The Simple Advantage in Categorical Generalization of Chinese Characters

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Abstract

Research in relational learning suggests that simple training instances may lead to better generalization than complex training instances. We examined whether this "simple advantage" extends to category learning in adults with simplified and traditional (more complex) Chinese writing scripts. In Experiment 1, participants learned Chinese characters and their English translations, performed a memorization test, and were asked to generalize their learning to the corresponding characters written in the other script. In Experiment 2, we removed the training phase and modified the tests to examine transfer based purely on perceptual similarities between simplified and traditional characters. We found the simple advantage in both experiments. Training with simplified characters produced better generalization than training with traditional characters, both when generalization relied on recognition memory and on pure perceptual similarities. This finding advances our understanding of how features of a learning opportunity interact with domain-general learning mechanisms to prepare the mind for transfer.

Keywords: categorization; generalization; transfer; memory; learning; similarity; features

Introduction

We can remember all kinds of details about our experiences in the world but our visual systems have the capacity to ignore all kinds of details as well. Categorization relies on dual processes: attending to similarities while simultaneously ignoring differences. Efficient generalization minimizes the necessary experience with learning instances (e.g., number of learning instances needed or time spent learning) and maximizes appropriate generalization.

Simple instances have been shown to engender rapid learning with selective attention to the right information for the task. Novices briefly trained with simple line drawings of diagnostic features were able to classify chicks with the accuracy of expert chicken sexers (Biederman & Shiffrar, 1987). Young children who were taught category labels with simple objects were more successful at generalizing to novel category members than when they were shown more complex learning objects (Son, Smith, & Goldstone, 2008). We refer to this asymmetry of transfer from simple versus complex training instances as *the simple advantage*.

Most of the research demonstrating the simple advantage have examined learning and transfer of relational concepts in mathematics (Kaminski, Sloutsky, & Heckler, 2008; Sloutsky, Kaminski, & Heckler, 2005; McNeil, Uttal, Jarvin, & Sternberg, 2009) and science (Goldstone & Sakamoto, 2003; Goldstone & Son, 2005). In these relational domains, in order to generalize learning to a new situation, one must pay more attention to structural information rather than superficial details that may differ across instances. Simple learning instances can facilitate such structural extraction by limiting the extraneous details and guiding attention to the right features.

Little is known, however, about whether this simple advantage can also support category generalization, particularly in adults. Although young children are better able to generalize category labels by learning from simplified exemplars (Son, Smith, & Goldstone, 2008), one might argue that simple learning instances do not benefit adults who are already experts in category learning (relative to infants).

The other side of the argument suggests that the mechanisms underlying infant and adult categorization might not differ significantly (Gureckis & Love, 2004). For example, research has shown that categorization behavior in infants and adults agree on the basic level (Horton & Markman, 1980), that infants tend to extract the same prototypes and make the same kind of inferences from category knowledge that adults do (Mervis & Crisafi, 1980; Baldwin, Markman, & Melartin, 1993). One exciting possibility is that infants and adults have the same basic categorization generalization "hardware" and only differ in their level of knowledge of the domain. This has been argued for in the analogy literature (e.g., Kotovsky & Gentner, 1996). To explore this possibility, we train and test English-speaking adults in a novel domain that contains complex and simple corresponding forms: Chinese character scripts.

For a number of political and historical reasons, the traditional Chinese writing system was simplified in 1949. The simplified characters have approximately 22.5% fewer strokes than the more complex traditional script (Gao & Kao, 2002). Several different simplification processes were employed; some based on Chinese history and meaning while others were straightforward perceptual simplifications. As a result, many characters and their components (recurring groups of strokes that make up the characters) took on quite different look (Harbaugh, 2003). Whether these differences between scripts affect the learnability of characters is the subject of ongoing debate amongst researchers who study Chinese language acquisition (see Chen & Yuen, 1991; McBride-Chang et al., 2005; Seybolt & Chiang, 1979). However, there has been little research to examine these differences partially due to complicated issues of aesthetics, history, politics, and tradition. This endeavor, primarily motivated by issues in cognition and learning, may shed light on this debate.

For the purpose of examining the simple advantage in categorization, these rich sets of naturally occurring simple and complex corresponding entities provides an ideally suited domain. As non-Chinese readers lack prior associations with these stimuli, differences in generalization between the scripts may be attributable to differences in the stimuli.

Purpose of Current Work

Two studies examined the simple advantage in adults' category generalization with simplified and complex Chinese characters. Does learning with simplified instances lead to greater category generalization than training with complex forms? Secondly, does this simple advantage occur even with minimal prior exposure to simplified forms?

Experiment 1

Participants were asked to study flashcards with a Chinese character on one side and an English definition on the other side. After each set, memorization was measured with a match-to-sample task in which students were briefly shown the English definition and had to pick out the matching character out of four answer choices. After the memory test, generalization was measured by the same matching task, except that participants had to match the definitions with characters of the unlearned script. In the Traditional-first condition, participants studied Traditional characters and their English definitions. The Traditional-first memory test involved Traditional characters while the generalization test replaced those choices with corresponding Simplified characters. In the Simple-first condition, participants studied and had a memory test with Simplified characters, but their generalization test had Traditional versions of the learned characters. If simplified learning instances promote generalization, then participants would show better generalization in the Simple-first than in the Traditional-first condition.

Method

Participants and Design 14 undergraduates (7 females and 7 males) participated for course credit. All reported to having no prior experience with Chinese characters. In this within-subject experiment, half of the participants experienced the Traditional-first condition (learning, memory test, generalization test) before the Simple-first condition while the other half experienced the two conditions in the reverse order.

Materials and Procedures Although there are historical or semantic reasons behind some types of simplification, the subset of characters chosen for this study are perceptually simplified forms of their traditional counterparts. In each pair of characters, up to two components (stroke groups called radicals) of the Traditional characters were omitted to produce their simplified version. Thus, Simplified characters had fewer strokes as well as fewer components. The Simplified characters used had 3-13 strokes per character (average 7.23 strokes), and their Traditional version had 8-22 strokes per character (average 14.06 strokes). There were 4 sets of 12 unique character pairs but each participant only studied two of these sets in either the Simplified or Traditional script. The number of omitted strokes, the number of omitted components, the location of the omitted components within each character, and the usage frequency were balanced across the character sets.

In the training phase, each participant received a randomly assigned set of 12 flashcards of either Traditional or Simplified characters according to their assigned condition. Each character was printed in black 36 pt SimSun (宋体) font and the English words were printed in black with 24 pt Calibri font. Participants were told to study the Chinese-English pairs, and that they would be tested on them later. They were not given a time limit for studying and most finished within 15 minutes.

Once participants handed in the flashcards, they were administered the memory and generalization tests on a computer using E-Prime 2.0 (Psychology Software Tools, Inc., Sharpsburg, PA, USA). For both tests, there were 12 trials, one for each of the 12 characters in the training set. A trial began with a fixation cross lasting for 0.5 seconds, followed by an English word for 2 seconds, then 4 Chinese characters. The distractor characters were randomly chosen from the set of trained characters. The inter-trial interval was 1 second. The order of the trials was random across participants. No feedback was provided after each trial, but average accuracy and response time were given at the end of each task. *Figure 1* shows a sample trial and procedure.

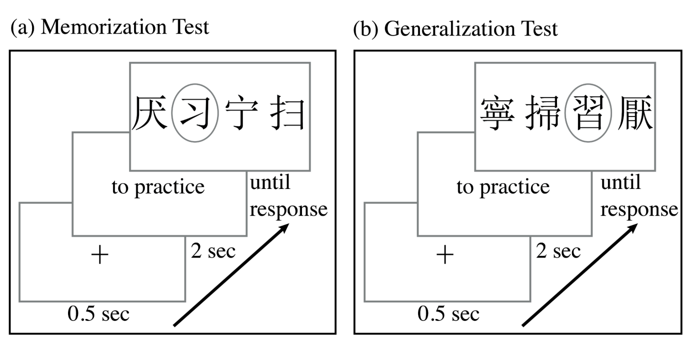

Figure 1: (a) Exact match test procedure and (b) Generalization test procedure of the Simple-first condition in Experiment 1.

In the memory test, participants chose from Chinese characters identical to those in their training set. The generalization task was set up identically to the memorization task, except that the answer choices in this task were characters written in the unlearned script. Before the generalization trials, these instructions appeared, "There are two types of scripts in the Chinese written language, Traditional and Simplified. You have just studied characters written in one of these two scripts, and now we would like to see how well you can recognize the same characters written in the other script."

Participants were given a 5-minute break before they were given another set of 12 flashcards with characters written in the other script. The entire procedure was repeated for the second set of characters.

Results and Discussion

Proportion correct and average response time data for correct responses are presented in *Figures 2* and *3* (see left panels).

Preliminary analyses There were no significant differences among the four sets of characters (*ps* > .10) and no effect of condition order (*ps* > .10), so accuracies and response times for each condition were collapsed across those variables.

Memorization and Transfer Results We conducted two 2 x 2 (condition x test type) repeated-measures analysis of variance (ANOVA) for accuracy and reaction time.

Accuracy. There was a main effect of test. Performance on memory test (M = .99, SD = .03) was better than generalization (M = .86, SD = .10), $F(1,12) = 26.89$, $p <$ 0.001, η^2 = .69. There was a main effect of condition, $F(1,12)$ = 8.98, p <.05, η^2 = .43, and a significant interaction, $F(1,12) = 9.04$, $p < .05$, $\eta^2 = .43$. Post-hoc *t*-tests confirmed that although the two conditions exhibited similar memory performance, the Simple-first condition generalized more accurately than the Traditional-first condition. Participants in both Traditional-first (M = .99, SD = .03) and Simple-first (M = .98, SD = .04) conditions successfully learned the word pairs and recognized them equally well, $t(12)$ = 1.00, p = .34. Generalization accuracy was significantly higher in the Simple-first condition (M = .91, SD = .06) than in the Traditional-first condition (M = .80, SD = .14), $t(12)$ = 3.045, p < .025, with Bonferroni correction. As predicted, participants who initially learned Simplified characters generalized their learning to the transfer script better than those who learned Traditional characters.

Response Times for Correct Trials (given in seconds per trial). Participants were faster on the memorization trials (M = 2.71, SD = .92) than generalization (M = 5.54, SD = 2.15), $F(1,12) = 46.25$, $p = .00$, η^2 = .79. Those in the Simple-first condition (M = 3.87, SD = 1.40) were generally faster than those in Traditional-first condition (M = 4.38, SD = 1.67), $F(1,12) = 5.24$, $p < .05$, η^2 = .30. Thus, when participants were trained with Simplified script, they tended to make more correct matches on both tests and did so faster than those who were trained with Traditional script. There was no significant interaction between condition and test type, $F(1,12) = 1.69$, $p = .22$.

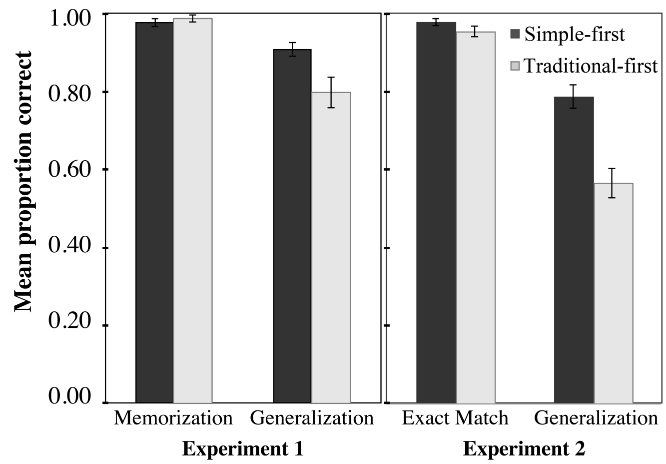

Figure 2: Accuracy data from the memorization and generalization tests in Experiment 1 (left panel) and from the exact match and generalization tests in Experiment 2 (right panel). (Error bars: ± 1 SE)

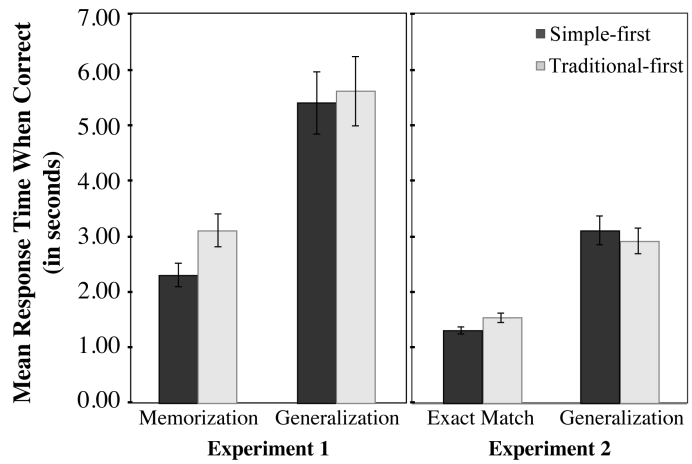

Figure 3: Response time data of accurate responses from the memorization and generalization tests in Experiment 1 (left panel) and from the exact match and generalization tests in Experiment 2 (right panel). ((Error bars: ± 1 SE)

In summary, when trained with Simplified characters, participants were both faster and more accurate than when trained with Traditional characters. More importantly, even though Simplified and Traditional characters were remembered equally well, Simplified training exemplars led to better generalization than Traditional ones. However, the simple advantage may be dependent on the amount of exposure to the learning instance. In Experiment 2, we ask whether training with Simplified characters is more efficient than training with Traditional characters even without extended training experience.

Experiment 2

To extend the findings of Experiment 1, we removed the training phase and modified the memorization and generalization tests to examine matches based purely on perceptual similarity. If simplicity promotes transfer by containing only the relevant perceptual features, then the simple advantage should persist even when generalization relies only on perceptual similarities between simplified and traditional characters.

Method

Participants and Design 23 undergraduates (10 males, 13 females) who reported having no knowledge of Chinese characters participated for course credit. Experiment 2 was also a within-subject design so order was counterbalanced across participants. Twelve were randomly assigned to participate in the Traditional-first condition before the Simple-first condition, and the other 11 participated in the Simple-first condition before the Traditional-first condition.

Materials and Procedures The stimuli and procedures were nearly identical to Experiment 1. The key difference in Experiment 2 was the lack of a training phase thus participants never connected any of the characters to English meanings. Each trial began with a fixation cross, followed by a Chinese character for 2 seconds, and 4 answer choices. In exact match trials, participants matched characters to identical characters. On the generalization task, participants were shown a character in one script and had to choose the match among characters written in the other script. A sample trial and procedure are shown in *Figure 4*.

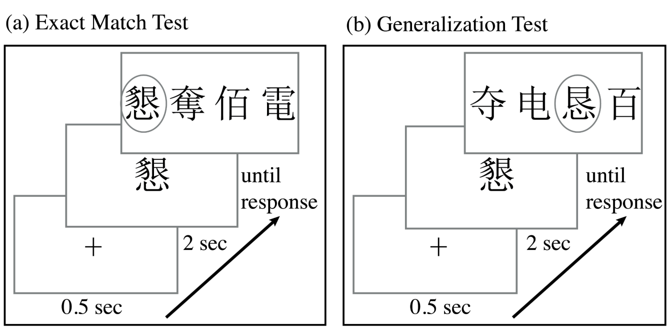

Figure 4: (a) Exact match test procedure and (b) Generalization test procedure of the Traditional-first condition in Experiment 2.

Results

Preliminary analyses Like Experiment 1, there was no effect of character set nor condition order (*ps* > .10) so the data were collapsed across those variables.

Exact match and generalization test results Average proportion correct and average response time results are presented in Figures 2 and 3 (right panels). Again, we conducted two 2 x 2 (condition x test type) repeated-measures analysis of variance (ANOVA) for accuracy and reaction time.

Accuracy. Results were consistent with findings from Experiment 1. There was a main effect of test such that participants made significantly more correct responses on the exact matching task (M = .97, SD = .05) than on the generalization task (M = .68, SD = .14), $F(1,22) = 129.72$, $p < .001$, $\eta^2 = .86$. There was also a main effect of condition, $F(1,22) = 33.42$, $p < .001$, $\eta^2 = .60$, and a significant interaction, $F(1,22) = 12.33$, $p < .01$, $\eta^2 = .36$. Post-hoc analyses confirmed that this difference was driven by the differential effect of the sample script on generalization. Follow-up pairwise *t*-tests showed no significant difference between the Simplified or Traditional exact match-to-sample task, $t(22) = 1.32$, $p = .20$. However, the Simple-first condition produced significantly better generalization performance (M = .79, SD = .14) than the Traditional-first condition (M = .57, SD = .18), $t(22) = 4.83$, $p < .001$, with Bonferroni correction. Again, as in Experiment 1, training with Simplified characters promoted greater generalization to Traditional characters than vice versa.

Response Times for Correct Trials (given in seconds per trial). There was a main effect of test type, $F(1,22) = 59.46$, $p < .001$, $\eta^2 = .73$, such that participants were faster in the Simple-first condition than in the Traditional-first condition. There was a significant interaction, $F(1,22) = 5.70$, $p < .05$, $\eta^2 = .21$, that suggested that although the Simple-first condition was faster than the Traditional-first condition in the exact-matching task, RTs in the generalization task were similar. Bonferroni-corrected pairwise *t*-tests confirmed a significant difference in RTs for the exact matching task for accurate responses between the Simple-first and Traditional-first condition, $t(22) = 3.91$, $p < .01$, and showed no significant difference conditions on generalization, $t(22) = 1.05$, $p = .21$.

While there was no difference in accuracy on the exact matching trials, Traditional characters required more time per correct response than Simplified characters (1.55 seconds vs. 1.32 seconds). This result is interesting in light of classic experiments and theories of similarity.

Similar to Podgorny and Garner's (1979) classic work that demonstrated participants judge the similarity of two Ss on a screen faster than two Ws, we also find that some Chinese characters are self-identified faster than others. Tversky's feature-based contrast model of similarity (1977) suggests that complex objects that share a greater number of overlapping features are more self-similar than simple objects. Traditional characters contain more strokes so one might assume that they should be more self-similar and should result in shorter RTs in our exact match task. However, it is important to keep in mind that the distractors in the field were also complex. These complex characters may be more similar to each other thus forcing participants to spend more time to distinguish the target among them.

General Discussion and Conclusion

We examined the simple advantage for generalization between simple and complex Chinese scripts. In Experiment 1, participants studied the characters and their English translations before attempting to generalize their learning to the same characters of the unlearned script. In Experiment 2, participants had only brief controlled exposure to the characters before undergoing the generalization test. In both experiments, there was a generalization advantage when the initially shown exemplar was simple.

Contrasting the results of these studies, generalization performance in Experiment 1 was more accurate yet slower than Experiment 2. This pattern is reasonable given the differences in the tasks across experiments. Those in Experiment 1 had to recall the characters from memory when given their English definitions whereas those in Experiment 2 saw exemplar characters immediately before making their choice. Taking more time to recall the trained characters may have helped participants in Experiment 1 generalize more accurately. A longer reaction time is probably less effective when generalization was more purely perceptual.

In the following sub-sections, we will discuss the theoretical and educational implications of these findings.

Theoretical Implications

These findings are consistent with results of past research on generalization by shape with young children (e.g., Son et al., 2008): simple instances promote better category generalization. Why are these instances advantageous for transfer? Simple training instances may allow for efficient encoding of the right initial features and/or retrieval of useful representations. Learning from complex characters may be detrimental just by having additional non-diagnostic features that are not present in novel transfer cases. Furthermore, complex instances may generally require greater attentional resources to learn and use.

Adults seem to face similar difficulties in categorization learning as children - that potentially useful and distracting features may not be psychologically separable at the time of learning (Schyns & Rodet, 1997). Being exposed to a simplified version first may have enabled our adult learners to recognize the complex character as containing the simple character along with other new features. Initial learning with a complex stimulus does not provide a decomposed perceptual vocabulary and thus the learner might miss the shared components between the complex and simple stimuli.

Additionally, this work raises more issues regarding the relationship between similarity, recognition memory, and category generalization. If recognition memory or category generalization is taken as a measure of similarity, this set of results provides further evidence for the asymmetry of similarity. There is an accuracy and/or RT asymmetry between the initially viewed exemplar and the potential matches such that performance is aided by an initially simple exemplar. Furthermore, this work raises the possibility that similarity judgments based on immediately seen features may operate differently than when based on features retrieved from exemplars in memory.

Practical Implications

If the end goal of education is generalization, the simple advantage appears to have broad implications. Even though generalization would likely occur with enough time and resources devoted to training with many complex, detailed instances (e.g., Kellman, Massey & Son, 2010), the present research suggests that simple training instances may be able to foster generalization more efficiently. Although previous research has directly examined the simple advantage with math and science domains, this research suggests that simple learning instances might also be useful in learning categories in general.

More directly, these results bear on the cognitive role of scripts in Chinese reading. Broadly speaking, there are no measurable differences in reading or spelling between the two scripts (Chan & Wang, 2003). A few studies suggest that learning to read with simplified characters is more related to visual skills than learning to read traditional characters (Chen & Yuen, 1991; McBride-Chang et al., 2005). Young children learning to read in mainland China (using simplified script) were more likely to base similarity judgments of characters based on visual characteristics than children from Hong Kong (primarily taught with traditional script) (Chen & Yuen, 1991). Although further research is necessary to determine whether learning a few characters in a lab setting is similar to learning hundreds of characters to gain literacy, our findings suggest that there might be a benefit of starting with simplified characters. Particularly if the goal is to read both scripts, learning the simplified script may be more helpful for learning the traditional script than the reverse.

Simplified characters contain fewer but more diagnostic components (radicals) so it may be advantageous to treat these recurring radicals as basic orthographic units. Perhaps an emphasis on explicitly learning these units early on may foster better generalization to full blown characters. Research on Chinese literacy (e.g., Tsai & Nunes, 2003) shows that expert readers are generally quite sensitive to these components. Whether such pedagogical practice supports future learning of new Chinese characters is a question for future research.

However, the relevance of these findings for Chinese literacy is limited in two significant ways. First, the characters used in these studies were only simplified via the component omission process. Future research should incorporate character sets created through other simplification methods such as replacing a complex component (e.g., four dashes) with a simpler one (e.g., a line) to draw broader conclusions about the simple advantage for Chinese reading. Second, reading is more than merely identifying or recognizing characters. Traditional characters include cues to pronunciation and meaning that have been removed in simplified characters.

These cues may be equally or even more important to full fledged reading than ease of recognition.

Conclusions

The simple advantage seems to be stable across a variety of tasks and domains, from categorization and object recognition to more complex forms of formal learning. This suggests that this effect stems from domain-general learning mechanisms that bridge or incorporate both perceptual and conceptual learning. In some sense, all learning situations are ill-constrained because a novice does not know which information is relevant or irrelevant. Simplicity supports learning by getting at the heart of this problem: the few features that are presented are all relevant.

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References

Baldwin, D. A., Markman, E., & Melartin, R. L. (1993). Infants' ability to draw inferences about nonobvious object properties: Evidence from exploratory play. *Child Development, 64,* 711-728.

Biederman, I., & Shiffrar, M. (1987). Sexing day-old chicks: A case study and expert systems analysis of a difficult perceptual learning task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*, 640-645.

Chan, L., & Wang, L. (2003). Linguistic awareness in learning to read Chinese: A comparative study of Beijing and Hong Kong children. In C. McBride-Chang & H.-C. Chen (Eds.), *Reading development in Chinese children* (pp. 91–106). Westport, CT: Praeger Press.

Chen, M. J., & Yuen, J. C.-K. (1991). Effects of pinyin and script type on verbal pro- cessing: Comparisons of China, Taiwan, and Hong Kong experience. *International Journal of Behavioral Development, 14,* 429-448.

Gao, D.-G., & Kao, H. S. R. (2002*).* Psycho-geometric analysis of commonly used Chinese characters. In H. S. R. Kao, C.-K. Leong, & D.-G. Gao (Eds.), *Cognitive neuroscience studies of the Chinese language* (pp. 195–206). Hong Kong: Hong Kong University Press.

Goldstone, R.L., & Sakamoto, Y. (2003). The transfer of abstract principles governing complex adaptive systems. *Cognitive Psychology, 46*, 414-466.

Goldstone, R.L., & Son, J.Y. (2005). The transfer of scientific principles using concrete and idealized simulations. *Journal of the Learning Sciences, 14*, 69-114.

Gureckis, T. M. & Love, B. C. (2004). Common mechanisms in infant and adult category learning. *Infancy, 5*(2), 173-198.

Harbaugh, R. (2003). *Chinese characters and culture*. Retrieved from http://www. zhongwen. com.

Horton, M. & Markman, E. (1980). Developmental differences in the acquisition of basic and superordinate categories. *Child Development, 51,* 708-719.

Kaminski, J. A., Sloutsky, V. M., & Heckler, A. F. (2008). The advantage of abstract examples in learning math. *Science, 320*, 454–455.

Kellman, P.J., Massey, C.M & Son, J. (2010). Perceptual learning modules in mathematics: Enhancing students' pattern recognition, structure extraction, and fluency. *Topics in Cognitive Science, 2*(2), 285-305.

Kotovsky, L. & Gentner, D. (1996). Comparison and categorization in the development of relational similarity. *Child Development, 67,* 2797-2822.

McBride-Chang, C., Chow, B.W.Y., Zhong, Y., Burgess, S., & Hayward, W. G. (2005). Chinese character acquisition and visual skills in two Chinese scripts. *Reading and Writing, 28*, 99-128.

McNeil, N. M., Uttal, D. H., Jarvin, L., & Sternberg, R. J. (2008). Should you show me the money? Concrete objects both hurt and help performance on mathematics problems. *Learning and Instruction, 19*, 171–184

Mervis, C. & Crisafi, M. (1980). Acquisition of basic object categories. *Cognitive Psychology, 12,* 496-522.

Podgorny, P., & Garner, W. (1979). Reaction time as a measure of inter- and intraobject visual similarity: Letters of the alphabet. *Perception & Psychophysics*, 26, 37-52.

Schyns, P.G., & Rodet, L. (1997). Categorization creates functional features. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 681-696.

Seybolt, P. J., & Chiang, G.K.-K. (1979). Introduction. In P. J. Seybolt & G. K.-K. Chiang (Eds.), *Language reform in China: Documents and Commentary* (pp. 1–10). White Plains, NY: M.E. Sharpe.

Shu, H., Chen, X., Anderson, R.C., Wu, N., & Yue, X. (2003). Properties of School Chinese: Implications for Learning to Read. *Child Development, 74*, 27–47.

Sloutsky, V.M., Kaminski, J.A., & Heckler, A.F. (2005). The advantage of simple symbols for learning and transfer. *Psychonomic Bulletin & Review, 12*, 508-513.

Son, J. Y., Smith, L. B., & Goldstone, R. L. (2008). Simplicity and generalization: Short-cutting abstraction in children's object categorizations. *Cognition, 108,* 626-638.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*, 257–285.

Tsai, K.-C., & Nunes, T. (2003). The role of character schema in learning novel Chinese characters. In C. McBride-Chang & H.-C. Chen (Eds.), *Reading development in Chinese children* (pp. l09–125). Westport, CT: Praeger Press.

Tversky, A. (1977). Features of similarity. *Psychological Review, 84* (4), 327–352.