus words in each trial had the same tones. The

position of the correct alternative was randomly determined and occurred with approximately equal frequency in all positions. The child was told that the test giver would read three words aloud. The child had to listen carefully to the beginning sound or the rime of each word (depending on which type of trial occurs) and choose the word that had a beginning sound or rime that was different from the others. The child was given similar instructions for each trial, following the model: "Say the words *bi, ban,* and *gou*". The child repeated the words. "One of them has a different beginning sound. Can you tell me which of these words has a different beginning sound -- *bi, ban,* or *gou*?" In the deletion test, the test giver read a disyllabic word twice (e.g., *shou-pa* 'handkerchief') and asked the child what was left if the initial consonant of the word was deleted. The initial consonant was read as its sound value rather than its corresponding *zhuyin fuhao* name. There were 10 trials (Max = 10). The scores on each of the phonological awareness tests were converted to proportional scores and averaged to form a composite score for each child. The reliability coefficient (Spearman-Brown) was .78 for the sound oddity test and .93 for the deletion test.

Chinese Character Recognition. The Chinese character recognition test is a standardized test developed by Huang (2004). There are 200 Chinese characters arranged from high to low frequency. Each child was required to read each character from high to low frequency till 20 errors were made consecutively. The test manual reports internal consistencies .99 and test-retest reliabilities from .81 to .95.

Results

Table 1 presents proportional scores in radical choices from the pseudocharacter choice task. As shown by Table 1, the fourth graders rarely chose pseudocharacters with irrelevant radicals for the invented objects, indicating that they had knowledge of the specific information about the relevance of the radicals used in the present study. The question was how they would weigh the relevant semantic and phonetic cues conveyed by the radicals when one cue was congruent with the invented object but the other was not.

Table 1 *Proportions in Radical Choices*

	Phonetic regularity					
	Regular		Semi-regular		Total	
Radical type	*M*	*SD*	*M*	*SD*	*M*	*SD*
Phonetic	.53	.37	.44	.37	.49	.36
Semantic	.46	.37	.55	.38	.50	.36
Irrelevant	.00	.02	.01	.04	.01	.02

To understand Chinese children's preferential use of radicals in interpreting new characters, the proportional scores in the choices for relevant radicals were analyzed by a 2 (regularity) x 2 (radical type) with both regularity and radical type as within-subjects factors. The proportional scores of choosing pseudocharacters with irrelevant radicals were not included in the analysis as they were negligible. There was no overall effect of radical type ($F(1, 92) = .04$, $p > .05$). The regularity effect was significant ($F(1, 92) = 4.68$, $p < .05$, $\eta^2 = .05$), which was qualified by a significant interaction effect between regularity and radical type ($F(1, 92) = 19.98$, $p > .001$, $\eta^2 = .18$). The interaction effect accounted for 18% of the variance in pseudocharacter choice. See Figure 1 for the interaction effect. As shown by Figure 1, the children demonstrated stronger preference for phonetic radicals when the phonetic radicals matched with the object names exactly than when the phonetic radicals matched with the object names partially ($t(92) = 4.59$, $p < .001$). In contrast, they showed stronger preference for semantic radicals when the phonetic radicals and the object names were related but not identical ($t(92) = 4.29$, $p < .001$).

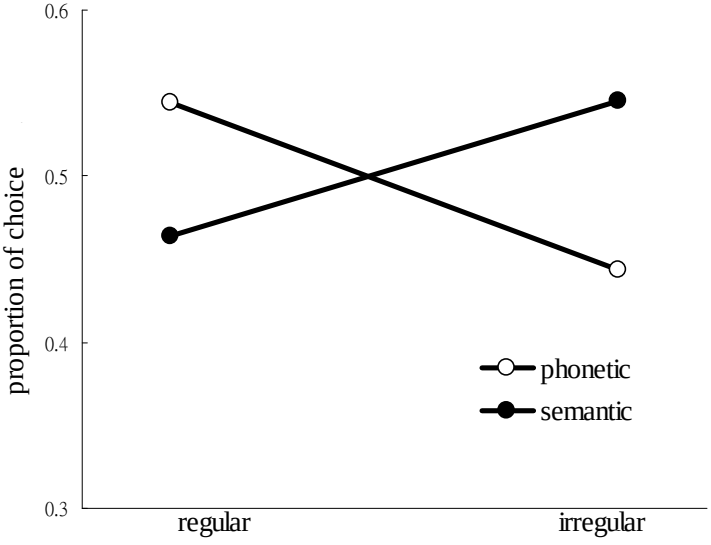

Figure 1 . The interaction effect between regularity and radical type

One interesting pattern of performance was noticed with the proceeding of the task. The children seemed to change their preferences in pseudocharacter choices. Many children put more weight on phonetic radicals for first several items but switched to semantic radicals for subsequent items, as shown by Figure 2. To test the effect of order, children' s performances in the first three items were compared to those in the last three items. The results of paired sample *t*-tests revealed that the proportion of choices of phonetic radicals in the first three items was significantly higher than that in the last three items ($t(92) = 2.48$, $p < .05$). In contrast, the proportion of semantic choices in the last three items was significantly higher than that in the first three items ($t(92) = 2.69$, $p < .01$).

To understand whether the preference for a certain type of radicals was related to character recognition or morphological awareness tested one year before and after the pseudocharacter choice task, correlational analyses were conducted. Neither the semantic choice nor the phonetic choice was related to any of the measures of character recognition or morphological awareness. We then computed the growth of character recognition and morphological awareness by subtracting children' s

scores obtained at the third grade from those at the fifth grade. The growth scores were then correlated with the radical choices. No significant correlations were identified. Finally, we calculated the differences between phonetic choices and semantic choices for each individual child. The differences were taken as an index of consistency in radical choices. No significant correlations were found between the consistency index and radical choices.

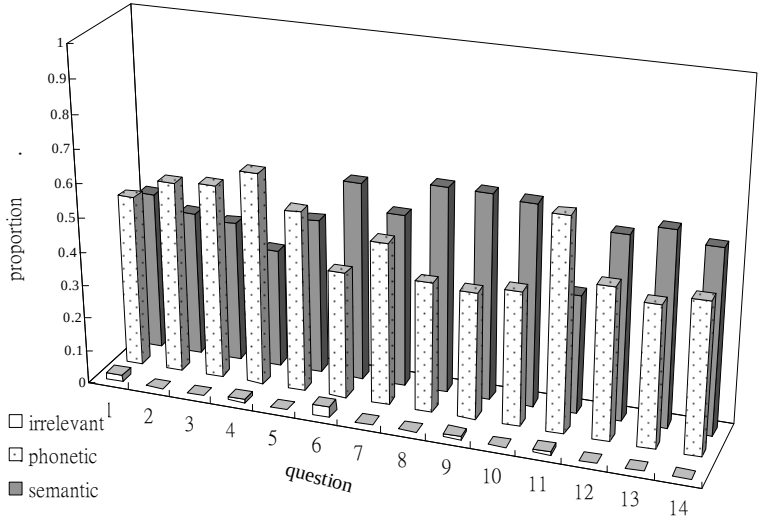

Figure 2. Proportions of radical choices across the 14 items

Discussion

This study investigated Chinese children's preferential use of phonetic versus semantic radicals in representing an invented object. Chinese fourth graders seemed to have developed an inventory of flexible and adaptive working hypotheses to interpret a new character. Overall, both semantic and phonetic radicals were utilized to the same extent, and no strong evidence of preference for a particular type of cues was found. This flexibility was reflected in the children's presumably strategic switch from giving more weight to phonetic radicals to giving more weight to semantic radicals during taking the pseudocharacter choice task. It appeared that the

fourth graders spontaneously attended to the phonetic information encoded in a new character to represent an invented object. An initial and quick attention to the phonetic cue of a written code is in accordance with the view that phonological recoding is a natural process of decoding a written code and the sine qua non for successful reading acquisition (Lee, Tsai et al., 2006; Share, 2004; Ziegler & Goswami, 2005).

One may argue that the children initially chose more phonetic cues than semantic cues because there are more phonetic radicals than semantic radicals in Chinese and many semantic cues are opaque and hard to distinguish from one another, as in 朋(radical 月) vs.脫(radical 肉). Though not impossible, this view can be challenged in several ways. First, the larger number of phonetic radicals over semantic radicals entails that a specific phonetic radical occurs less frequently than a specific semantic radical in a fixed set of running characters. In an analysis of Chinese characters explicitly taught in Chinese elementary school, Shu et al. showed that an average phonetic family (i.e., characters with the same phonetic radical) has 3.23 members, whereas an average semantic family (i.e., characters that share the same semantic radical) has 14.99 members. Second, although semantic radicals can be sometimes opaque, the cueing function of semantic radicals is stronger than that of phonetic radicals (Shu et al., 2003). Additionally, the most canonical meaning of the semantic radical was used to encode the invented object in the present study. In contrast, the canonical pronunciation of the phonetic radical did not always match with the name of the invented object. In the verbal description of the invented object, the participants heard the test-giver mention the semantic category of the invented object three times and the name twice. The name of the invented object was not made more salient than the semantic category of object in the verbal description. Thus, the initial preference for phonetic radicals was not attributable to the higher reliability of the phonetic function embedded in the pseudocharacters as well as in the normal encountering with the print.

The initial preference for the phonetic radical over the semantic radical supported the idea that children’s preference for phonetic radicals is a natural process of decoding a new character (Koda, 2007; Lee, Tsai et al., 2006; Share, 2004; Ziegler & Goswami, 2005). It appeared that only after several exposures to the stimuli did some children begin to notice the relevance of the semantic cues, then re-evaluate prior cue weighing, and assign more weight to the semantic cues. These

children probably came to realize that their initial choices were spontaneous, not based on sophisticated insight, and thus were not favored in the task. Alternatively, these children might have found that across the items, semantic cues were consistently canonical whereas phonetic cues varied in regularity.

The flexibility in utilizing varying cues in decoding written codes has been discussed in the *psycholinguistic grain size hypothesis* (Goswami, Ziegler, Dalton, & Schneider, 2003; Ziegler & Goswami, 2005). According to the hypothesis, children learning to read relatively inconsistent orthographies show considerable flexibility in making use of different unit sizes at which phonology is represented in orthography. This hypothesis has been verified in a study of Chinese readers, which found that Chinese first graders are able to use both the whole word unit and the component character in reading two-character words (Chu & Leung, 2005). The present results go beyond this earlier investigation by showing that Chinese children also use sub-character units in interpreting new characters. On top of that, the flexibility is not only revealed at different unit size of phonology but also at different functional dimensions. Many participants seemed to apply a mixture of phonetic and semantic decoding strategies to gather maximally relevant information for interpreting a new Chinese character.

In the present study, regularity of the phonetic radicals came to play a role in pseudocharacter choices. The children showed stronger tendency to choose a pseudocharacter with a relevant phonetic cue when the phonetic cue matched with the object name exactly. This result echoes the typical regularity effect in naming Chinese characters or pseudocharacters (e.g., Anderson et al., 2003; Ho & Bryant, 1997). A naming task makes it likely that children would explore phonetic cues that are not normally used in a non-naming task. The observation of the regularity effect in the non-naming task of the present study, in which children were provided useful phonetic as well as semantic information, further strengthened the view that exploring phonetic information in print is a natural process of learning to read (Lee, Hung, & Tzeng, 2006; Share, 2004; Ziegler & Goswami, 2005). The present study extended the findings of previous studies by showing that when the phonetic cue matched with the object name partially, children tended to choose a pseudocharacter with an informative semantic cue. Although children's preference of choice was affected by phonetic regularity, the proportion of choice for the phonetic radical with partial information was still substantial (.44). This result is in accordance with the

observation that children as young as second grade can make use of regular as well as irregular phonetic radicals to learn the pronunciations of novel characters (Anderson et al., 2003). Reduced regularity might have made the children more hesitant about choosing pseudocharacters with partial phonetic information over those with transparent semantic information, but it did not make the children completely override the information carried by the phonetic radical in honor of the semantic radical.

Children's preference given to the phonetic versus the semantic radical was not correlated with character recognition or morphological awareness measured one year before and after. On its face, the result seemed to be in conflict with previous findings that awareness of the radicals is associated with individual differences in character reading and sentence comprehension (Ho et al., 2003; Ku & Anderson, 2001; Shu & Anderson, 1997). However, the present study measured children's preference in choosing between semantic and phonetic radicals. The pseudocharacter choice task did not tap individual differences in the awareness of the radicals because two children could have the same radical knowledge but nonetheless chose different pseudocharacters. In addition, the radicals used in the present study were presumably the ones that were familiar to the participants of this age, as evidenced by the almost negligible choices of irrelevant pseudocharacters. The irrelevant pseudocharacters were constructed with a legal phonetic radical and a legal semantic radical in their legal positions, so they were legal pseudocharacters but the functional cues were irrelevant for the object names. Avoidance of the irrelevant cues indicated that the children had knowledge of the relevance of the functional cues rather than just the legality of the pseudocharacters. Thus, the nil correlations between preferences in pseudocharacter choice and character recognition or morphological awareness were not attributable to their lack of knowledge of the relevant cues. The results of the correlational analyses did not support the prevailing notion that only poorer readers tended to utilize primitive phonetic cues, as there was no significant correlation between cue choices and character recognition.

In summary, the results of the study indicate that Chinese fourth graders have developed an inventory of working hypotheses in interpreting new characters that are flexible and adaptive to the task demands irrespective of individual differences in character recognition and morphological awareness. Phonetic recoding seems to

be a natural decoding process and spontaneously used by young Chinese readers. Contrary to the prevailing notion, it is not a strategy exclusively used by poor readers. The teacher may reconsider how to deal with the phonetic overgeneralization errors and make them conducive to learning, as sensitivity to the internal structure of existing words, new words, and possible words may distinguish poor and good readers (Leong & Ho, 2008). Specially, the teacher may consider capitalizing on children's natural tendency to explore phonetic information in print via directing young learner's attention to the phonetic cues in the characters as well as the similarity or the alternation regularity in the pronunciations between the phonetic radical and the character. If children were able to make efficient use of phonetic cues early in learning to read, they would be able to predict the pronunciations of unfamiliar characters or words (Chan & Siegel, 2001; Shu et al., 2003; Shu et al., 2000) and develop a self-teaching ability by accessing the oral lexicon through phonological codes (Share, 2004). Given the exploratory nature of the present study, the frequency of the radicals was not controlled, though the participants were shown to be familiar with the radicals. Ideally, to obtain a comprehensive picture about how phonetic and the semantic radicals are weighed by developing learners, future study should control the frequency and familiarity of the radicals in pseudocharacters to the children. In addition, future studies can manipulate transparency of semantic radicals to see how semantic transparency interacts with phonetic regularity.

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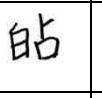
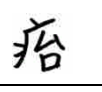
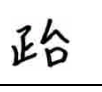
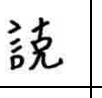
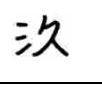
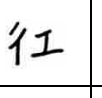
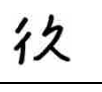
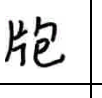
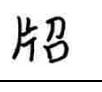
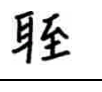
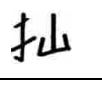
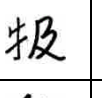
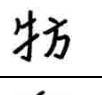
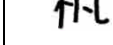
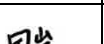
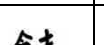
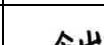
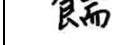
Appendix A

Stimuli for the pseudocharacter choice task

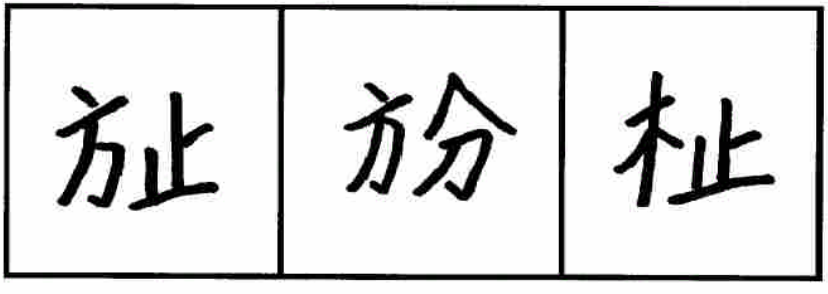
Semantic radicals			Phonetic radicals			Pseudocharacters		
	meaning			Regular	Semi-regular	S	P	I
衤	clothing		占	zhan	chan			
木	tree		分	fen	pen			
虫	insect		光	guang	kuang			
疒	illness		朱	zhu	chu			
足	foot		見	jian	qian			
氵	water		工	gong	kong			
目	eye		包	bao	pao			
舟	boat		交	jiao	qiao			
扌	hand		千	qian	jian			
火	fire		及	ji	qi			
++	grass		巴	ba	pa			

犭	dog		叉	cha	zha			
風	wind		表	biao	paio			
石	rock		申	shen	chen			

S = pseudocharacters with helpful semantic radicals; P = pseudocharacters with helpful phonetic radicals; I = pseudocharacters with irrelevant radicals

Appendix B

Sample presentation



Chinese Children's Preferential Use of Sublexical Cuesin Interpreting Chinese Characters

Chieh-Fang Hu*

Scholars have noted that Chinese children use sublexical cues in decoding a Chinese character when the cues convey information that is congruent with the character. However, it is not clear how Chinese children weigh sublexical cues differentially when the cues convey relevant but incongruent information. Ninety-three Chinese fourth graders took a pseudocharacter choice task, in which they chose from three pseudocharacters the one that best represented an invented object with a novel name. Each pseudocharacter was composed of a semantic radical and a phonetic radical. In two pseudocharacters, one radical conveyed relevant information and the other incongruent. In the third, both radicals were irrelevant. Overall, the fourth graders chose only the characters with relevant radicals, but they did not show preference in overriding one relevant radical in honor of the other. Their choice of pseudocharacters was affected by task factors, i.e., phonetic regularity and order of presentation, but not predicted by learner characteristics, i.e., character reading ability and morphological awareness. The results indicate that Chinese fourth graders have developed an inventory of working hypotheses in interpreting new characters, and that their preferences for radicals are quite flexible and adaptive in attuning to the nature of the task irrespective of character reading ability and morphological awareness.

Keywords: phonetic radical, semantic radical, Chinese character reading, morphological awareness

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