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How Semantic Radical in Chinese Language Facilitated Inductive Reasoning

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Abstract. Sixteen healthy undergraduate students were employed to explore how semantic radical in Chinese language facilitated inductive reasoning. Pseduo Chinese characters were employed as experiment material, have of them with right orthography and half were wrong. Participants were asked to do the inductive resoning tasks based on these pseduo characters. The result showed that: semantic radical, be it physical or semantic features, facilitated the inductive inference and such facilitation was closely related to the processes of semantic radical as lexical information was accessed early than that of conceptual information. Furthermore, semantic radical facilitated the inductive inference independently without the access to the meaning of a certain character.

Keywords: Semantic Radical, Chinese Language, Inductive Reasoning.

1. Introduction

Chinese is a logographic language, the most widely used Chinese characters are pictophmetic characters, which are composed of semantic radical and phonetic radical. Semantic radical representing its meaning and category information and phonetic radical representing its pronunciation. In this case, for a pictophmetic character, the category information was clearly shown in its semantic radical. Additionally, nearly 80% Chinese characters were pictophmetic characters. Unlike syllable languages like English, category of Chinese pictophmetic characters can be accessed without knowing its actual meaning or pronunciation. As the beginning examples showed that, Chinese students can easily judge the word zinc as a metal object without knowing any feature of zinc itself simply by the Chinese character "锌". A study of Chinese characters revealed that the representation of a radical at radical level and the representation of that radical at character level are reciprocally linked[1]. Semantic radical can not only be represented in lexical level, but also can be independently accessed to conceptual level[2]. Generally, a skilled reader developed word representation that included strong interconnections among three lexical constituents, i.e., orthography, phonology, and semantics (Perfetti, Liu, & Tan, 2005), when the characters contained a semantic radical, it showed processing bias, semantic radicals correctly pertaining to character meaning facilitated reaction time in semantic categorization task, and semantic path seemed to be the default means of character recognition[3] . Previous study also showed that hatever a character or compound word is, as long as it follows a semantic radical, it will facilitate classification task [4].

In summary, linguistic information was more closely related to superordinate level concept processing. Category information contained by semantic radical may facilitate the superordinate level inference. Meanwhile, semantic radical can access to concept level information independently, therefore, the facilitation of semantic radical can work without decoding the whole character. In order to exam the two hypotheses above, we employed two tasks: inductive inference task and pseudo characters inference task. For inductive inference task, we use the subordinate level concept as premise, and the result could be the subordinate, basic and superordinate level concept; for pseudo characters inference task, we use pseudo characters as material, which contained semantic radical, but cannot access the mean of the character. As semantic radical recognition was influenced by orthography [5], thus the pseudo characters was further divided into orthographic right and orthographic wrong group. And event-related potentials technique was employed to obtain further electrophysiological evidence.

2. Method

2.1 Participants

Sixteen healthy undergraduate students participated in the study with five men and eleven women. All participants (age range: 19-24 years), both in pilot and formal study, were right-handed with normal or corrected-to-normal vision, and had no brain injury and mental illness. They had not taken part in similar experiments before, and they all received reimbursement for their participation after the experiment.

2.2 Materials

Pseudo characters were chosen and made by experimenters. Pseudo characters contain orthographically correct and orthographically wrong conditions.

Semantic-plus-phonetic characters are constituted by phonetic and semantic radical, aiming at further affirming that the accessed meaning of inference is conducted by semantic radical rather than phonetic radical. This article examines participants who used semantic radical to get semantic access of inference or only depended on similarity of inference. If the participants infer from the similarity, there might be no difference between phonetic and semantic radical in the semantic accesses,

2.3 Design and Procedure

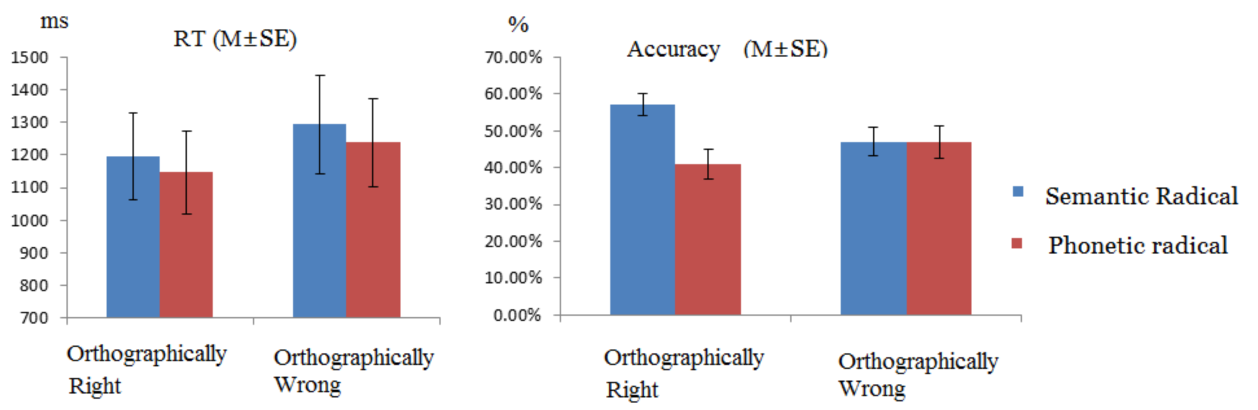
This experiment has two independent variables, between them, one is radical, which has two levels (phonetic radical and semantic radical) the character pair for one trail either with the same semantic radical or the same phonetic radical. The other is orthography, which also has two levels (orthographically right and orthographically wrong). The experiment instruction was presented in Chinese which literally read, you will see a fixation cross '+' in the screen center, subsequently, you will see a name of an Alien object. And then a capital, for example 'X', was presented in the center of the screen. The capital means that the premise object has the characteristics of X, and the X is on behalf of the character. After the capital you will see another object's name, your task is to judge how likely it is that the later object possesses a feature of X. If you consider the later object has more possibility of a feature X, press the button 1, if has less possibility, press the button 5. If you understand instructions, press any key to precede the experiment. Before the formal study, there is a practice. After the practice, if you still have any questions about the experimental requirements, you can seek the experimenter for help and repeat the practice.

2.4 Result

2.4.1 Behavioral Responses

2.4.2 Selection Rate

Because of pseudo characters used in the experiment, there is no absolute right selection. To calculate the selection rate--under certain condition, i.e., the rate of selecting "YES", was adopted. 2 (radical: phonetic radical, semantic radical) × 2 (orthography: orthographically right and orthographically wrong) repeated measurement ANOVAs was carried out for data analysis. The main effect of orthography was not significant (see Figure 1), F (1,15) =.455, p=.510, η_p^2=.029. The main effect of semantic radical was also not significant, F (1,15) =2.410, p=.141, η_p^2=0.138. The interaction was significant, F (1,15) =8.613, p=.010, η_p^2=.365. Simple effect analysis found that under the condition of orthographically right, the selection rate for semantic radical was significantly higher than the selection rate for phonetic radical, t (1,15) =2.533, p=-.023. Under the condition of orthographically wrong, the selection rate difference between semantic radical inference and phonetic radical inference was not significant, t (1,15) =.006, p=.995.



Reaction times was faster under the orthographically right condition, and under this condition, participants do there inference more rely on semantic radicals.

Figure 1. Behavior Result Reaction Time

In terms of RT, the main effect of radical was not significant, F (1,15) = 5.117, p=.039, $\eta_p{}^2$=.254. The selection rate for semantic radical was significantly slower than the selection rate for phonetic radical. The main effect of orthography was significant, F(1,15)=6.094, p=.026, $\eta_p{}^2$=.289. The RT for orthographically right was significantly faster than the RT for orthographically wrong. And the interaction was not significant, F(1,17)=.020, p=.889, $\eta_p{}^2$=.001.

2.5 Discussion

Generally, orthographic and semantic radical affected the inference task in a combined fashion. Semantic radical showed a selection rate bias in orthographically right condition, while the selection rate was not significantly different between semantic and phonetic radical under the orthographically wrong condition. For the reaction time, participants reacted faster with phonetic radical, which was due to the fact that participants responded the rejection reaction for phonetic radical as rejection can be faster than that of acceptance reaction[6] ; meanwhile, it seemed quite impossible to conduct any meaningful inference on phonetic radicals, while participant can retrieve category conception from semantic radical, which consumed more time in cognitive processing. Besides, faster in RT for orthographically right condition than wrong condition were found, which suggested that orthography correlated with the radical processing [7], as reaction times to letters are faster than to symbols or pseudo-letters[8], and right orthography facilitated the semantic radical retrieval processing. When performing an inference task, participants first categorized the items and then made their inferences . Combining these result together, we tentatively summarized that, participants first classified rather than inferred categories as phonetic radical need not provide any semantic information which might be rejected in the classifying stage; while the story was totally different in terms of semantic radical which needed classify first, and then passed through the inference stage; in addition, right orthography facilitated the processing for both radicals.

3. Conclusion

Semantic radical, be it physical or semantic features, facilitated the inductive inference and such facilitation was closely related to the processes of semantic radical as lexical information was accessed early than that of conceptual information. Furthermore, semantic radical facilitated the inductive inference independently without the access to the meaning of a certain character.

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