Universal Journal of Psychology 2(5): 151-157, 2014
DOI: 10.13189/ ujp.2014.020501 http://www.hrpub.org

The Switching Effect Involving the Affective System in Chinese Affective Concept Processing

Liusheng Wang[1,2,*],Jing Li[1]

[1]School of Education, Nantong University, Nantong, Jiangsu, 226007, China
[2]School of Psychology and Cognitive Science, East China Normal University, Shanghai, 200062, China
*Corresponding Author: willow76@ntu.edu.cn

Abstract The embodied cognition hypothesis holds the view that concepts are not only grounded in perceptions and actions, but are also important in affective (introspective) experiences. This research explores the switching effect involving affective systems in Chinese affective concept processing. The current study employed a 2×2×2 within-subject experiment with modality context (different vs. same), modality type of property (sensory vs. affective), and valence of word (positive vs. negative) as the independent variables, with reaction time as the dependent variable. Thirty-nine Chinese female college students were required to conduct a property verification task. The results showed a switching effect between verifying sensory properties of concepts and verifying affective properties of concepts, wherein participants responded more slowly to targets preceded by different modality context trials than those preceded by the same modality context trials. These results provide empirical evidence for the embodied cognition of concepts.

Keywords Embodied Cognition, Switching Effect, Affective Concept Processing

1. Introduction

The switching effect refers to the time cost in which reaction times are longer for all stimulus types when they are preceded by a stimulus from a different modality, as opposed to a stimulus from the same modality. This has been interpreted as an exogenously driven attention cost for the switch trials (Coulson, Zeelenberg, Pecher, & Collins, 2011), although it has been conceptualized in different ways (e.g., switching cost, shift cost, modality shift effect).

The switching effect was originally studied in broad terms in perception processing, in which switching from one modality to another during perceptual processing incurs a processing cost. The switching effect has gradually started being used in the concept processing field, where it is called the conceptual modality switching effect, which is the focus of the current study. The conceptual modality switching effect involves shifts within a field of perception, such as the visual, auditory, gustatory or tactile field, but also those occurring across perceptual fields and conceptual tasks, which often use affective concepts as indices in concept processing. Studies about switching effect both within perceptual fields and across perceptual and conceptual tasks could provide evidence for the embodied cognition theory. However, while many studies focused on the former, little attention was paid to the latter.

Some researchers have discussed concept processing more from the point of view of embodied cognition. Embodied cognition theory proposes that modal simulations, bodily states, and situated actions all underlie individuals' cognition (Lawrence W. Barsalou, 2008). The cognitive system utilizes the environment and the body as external informational structures that complement internal representations. Internal representations, in turn, have a situated character, implemented via simulations in the brain's modal systems, making them well suited for interfacing with external structures (Lawrence W. Barsalou, 2010). Some brain researchers support the notion that mental access to concepts is based on the internal creation of embodied experiences which show that the motor and pre-motor cortex areas associated with specific body parts (i.e., the hands, legs and mouth) become active in response to motor language that refers to those body parts(Klepp et al., 2014; Vigliocco, Vinson, Druks, Barber, & Cappa, 2011). Using these concepts is qualitatively similar in some ways to experiencing the real-world scenarios they are built from. Other dimensions of experience are also relevant to simulation: anything that is experienced, including affect, social interactions, subjective judgments, and other imagined scenarios, can be utilized to form part of a simulation (Bergen & Feldman, 2008). Therefore, a concept, as the embodied cognition theory claims, is not only a type of sensory-motor simulation but also an experiential simulation involving, at least partially, a reactivation of brain regions, the sensory system and the affective system that participated in the acquisition of the concept; concepts representations and perceptual representations are truly, albeit partially, based on the same systems. The switching effect involving experiential simulation could provide evidence for embodied cognition.

Pecher and her colleagues supported the hypothesis that perceptual simulation underlies conceptual processing through switching effect experiments. When participants verified pairs of properties, they verified the second property more quickly when it came from the same modality as the first property than when it came from a different modality. For example, verifying a property in the auditory modality (e.g., BLENDER-loud) would occur more slowly after verifying a property in a different modality (e.g., CRANBERRIES-tart) than in the same modality (e.g., LEAVES-rustling) (Pecher, Zeelenberg, & Barsalou, 2003). Furthermore, van Dantzig et al., designed an experiment wherein participants performed a perceptual detection task and a conceptual property verification task in alternation (van Dantzig, Pecher, Zeelenberg, & Barsalou, 2008). In the perceptual task, participants decided whether a simple perceptual stimulus (a light flash, a tone, or a vibration) appeared on the left or on the right. In the conceptual task, participants decided whether a property was true for a concept or not. The properties were modality specific and came from the same three modalities (i.e., vision, audition, and touch) as the perceptual stimuli. Responses on the property verification task were slower for the trials that were preceded by a perceptual trial in a different modality than for those that were preceded by a perceptual trial in the same modality. This finding of a modality-switch effect across perceptual and conceptual processing, supports the hypothesis that pure perceptual processing (perceiving stimuli without any semantic meaning) can affect the activation of conceptual knowledge, and that perceptual and conceptual representations are partially based on the same systems.

Recently, one ERPs study on the perception modality effect in a property verification task found that for visual property verifications, a modality switch was associated with an increased amplitude of N400; for auditory verifications, however, the switch led to a larger late positive complex. Observed ERP effects of a modality switch suggest that property words access perceptual brain systems. Moreover, the timing and pattern of the effects indicate that perceptual systems impact the decision-making stage during the verification of auditory properties, and the semantic stage during the verification of visual properties (Coulson, et al., 2011).

In addition to the switching effect during concept processing within perception, the switching effect involving the affective system also has been studied, and this turned out to show good evidence for embodied cognition(Tillman, Hutchinson, Jordan, & Louwerse, 2013; Vermeulen, Niedenthal, & Luminet, 2007). At present, however, evidence regarding the switching effect involving the affective system is scarce. Vermeulen et al., have investigated switching costs when verifying properties of positive and negative (affective) concepts. Parallel to switching costs in neutral concepts, the study showed that for positive and negative concepts, verifying properties from different modalities produced processing costs such that reaction times were longer and error rates were higher. Importantly, this effect was observed when switching from the affective system to sensory modalities, and vice-versa. For example, reaction times for targets (TRIUMPH-exhilarating) preceded by the same modality context trials (COUPLE-happy) were significantly smaller than those preceded by different modality context trials (VICTORY-sung). Researchers thought that these results supported the embodied cognition view of emotion in humans (Vermeulen, et al., 2007). The switching cost also implies that participants who perform mundane property verification are accessing modal mental simulations. However, some factors, such as sex factor, were not effectively controlled for or counterbalanced in the experimental design. The influences of sex factor exists in language processing and the shift effect(Glenberg, Webster, Mouilso, Havas, & Lindeman, 2009). Now, however, since embodied cognition implies that interaction between the internal state and the external environment (experiential) is important for concept representation, the sex factor might be one variable to be taken into consideration during experiments.

Many studies have reported a sex difference in language or word processing, including the sex differences in embodied cognition. Recently, one review reported that a large number of studies have been devoted to functional differences across sexes in the phonological, orthographic and semantic processing at lexical level, sentence processing, passage processing and verbal learning and memory and so on(Li, Yang, & Zhang, 2011). One study on gender, emotion and embodiment of language comprehension has demonstrated that females understand sentences about sad events with greater facility than males, males understand sentences about angry events with greater facility than females; the shift time of reading sentences from one emotion to another varies between sexes, reading a sad sentence slows the reading of a happy sentence more for females than for males, whereas reading an angry sentence slows the reading of a happy sentence more for males than for females; gender and emotional content of sentences interact with the response mode(Glenberg, et al., 2009). Hutchinson and Louwerse also found that individual differences (i.e., gender differences) modulated the findings of experiments in which how linguistic context and embodiment predict processing valence words. In their results, the interaction between gender and embodiment factor is significant, suggesting while comprehension of conceptual metaphors can be explained by both linguistic and embodiment factors, their relative salience is modulated by cognitive task and gender differences(Hutchinson & Louwerse, 2012). Therefore, the sex of participants should be taken into consideration when designing the concept processing.

Language of stimuli is another issue to consider in this study. Chinese, as an ideograph, differs from English as a phonograph. The forms of written Chinese characters connect with their meanings, while their forms separate from their sounds. However, the form of a written English word connects with its sound, but separates from its meaning. The differences existing between Chinese and English have affected the languages learning and thinking styles which have inevitably greatly influenced the two cultural modes. Bidirectional connections among form, sound and meaning of a word for any language exist in mental dictionary. When Chinese character was processed, the shortcut linking the form and its meaning was found for Chinese participants, while the sound of a word was paid more attention to for participants whose mother language was phonograph, such as English (Feng, 2009). The bidirectional connections among form, sound and meaning of a word may affect the processing speed in property verification task in which participants have to verify the relationship between a property and concept.

In this study, the objectives are to find out evidence for the involvement of sensory and affective systems in conceptual processing by means of switching effect experiments, and to expand upon the conclusions regarding embodied cognition by Vermeulen et al by using Chinese affective concepts and excluding gender factors.

2. Method

2.1. Participants

The participants were 40 female college students in China; among them, data for one participant was excluded for mistaking during the experiment. The mean age of the participants was 21.54 years (SD = 1.02) and each had normal or corrected-to-normal vision. No participant reported any history of psychiatric disorder or neurological damage.

2.2. Materials

The stimuli pool consisted of 192 Chinese words in two parts, each word consisting of 2 Chinese characters. The first part stimuli consisted of 108 words from a data set named *Chinese Affective Words System* (Wang, Zhou, & Luo, 2008), while the second part stimuli consisted of 84 words whose valences were assessed by 100 undergraduates on a 7-point scale. Half were positive valence (mean = 6.41, SD = .70), while half were negative valence (mean = 2.76, SD = .53). The difference in valence was significant ($t\ (190) = 40.63$, $p < .001$). The frequency of words was also taken into consideration. Based on the *Dictionary of Frequency of Modern Chinese Words*, which was edited by the Institute of Language Teaching at Beijing Language and Culture College, there was no significant difference between the frequency of positive valence words and that of negative valence words ($t\ (190) = .62$, $p > .05$).

A set of 96 concept-property associations was developed based on the above 192 words. Forty-eight positive nouns and 48 negative nouns were selected as concepts for the concept-property associations. Twenty-four positive affective words and 24 negative affective words were selected as affective properties, and they did not belong to auditory, or visual words, but were relevant to affective system. Additionally, forty-eight words were taken as sensory properties. Among these were 12 positive and 12 negative auditory words, as well as 12 positive and 12 negative visual words.

Table 1. Examples of the critical target and modality context trials from the two valences

Valences	Target modalities	Same modality trials		Different modality trials	
		Context trials	Target trials	Context trials	Target trials
Positive	Visual	月亮-明亮	苹果-红润	母亲-敬爱	草地-翠绿
		MOON--bright	APPLE--red	MOTHER--respected	GRASS--green
	Auditory	歌唱-动听	电铃-清脆	英雄-敬佩	胜利-鼓掌
		SONG--splendid	BELL--melodious	HERO-admiration	Victory-clap
	Affective	笑话-开心	童年-欢乐	花朵-艳丽	情侣-喜爱
		JOKE--happy	CHILDHOOD--joyous	FLOWER--gorgeous	LOVER--lovely
Negative	Visual	伤口-破损	战场-混乱	困境-焦躁	泥浆-混浊
		WOUND--worn	BATTLEFIELD--mess	PLIGHT--restless	MUD--turbid
	Auditory	苍蝇-嗡嗡	疼痛-呻吟	难民-惊惶	杀戮-哀求
		FLY--hum	PAIN--moan	REFUGEE--trepidation	MASSACRE--imploring
	Affective	死亡-恐惧	噩耗-悲痛	感冒-咳嗽	谣言-愤懑
		EVIL--fear	GRIEVIOUSNEWS-distressed	FLU--cough	RUMOUR--angry

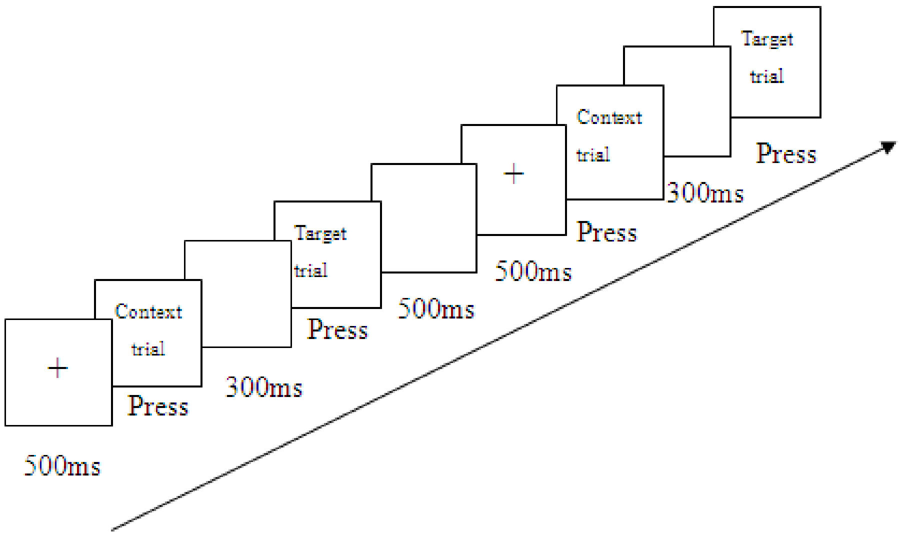


Figure 1. Illustration of the experimental procedure

From these 96 concept-property associations, 48 pairs were formed with one context association followed by one target association. Half of these (24 pairs) were formed using two different concepts coupled with properties from the same modality (e.g., *MOON*—bright / *APPLE*—red) (see Table 1), where 12 pairs were affective modality and 12 pairs were sensory modality. The remaining half (24 pairs) were formed using two different concepts coupled with properties from different modalities (*MOTHER*—respected / *GRASS*—green), including 12 pairs with affective modality as a target and 12 pairs with sensory modality as a target. All 96 critical concept-property associations were true, indicating that the property was true for each respective concept. Importantly, the valence of the CONCEPT–property associations matched within pairs. This means that a positive CONCEPT–property association could only be paired with another positive CONCEPT–property association, and the same applied to negative associations.

In addition to the critical pairs, filler trials were also designed so as to mask the intention of the experiment. An additional 72 concept-property associations were used as intervention stimuli. 22 of these concept-property associations were real, and the remaining 50 associations were fake. These were then randomly placed into different pairs. And another 20 concept-property associations were used as practice stimuli, wherein half were true and half were false.

2.3 Procedure

Participants were required to conduct a property verification task in which they had to verify, as quickly and as accurately as possible, whether a property tended to be true for the concept.

After the introduction, each trial began with a 500 ms fixation (+), followed by the presented context association, and participants were required to verify whether the property was true by pressing the “F” key (true) or the “J” key (false). The trial continued with a 300 ms blank screen, followed by the target association, wherein participants were required to verify, once again, whether the property was true. This screen was then replaced by a 500 ms blank screen, after which the next trial started (Fig.1). The modality context, or target association screen, remained until either a response was made or 6,000 ms passed. The response keys connecting correct or false were counterbalanced among participants. The experiment was divided into 6 different blocks, each consisting of 8 pairs of real stimuli and 6 pairs of intervention stimuli. Each block was separated by a flexible rest period, which the participants could then terminate once they were ready to work again. In order to avoid a position effect, each pair was randomly presented within a block. 6 blocks were assigned to 6 sequences according to the Latin square design, and each participant was randomly assigned to conduct one of the 6 sequences. Twenty concept-property association trials took place as a single practice block before the experiment. All the stimuli were conducted using the E-prime software package. The entire experiment lasted about 10 minutes.

2.4 Preliminary analysis of data

First of all, the responses to intervention trials were removed. All response analyses were performed on the correct responses only. Incorrect responses to real associations (9.5% of the data), regardless of whether they were responses to modality context trials or target trials, were omitted, as well as any extreme reaction times (3.4% of the data) falling outside 3 standard deviations from the mean.

3. Results

One 2 (Target valence: positive, negative) × 2 (Modality context: same, different) × 2 (Target modality type: affective, sensory) Repeated measures ANOVA was conducted with the reaction times (RTs) as dependent variables. Although a three-way interaction was significant(Figure 2), $F(1, 38) = 5.69$, $p < .05$, $\eta2 = .13$, the main effects of the switching effect were reported earlier based on planned comparisons. The results showed a main effect of modality context; RTs for targets preceded by the same modality context trials were smaller (M = 1111.82 ms; SE = 22.73) than those preceded by other modality context trials (M = 1197.89 ms; SE = 30.14), $F(1, 38) = 16.73$, $p < .001$, $\eta2 = .306$. This result indicates a switching effect across modality contexts. There was also a main effect of valence, $F(1, 38) = 79.59$, $p < .001$, $\eta2 = .677$. The responses were faster with positive trials (M = 996.64 ms, SE = 23.62) than with negative trials (M = 1313.08 ms, SE = 35.71). A main effect of a modality type was not found ($p > .05$) .

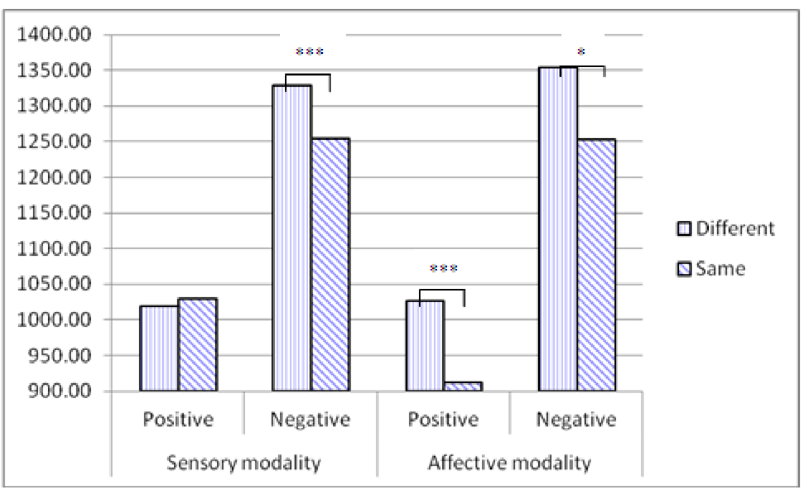
An analysis of RTs revealed significant interaction between the modality context and valence, $F(1, 38) = 4.55$, $p < .05$, $\eta2 = .107$, and this was due to a smaller valence effect when modality contexts were the same (positive, M =970.40 ms; negative, M = 1253.00 ms) than when they were different (positive, M = 1023.00 ms; negative, M = 1373.00 ms). As Table 2 shows, simple effect analyses indicate that modality-switching effects (modality context effects) were present for all affective concepts of the two systems (sensory and affective), except for positive concepts in the sensory modality type.

4. Discussion

The aim of this study is to explore the switching effect involving affective system in Chinese affective concepts processing. The results of experiment showed the switching effects between affective concepts and their affective properties.

According to the embodied cognition theory, concepts are grounded in simulations of actual experiences, with instances of those concepts in the sensorimotor systems(L. W. Barsalou, 1999; L. W. Barsalou, 2003). Affective concepts are simulators of actual experiences involving the affective system. If verifying a property of a concept represented in a different modality of property (i.e., sensory and affective property of concept) incurs a processing cost, affective information processing of affective concepts involves the sensorimotor system, as well as the affective system.

In this study, similar switching effects occurred for affective concepts and their affective properties when processed by females, and this replicated Vermeulen et al.'s (2007) work and expanded upon their conclusions. Similar switching effects were also incurred, whether switching involved sensorial modalities or the affective system. The findings could provide support for the view that a judgment that a CHILDHOOD can be joyous or A RUMOUR can be angry involves a simulation of this potential property in the affective system. As one study has stated, a concept is equivalent to a simulator, for it contains the knowledge and accompanying processes that allow an individual to represent some kind of entity or event adequately (L. W. Barsalou, 1999). Representations of external (perception) and internal (proprioception, emotion and introspection) states, as well as actions, critically constitute concepts and thus play a fundamental functional role in linguistic understanding and conceptual thinking. Conceptual features (e.g., visual, acoustic, action-related, emotional) are represented by cortical cell assemblies distributed over sensory, motor, and emotional regions of the brain (Kiefer & Pulvermüller, 2012). Such an empirical finding is predicted by the fact that the role of affective, or emotional information - as another type of experiential information - is foundational (i.e., primary and necessary) in learning, and represents meaning, especially for abstract words/concepts (Vigliocco, Meteyard, Andrews, & Kousta, 2009).



Note: Positive and negative refers to valence of targets, different and same refers to modality context, sensory modality and affective modality refers to target modality. *** 0.001, * 0.05.

Figure 2. Mean reaction times as an interaction function of modality context, valence and modality type (ms).

Table 2. Mean response times in milliseconds (SD) and t test comparisons for verifying properties on target trials as a function of valence of targets, target modality type (sensory, affective) and modality context

	Sensory modality				Affective modality			
Valences	Different	Same	Switching effect	t	Different	Same	Switching effect	t
Positive	1019.26	1029.26	-10.00	0.419	1026.47	911.55	114.92	3.618***
(SD)	(184.31)	(181.80)			(229.32)	(146.61)		
Negative	1392.21	1253.82	138.39	3.885***	1353.64	1252.67	100.97	2.092*
(SD)	(252.18)	(189.67)			(407.79)	(290.54)		

Language issue of stimuli was speculated to influence the concepts processing. The results of the current study showed that the reaction times were indeed different in the property verification task between ideographic language and phonographic language. However, the switching effects came up for two types of language stimuli. The influence of language stimuli on processing speed for target trials was the same as that for context trials, and switching effect addressed the discrepancy between target and context trial. This indicates that the switching effect exists in different types of language stimuli.

One interesting interaction between the modality context and the valence of target trials was also observed in which there is a smaller valence effect for properties verified in the same modality than in a different modality. Namely, the verification of properties of positive concepts was performed more quickly than that of negative concepts, particularly if the properties to be verified were presented in the same modality as the previous one. This could be explained by attention bias. When the emotional information is processed, attention bias would be found. Researchers have proved that negative information (e.g., threat-related and ambiguous cues) can influence the magnitude of the IOR (inhibition of return) effect, which increases attention dwell-time and disengagement of attention from threat-related stimuli (Fox, Russo, & Dutton, 2002). Attention is guided more potently by negative information, such as fearful facial expressions or negative words (Fox, Mathews, Calder, & Yiend, 2007; Ohman, Lundqvist, & Esteves, 2001). Therefore, the verification of affective information or of affective concepts should show a valence effect. When attention is captured by negative information in concepts, then the verification of this negative information will be even slower, since attention to the negative information inhibits the processing of other information (e.g., emotion-unrelated, or positive information).

Last, the current study considered modality context (same vs. different) as a factor. In our procedure, the duration of mask screen within pairings is 300ms, while the duration of mask screen between parings is 500ms. The procedure accentuates a role of these concept-target pairings by introducing longer breaks between trials than within. It avoided the interference between the target associate in the former trial and the context associate in the latter trial which might make the modality context the confounding factor.

The present research supports the notion that a concept is not only sensory-motor simulation, but also experiential simulation involving, at least partially, the reactivation of brain regions – the sensory system and the affective system - as proposed by the embodied cognition theory. Experiential knowledge, including affective information, is rich in the real world, and the gender difference varies in experiential knowledge processing, for example, a sex-related bias plays an important role in the expression of cognitive sex differences(Gosavi, 2013). Therefore, future work will examine the differences between the sexes in experiential simulations, so as to further develop the embodied cognition theory.

Acknowledgments

This research was supported by Ministry of Education grants 11YJC1900025 and 10JJDXLX001, and Jiangsu Educational Science Planning grant C-a/2011/01/23.

REFERENCES

[1] Barsalou, L. W. (1999). Perceptual symbol systems. Behavioral and Brain Sciences, 22(1), 577-660.

[2] Barsalou, L. W. (2003). Abstraction in perceptual symbol systems. Philosophical Transactions of the Royal Society B: Biological Sciences, 358(1435), 1177-1187.

[3] Barsalou, L. W. (2008). Cognitive and neural contributions to understanding the conceptual system. Current Directions in Psychological Science, 17(2), 91-95.

[4] Barsalou, L. W. (2010). Grounded cognition: past, present, and future. Topics in Cognitive Science, 2(4), 716-724.

[5] Bergen, B., & Feldman, J. (2008). Embodied concept learning. In P. Calvo & T. Gomila (Eds.), Handbook of Cognitive Science: An Embodied Approach (pp. 313-331). San Diego: Elsevier Science.

[6] Coulson, S., Zeelenberg, R., Pecher, D., & Collins, J. (2011). Modality switching in a property verification task: an ERP study of what happens when candles flicker after high heels click. Frontiers in Psychology, 2, 1-10.

[7] Feng, L. (2009). A study of the orthographic, phonological and semantic processing of Chinesemorphemes by foreign students and the constructive pattern of their mental lexicon.

Chinese Teaching in the World, 23(1), 101-110.

[8] Fox, E., Mathews, A., Calder, A. J., & Yiend, J. (2007). Anxiety and sensitivity to gaze direction in emotionally expressive faces. Emotion, 7(3), 478-486.

[9] Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: evidence for delayed disengagement from emotional faces. Cognition and Emotion, 16(3), 355-379.

[10] Glenberg, A. M., Webster, B. J., Mouilso, E., Havas, D., & Lindeman, L. M. (2009). Gender, Emotion, and the Embodiment of Language Comprehension. Emotion Review, 1(2), 151-161.

[11] Gosavi, R. (2013). Embodied cognition and sex differences in singular versus combined tasks. University of California, San Diego.

[12] Hutchinson, S., & Louwerse, M. M. (2012). The upbeat of language Linguistic context and perceptual simulation predict processing valence words. In N. Miyake, D. Peebles & R. P. Cooper (Eds.), Proceedings of the 34th Annual Conference of the Cognitive Science Society (pp. 1709-1714). Austin, TX: Cognitive Science Society.

[13] Kiefer, M., & Pulvermüller, F. (2012). Conceptual representations in mind and brain: theoretical developments, current evidence and future directions. Cortex, 48(7), 805-825.

[14] Klepp, A., Weissler, H., Niccolai, V., Terhalle, A., Geisler, H., Schnitzler, A., et al. (2014). Neuromagnetic hand and foot motor sources recruited during action verb processing. Brain and Language, 128(1), 41-52.

[15] Li, Y., Yang, D., & Zhang, Q. (2011). Sex differences in language processing and its neural mechanisems. Advances in Psychological Science, 19(11), 1625-1634.

[16] Ohman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: a threat advantage with schematic stimuli. Journal of Personality and Social Psychology, 80(3), 381-396.

[17] Pecher, D., Zeelenberg, R., & Barsalou, L. W. (2003). Verifying conceptual properties in different modalities produces switching costs. Psychological Science, 14, 119-124.

[18] Tillman, R., Hutchinson, S., Jordan, S., & Louwerse, M. M. (2013). Verifying properties from different emotions produces switching costs: Evidence for coarse-grained language statistics and fine-grained perceptual simulation. In M. Knauff, M. Pauen, N. Sebanz & I. Washsmuth (Eds.), Proceedings of the 35th Annual Conference of the Cognitive Science Society (pp. 3551-3556). Austin, TX: Cognitive Science Society.

[19] van Dantzig, S., Pecher, D., Zeelenberg, R., & Barsalou, L. (2008). Perceptual processing affects conceptual processing. Cognitive Science: A Multidisciplinary Journal, 32(3), 579-590.

[20] Vermeulen, N., Niedenthal, P. M., & Luminet, O. (2007). Switching between sensory and affective systems incurs processing costs. Cognitive Science, 31(1), 183-192.

[21] Vigliocco, G., Meteyard, L., Andrews, M., & Kousta, S. (2009). Toward a theory of semantic representation. Language and Cognition, 1(2), 219-247.

[22] Vigliocco, G., Vinson, D. P., Druks, J., Barber, H., & Cappa, S. F. (2011). Nouns and verbs in the brain: a review of behavioural, electrophysiological, neuropsychological and imaging studies. Neuroscience & Biobehavioral Reviews, 35(3), 407-426.

[23] Wang, Y., Zhou, L., & Luo, Y. (2008). The pilot establishment and evaluation of Chinese affective words system. Chinses Mental Health Journal, 22(8), 608-612.