Acta Psychologica 143 (2013) 269–276

Contents lists available at SciVerse ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/ locate/actpsy

The effects of the concreteness of differently valenced words on affective priming

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ARTICLE INFO

Article history:
Received 12 September 2012
Received in revised form 3 April 2013
Accepted 6 April 2013
Available online 15 May 2013

PsycINFO classification:
2340 Cognitive Processes
2360 Motivation & Emotion

Keywords:
Concreteness
Abstract words
Affective association
Valence
Affective priming

ABSTRACT

This study aimed to determine whether affective priming is influenced by the concreteness of emotional words. To address this question, we conducted three experiments using lexical decision-priming task. In Experiment 1, positive-abstract (PA) and positive-concrete (PC) words were used as primes to examine the effect of the concreteness of positive words on affective priming, and in Experiment 2, negative-abstract (NA) and negative-concrete (NC) words were used as primes to examine the effect of the concreteness of negative words on affective priming. Results showed that participants responded faster to affectively congruent-abstract trails than incongruent-abstract trails in PA prime conditions, but for PC or negative word (NC and NA) prime conditions, there were no differences between the response times of congruent trails and incongruent trails. To examine the reliability of the priming effects observed in Experiments 1 and 2, we set up a neutral condition as a baseline in Experiment 3, through which we confirmed the difference in the affective priming effect between positive and negative primes in a concrete–abstract dimension. PA words were found to have the tendency to possess more emotional load and facilitate affective association between the prime and the target. The study finding suggests that aside from arousal and valence, the concreteness of positive words also has an impact on affective priming effect.

1. Introduction

The affective priming effect refers to the facilitated response to a target when it is preceded by an affectively congruent prime instead of an affectively incongruent prime (see Fazio, 2001). For example, target words (e.g., *wedding*) that are preceded by prime words with the same valence (e.g., *happy*) produce quicker responses than those preceded by prime words with the opposite valence (e.g., *corpse*). Although current literature on affective priming has focused on the contributions of arousal and valence to the affective priming effect (De Houwer, Hermans, Rothermund, & Wentura, 2002; Hinojosa, Carretie, Mendez-Be´rtolo, Mı´guez, & Pozo, 2009; Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007; Steinbeis & Koelsch, 2009; Thomas & LaBar, 2005; Zhang, Lawson, Guo, & Jiang, 2006), recent studies suggested that the concreteness of words plays an important role in affective processing (Kanske & Kotz, 2007; Kousta, Vigliocco, Vinson, Andrews, & Del Campo, 2011; Tse & Altarriba, 2009; Wang & Yao, 2012). Based on such relationship, the present study explored the contributions of concreteness of words to affective priming.

As so far, the vast majority of studies have examined the contributions of arousal and valence of words to the affective priming effect. For instance, Thomas and LaBar (2005) reported that high-arousing negative words (taboo words) showed greater priming effect than low-arousing negative and neutral words in the lexical decision task. Hinojosa et al. (2009) demonstrated that the processing of high-arousing incongruent trials, as compared with high-arousing congruent trials, was associated with enhanced amplitude of a late positive component (LPC) that peaks approximately 500 ms after the presentation of the stimulus, whereas no difference was observed between low-arousing congruent and low-arousing incongruent trials. Aside from arousal, valence dimension has also been the focus of affective priming research. Zhang et al. (2006) used pictures and words as primes to investigate visual affective priming effects. They reported that the individuals responded faster to affectively congruent trials than to affectively incongruent trials. Steinbeis and Koelsch (2009) reported that participants evaluated emotional words congruous to the affect expressed by a preceding chord (chord-positive words) faster than words incongruous to the preceding chord (chord-negative words).

Studies have shown that the size of priming effects between positive and negative prime words is different. Neutral and positive words as primes yielded significant priming effects, whereas negative primes did not (Rossell & Nobre, 2004; Rossell, Shapleske, & David, 2000; Sass et al., 2012). One explanation for such results is that the emotional cue of a prime can govern both the activation and use of affective associations (Clore & Storbeck, 2006; Gasper, 2004). Specifically, a positive affect increases accessibility and the use of associations, whereas a negative affect inhibits it (Storbeck & Clore, 2005).

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http://dx.doi.org/10.1016/j.actpsy.2013.04.008

Another explanation is that the positive affect supports a holistic processing mode, characterized in memory by the activation of wide semantic fields, including weak or remote associates. By contrast, negative affect supports an analytic processing mode, characterized by a more restricted spread of activation to close associates and dominant word meanings (Bolte, Goschke, & Kuhl, 2003). Thus, positive and negative primes are known to have facilitatory or inhibitory roles in affective priming.

Studies have found that concreteness has an impact on the processing of emotional words. Generally, concrete words (it refers to specific objects or events, e.g., *apple*, *corpse*) are found to have cognitive processing advantages over abstract words (it refers to more general and/or complex concepts, e.g., *courage*, *revenge*). Such a characteristic defines the so-called "concreteness effect" (Paivio, 1991). Interestingly, when a word contains not only a conceptual component that reflects an object or event but also an emotional component that reflects a certain attitude or emotion (for example, the word "*wedding*" contains both the concept of "*ceremony*" and the emotion of "*happiness*"), the emotional feature and concreteness can influence each other in processing the words (Kanske & Kotz, 2007; Wang & Yao, 2012). For example, Wang and Yao (2012) found the advantage of concrete words disappearing whenever concrete and abstract words both contained emotional concepts in the lexical decision task. Tse and Altarriba (2009) found that the concreteness effect occurred for positive words but not for negative words in immediate serial recall. Additionally, an fMRI study exploring the relation between the concreteness and emotionality of words suggested that emotional valence ratings significantly predicted concreteness ratings. More valenced words tend to be more abstract, whereas neutral words tend to be more concrete. And for abstract words, ratings of emotionality predicted modulation of BOLD (blood oxygen level dependent) signal in the rostral anterior cingulate cortex, an area associated with emotional processing (Vigliocco et al., 2013).

With respect to the interaction between concreteness and emotionality of words, Kousta et al. (2011) proposed a new hypothesis of how emotionality of words plays roles in the processing of concrete and abstract concepts. Specifically, they proposed that concrete and abstract words are composed of different types of information: experiential information (sensory, motor, and affective) and linguistic information. The processing of concrete and abstract words differs according to the composition of sensory, motor, or affective information in the word, with sensory-motor information being more preponderant for concrete concepts and affective information being more preponderant for abstract concepts. Researchers proposed that the processing advantage for abstract words was due to differences in affective information between concrete and abstract words, abstract words tend to be more affectively associated or have a higher emotional load than concrete words (Kousta et al., 2011; Vigliocco, Meteyard, Andrews, & Kousta, 2009; Vigliocco et al., 2013). Note here that affective association or emotional load should be considered as a continuous variable spanning across words of all types (rather than a variable identifying the special category of emotion words, as originally hypothesized by Altarriba, Bauer, & Benvenuto, 1999), which implies that the meaning of words is related to emotion in semantic memory but binds together different weights and amounts of affective information. In this sense, all kinds of words (regardless of whether they are concrete or abstract words) contain affective information to some extent, but they all concerned with the emotion weakly or strongly. In view of the differences in affective association between concrete and abstract words, we inferred that concrete and abstract words should play different roles in the processing of affective priming. However, whether the concreteness of words influences on affective priming effect by virtue of abstract words having more affective associations than concrete words, it remains an open question.

Taken together, a large number of studies to date have investigated the contribution of arousal and valence of words to affective priming, but only a few have considered the role of concreteness of words. According to literature on the relationship between emotionality and concreteness, the first aim of the present study is to investigate whether concreteness influences affective priming in the lexical decision-priming task, thereby expanding and enriching current literature on affective priming. We hypothesized that abstract primes showed stronger affective priming than concrete primes. According to the different roles of primed valence, the second aim of the present study is to replicate past research demonstrating the difference in positive and negative primes in priming processing. We hypothesized that a significant affective priming effect occurred for positive primes but not for negative primes in a concrete–abstract dimension. In exploring these issues in the present study, concrete and abstract words that shared similar polar valence and arousal as primes were separately set up in Experiments 1 and 2. Additionally, we completed a third experiment using a neutral condition as a baseline to examine the reliability of priming effects elicited by positive and negative prime words in a concrete–abstract dimension.

2. Experiment 1: the contribution of positive concrete and abstract prime to affective priming

2.1. Method

2.1.1. Participants

Forty two right-handed volunteers (18 males, 24 females; mean age = 21.6) from Shaanxi Normal University participated in this experiment. All participants reported normal or corrected-to-normal vision, and received monetary compensation for participating in the study.

2.1.2. Materials

Words that were presented in our study were selected from Chinese Affective Words System (CAWS) (Wang, Zhou, & Luo, 2008). Word pairs were made based on four pools of stimuli (see Appendix): 9 positive-concrete words (PC: *e.g.*, *gift*, *feast*), 9 positive-abstract words (PA: e.g., *talent*, *honor*), 9 negative-concrete words (NC: e.g., *refugee*, *burglar*), and 9 negative-abstract words (NA: e.g., *false*, *deprive*). In a previous phase, a 120-word list (30 words each) was evaluated by 25 subjects (different from those who participated in the LDT), who rated the valence, arousal, concreteness and familiarity of each word on a 9-point scale (9 being very positive, very activating, very concrete or very familiar, respectively). Words that were presented to participants in the formal experiments were selected

Table 1
Means of valence (1, negative to 9, positive), arousal (1, calming to 9, arousing), and concreteness (1, abstract to 9, concrete).

	Valence	Arousal	Concreteness	Familiarity	Strokes
Positive concrete primes	6.8	5.7	6.8	5.2	15.9
Positive abstract primes	6.8	5.6	4.4	5.3	15.8
Negative concrete primes	2.9	5.8	6.7	5.0	16.2
Negative abstract primes	3.0	5.5	4.3	5.1	15.4
One-way ANOVA on each factor	$F(3,32) = 438.1$, $p < .000$	$F(3,32) = 1.38$, $p = .27$,n.s	$F(3,32) = 176.7$, $p < .000$	$F(3,32) = 1.16$, $p = .34$,n.s	$F(3,32) = 1.48$, $p = .24$,n.s

n.s. = nonsignificant. ANOVA = analysis of variance.

according to several criteria that were contrasted with one-way analysis of variance (ANOVA; see Table 1) and post hoc analyses with the Bonferroni correction ($\alpha < .05$): words of PC, NC, PA, NA were matched by arousal, familiarity and strokes, yet differed in valence and concreteness. Table 1 summarizes the mean ratings for each of the four pools of stimuli in every dimension.

The 144 word-word pairs were created: 72 affective congruent word pairs (36 PC–PC and 36 PA–PA), 72 affective incongruent word pairs (36 PC–NC and 36 PA–NA). In different word-word pairs, PC and PA primes were presented four times, then four pools of target words were presented two times during Experiment 1. There is evidence showing that a repetition effect was found for the first presentation of a stimulus, but not for a second presentation (Olofsson & Polich, 2007). Thus, in order to prevent a repetition effect, we ensured that none of the words were presented for the first time, by asking participants to read a paper list containing all the words used in the experiment before the practice phase. Moreover, we took special care to rule out semantic relationships between primes and targets beyond the level of affective. 17 additional subjects, who did not participate in the rating or formal study, scored the semantic relatedness between primes and targets using a 5-point scale (1 for semantically unrelated; 5 for highest semantic relation). The semantic relatedness between primes and targets in four conditions was respectively as follows: 1.7(0.6), 1.6(0.7), 1.7(0.8), 1.5(0.6). In addition, the 144 pronounceable pseudowords were created by altering one random character within different real words.

2.1.3. Task and procedure

All 288 trials were presented to every subject in four blocks of trials. Two of the four blocks began with PC primes and contained a total of 72 trials (18 PC–PC, 18 PC–NC, and 36 PC–pseudoword). The other two blocks began with PA primes, and also contained 72 trials (18 PA–PA, 18 PA–NA, and 36 PA–pseudoword). Each subject therefore received the same proportion of congruent pairs (PC–PC, PA–PA) and incongruent pairs (PC–NC, PA–NA), and the presentation order of the four blocks was randomly selected.

Participants were instructed to focus on the first word but only respond to the second word. Participants responded by pressing the "F" key at the presentation of a real word and the "J" key when the word shown was a pseudoword. These two keys were counterbalanced across participants. Participants were also told to respond as quickly and accurately as possible. Prior to the experiment trials, each participant performed 14 practice trials to prove that they completely understood the trial procedure. After each block, participants were given a 2-min break, and the whole experiment lasted for approximately 30 min, including instruction and practice time. Fig. 1 shows the timing of a trial. Stimuli were white on a black background. Each trial began with a fixation point presented for 500 ms, followed by a prime word for 200 ms. After an interval of 100 ms, a target word was presented for 300 ms followed by another blank screen for 2500 ms, at which time participants responded. The intertrial interval was1800–2300 ms. The task was presented by E-Prime 1.0.

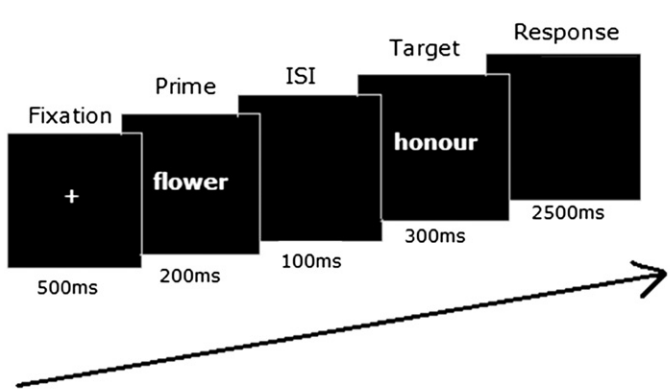

Fig. 1. The lexical decision-priming task. Following a fixation, a prime word was presented for 200 ms, an interval for 100 ms followed by a target word which was presented for 300 ms and another blank screen to response.

2.2. Results

Accuracy for each trial in the four conditions was high (97.2%) and did not differ across conditions, thus consequent analysis concentrated on the response times (RTs) data. We excluded from the analyses RT responses above or below 2.5 standard deviations from the mean (4.3% of overall trials). Two participants were excluded for response times that were 2.5 SDs below the grand mean. The analyses reported were carried out on correct responses only.

We carried out two ANOVAs in order to test generality over participants (F_1) and items (F_2). The 2 Concreteness of word pairs (concrete, abstract) $\times$ 2 Affective Congruency (congruent, incongruent) repeated measures ANOVA on RTs indicated a significant main effect of Concreteness type (F_1 (1, 39) = 41.34, $p < .001$; F_2 (1,35) = 36.12, $p < .001$), abstract pairs (391.0 ms) were slower than concrete pairs (358.2 ms). There was also a significant main effect of Affective Congruency (F_1 (1, 39) = 8.45, $p = .006$; F_2 (1, 35) = 21.29, $p < .001$), affectively incongruent trials (381.1 ms) were slower than affectively congruent trials (368.1 ms). An interaction between Concreteness of word pairs and Affective Congruency was significant (F_1 (1, 39) = 20.75, $p < .001$, F_2 (1, 35) = 4.79, $p = .03$). The simple effects analysis of the two-way interaction indicated no significant affective congruency effects in the concrete pair conditions (F_1 (1, 39) = 0.06, $p = .89$; F_2 (1, 35) = 1.18, $p = .29$). For the abstract pair conditions, however, RTs to affectively incongruent pairs (405.3 ms) were slower than those to affectively congruent pairs (376.7 ms) (F_1 (1, 39) = 9.69, $p = .004$; F_2 (1, 35) = 21.51, $p < .001$). Table 2 illustrates the RTs and SDs of each condition and affective priming effects (subtracting affectively incongruent trials from affectively congruent trials). Affective priming effects for each condition are also shown in Fig. 2.

The present results showed a significant priming effect in PA prime conditions, but the priming effect of PC prime conditions failed to reach a level of significance. The priming effect obtained with PA primes indicated that PA words might have more affective associations than PC words. According to the spread of activation on account of these results, the PA prime facilitated target processing when followed by the PA target containing more emotional load; this facilitation did not occur in the PC prime when followed by a less emotional load PC target. This result indicates that the concreteness of positive words contributes to affective priming.

3. Experiment 2: the contribution of negative concrete and abstract prime to affective priming

As mentioned previously, priming valence plays a facilitatory or inhibitory role in affective priming; thus, in Experiment 2, NC and NA prime conditions were substituted for the PC and PA, respectively.

Table 2
Positive concrete or abstract words as primes, the RTs (ms) and SDs of each condition and affective priming effects.

Type of the prime–target	Example	Mean RT	SD	APE
Positive concrete–positive concrete	Partner–jewelry	356.9	10.5	2.7
Positive concrete–negative concrete	Feast–nutcase	359.6	10.8	
Positive abstract–positive abstract	Sublime–miracle	376.7	11.6	28.6*
Positive abstract–negative abstract	Loyalty–absurd	405.3	11.2	

APE(affective priming effect) = RT affectively incongruent-RT affectively congruent.
* $p < .05$, two-tailed.

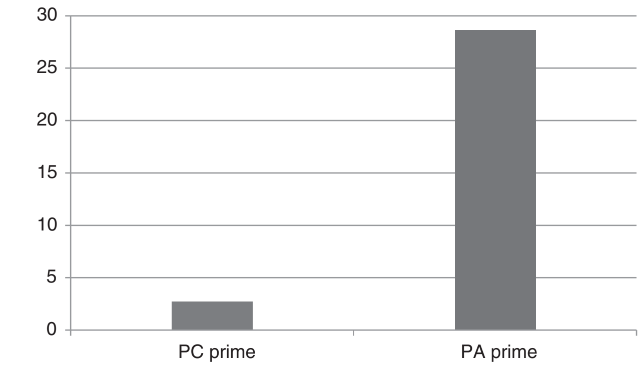

Fig. 2. The affective priming effects of positive concrete and abstract words: PC prime = positive concrete words as primes, PA prime = positive abstract words as primes.

3.1. Method

3.1.1. Participants

Forty two right-handed volunteers (18 males, 24 females; Mean age = 19.3) from Shaanxi Normal University participated in this experiment. All participants reported normal or corrected-to-normal vision and received monetary compensation for participating in the study.

3.1.2. Materials

The experimental materials were the same as were used in Experiment 1, except for differing in the valence of priming words. We used NC and NA words as primes in this experiment. There were 144 trials of prime–target pairs: 72 affectively congruent prime–target pairs (36 NC–NC and 36 NA–NA), and 72 affectively incongruent prime–target pairs (36 NC–PC and 36 NA–PA). The 144 pronounceable pseudowords we used were the same as in Experiment 1.

3.1.3. Task and procedure

The experimental procedure was the same as that of Experiment 1.

3.2. Results

Accuracy for each trial at both conditions was high (97.7%) and did not differ across conditions. Thus consequent analysis concentrated on the RT data. We excluded from the analyses RT responses above or below 2.5 standard deviations from the mean (0.4% of overall trials), and every participant was within 2.5 SDs of this mean. The analyses reported were carried out on correct responses only.

The 2 Concreteness of the word pairs (concrete, abstract) × 2 Affective Congruency (congruent, incongruent) repeated measures ANOVA on RTs revealed that a significant main effect of Concreteness type (F_1 (1, 41) = 19.0, $p < .001$; F_2 (1, 35) = 10.52, $p = .003$), abstract pairs (377.8 ms) were slower than concrete pairs (354.5 ms). And a significant main effect of Affective Congruency, (F_1 (1, 41) = 6.56, $p = .01$; F_2 (1, 35) = 7.16, $p = .011$), 361.6 ms for congruent pairs, and 370.7 ms for incongruent pairs. An interaction between Concreteness of the pairs and Affective Congruency was not significant (F_1 (1, 41) = 0.004, $p = .95$; F_2 (1, 35) = 0.3, $p = .59$). The RTs and SDs of each condition and affective priming effects were presented in Table 3. The affective priming effects of negative concrete and abstract words are also seen in Fig. 3.

The results revealed no affective priming effect in the NC and NA prime conditions, indicating no significant differences in affective association or emotional load of NA and NC words. Thus, both NA and NC primes did not facilitate target processing, regardless of whether they were followed by the same or opposite valence targets. In summary, the difference in the pattern of positive prime conditions and the concreteness of negative words do not influence affective priming.

Table 3
Negative concrete or abstract words as prime, the RTs (ms) and SDs of each condition and affective priming effect.

Type of the prime–target	Example	Mean RT	SD	APE
Negative concrete–negative concrete	Remains–quarrel	355.1	10.5	3.9
Negative concrete–positive concrete	Tussle–lovers	359.0	10.8	
Negative abstract–negative abstract	Absurd–shameful	378.2	11.6	4.3
Negative abstract–positive abstract	Absurd–loyalty	382.5	11.2	

APE (affective priming effect) = RT affectively incongruent-RT affectively congruent.

3.3. A cross experiment analysis

In order to compare the difference in positive and negative primes on priming processing in a concrete–abstract dimension, we conducted an analysis across the two experiments. A 2 × 2 × 2 ANOVA was conducted on RTs with Concreteness of word pairs (concrete pairs vs. abstract pairs) as the between-subject variable, Prime type (positive words primes in Experiment 1 vs. negative words primes in Experiment 2) and Affective Congruency (congruent vs. incongruent) as within-subjects variable. The results confirmed the findings of Experiments 1 and 2, which revealed a main effect for Concreteness of pairs (F_1 (1, 78) = 57.56, $p < .001$; F_2 (1, 70) = 40.89, $p < .001$), with quicker response to concrete pairs (356.4 ms) than to abstract pairs (384.4 ms). There were significant interactions between Concreteness of pairs and Affective Congruency (F_1 (1, 78) = 10.75, $p = .002$; F_2 (1, 70) = 6.25, $p = .04$); Prime type and Affective Congruency (F_1 (1, 78) = 15.0, $p < .001$; F_2 (1, 70) = 20.12, $p < .001$). However, the key statistical effect was an interaction of Prime type, Affective Congruency and Concreteness of pairs (F_1 (1, 78) = 11.36, $p < .001$; F_2 (1, 70) = 4.63, $p = .05$). Examining the abstract pairs, participants responded faster to affective congruence trials than incongruence trials in PA prime conditions rather than in NA prime conditions (F_1 (1, 78) = 21.37, $p < .001$; F_2 (1, 70) = 21.41, $p < .001$), but for concrete pairs, the mean RTs for affective congruence and incongruence trials were not significantly different in PC prime or in NC prime conditions (F_1 (1, 78) = 0.89, $p = .35$; F_2 (1, 70) = 2.75, $p = .10$). The priming effects of four prime types are seen in Fig. 4.

4. Experiment 3: an examination of differences in affective priming effects between positive and negative primes in concrete and abstract dimensions

Experiments 1 and 2 explored the differentiation of the priming effect between differently valenced words in the concrete–abstract dimension. Although we did conduct a cross-experimental analysis and confirmed that the positive and negative prime words in the concrete–abstract dimension influence affective priming in different

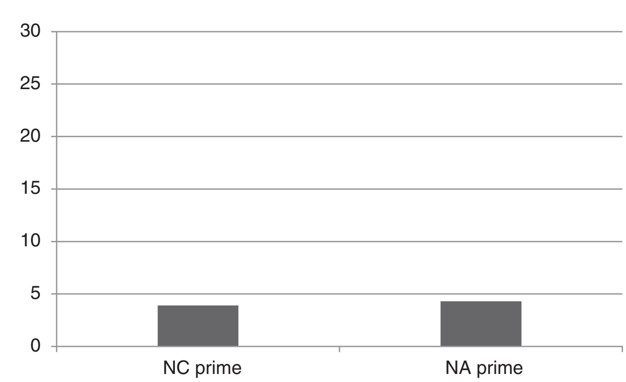

Fig. 3. The affective priming effects of negative concrete and abstract words: NC prime = negative concrete words as primes, NA prime = negative abstract words as primes.

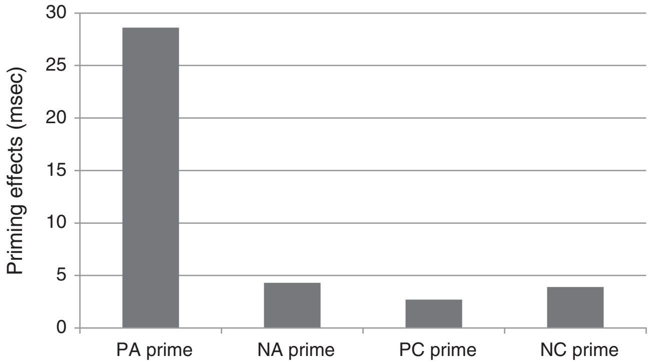

Fig. 4. The affective priming effects of four types primes. See Figs. 2 and 3 caption for the meaning of PA prime, NA prime, PC prime and NC prime.

ways, designing a control experiment was necessary to examine the reliability of the effects. Therefore, a replication of the results using a neutral condition as a baseline was advisable. In Experiment 3, we used concrete and abstract words with positive, neutral, and negative valences as primes, and used neutral concrete and abstract words as targets. We hypothesized that for positive primes, the PA prime would differ from the PC prime; however, for negative primes, no significant difference would be found in the reaction times of NC and NA primes. As for neutral conditions, a traditional concreteness effect would be revealed, that is, neutral concrete words would have a cognitive advantage over neutral abstract words.

4.1. Method

4.1.1. Participants

An additional 40 right-handed subjects (18 males, 22 females; Mean age = 22.3) from Shaanxi Normal University participated in this experiment. All participants reported normal or corrected-to-normal vision and received monetary compensation for participating in the study.

4.1.2. Materials

The positive and negative primed words were taken from the word pools used in Experiments 1 and 2. There were 18 of the positive words (9 PC, 9 PA) and 18 negative words (9 NC, 9 NA). Additionally, nine neutral concrete words (*e.g.*, *freezer*) and 9 neutral abstract words (*e.g.*, *rule*) were selected from CAWS and evaluated by 20 participants according to the same criteria as in Experiment 1. Neutral concrete and abstract words were carefully matched by valence, arousal, familiarity and strokes, but had different concreteness ratings. Table 4 summarizes the mean ratings for the neutral concrete and abstract words in each dimension. Additionally, six categories of words in this Experiment were contrasted using one-way analysis of variance: there were no significant differences in word familiarity (F (5, 48) = 1.2, p = 0.32) and strokes (F (5, 48) = 0.87, p = 0.51) between the six categories words. There were, however, significant differences in emotional valence (F (5, 48) = 183.8, $p < .001$) and concreteness (F (5, 48) = 138.0, $p < .001$) between the three affective conditions; arousal ratings for positive words and negative words were greater than for neutral words (F (5, 48) = 26.1, $p < .001$).

In this experiment, participants viewed 432 prime–target pairs: 216 word–word pairs, and 216 word–pseudoword pairs. The word–word conditions included 36 PC-neutral concrete pairs (*e.g.*, *wedding–railway*), 36 PA–neutral abstract pairs (*e.g.*, *honor–daily*), 36 NC–neutral concrete pairs (*e.g.*, *corpse–train*) and 36 NA–neutral abstract pairs (*e.g.*, *false–rule*). In addition, there were 36 neutral concrete–neutral concrete pairs (*e.g.*, *light–ant*) and 36 neutral abstract–neutral abstract pairs (*e.g.*, *topic–norm*) as a baseline condition. The 144 pronounceable pseudowords were the same as in Experiment 1, and 72 pseudowords were created by the process explained in Experiment 1. Semantic relatedness was confirmed by collecting ratings from another 15 participants. The semantic relatedness between primes and targets was then rated on a 5-point scale (1 for semantically unrelated; 5 for highest semantically relatedness), and there were no significant differences in the degree of relatedness between any of the categories: PC prime = 1.52 (0.2), PA prime = 1.57 (0.3), NC prime = 1.48 (0.2), and NA = 1.42 (0.4). As in Experiments 1 and 2, six categories of paired priming words were presented eight times, neutral concrete and abstract target words were presented four times. All neutral items in this experiment can be found in the Appendix.

4.1.3. Task and procedure

All 432 trials were presented to every subject in six blocks of trials. Two blocks began with PC or PA primes, and each contained 72 trials (18 PC–neutral concrete, 18 PC–pseudoword, 18 PA–neutral abstract, 18 PA–pseudoword). Another two of them began with NC or NA primes (18 NC–neutral concrete and 18 NC–pseudoword, 18 NA–neutral abstract and 18 NA–pseudoword). The final two blocks were used as a baseline condition, and also included 72 trials (18 neutral concrete–neutral concrete and 18 neutral concrete–pseudoword, 18 neutral abstract–neutral abstract and 18 neutral abstract–pseudoword). Each participant received the same proportion of word–word pairs and word–pseudoword pairs and the presentation order of the six blocks was randomly selected. The experimental task procedures were the same as those in Experiment 1. Testing lasted approximately 40 min, including instruction and practice time.

4.2. Results

Overall accuracy was high (97.0%) and did not differentiate reliably between experimental conditions. We excluded from the analyses RT responses above or below 2.5 standard deviations from the mean (0.7% of overall trials), and every participant was within 2.5 SDs of this mean. The analyses reported were carried out on correct responses only.

We conducted the repeated measure analysis of variance (ANOVA) testing the factors Prime affect (positive vs. negative vs. neutral) and Target concreteness type (concrete vs. abstract) which revealed a main effect for Prime affect (F_1 (2,78) = 3.39, p = .05; F_2 (2,70) = 30.06, $p < .001$). Post-hoc comparisons showed that responses to negative primes (369.1 ms) were slower than to positive primes (349.5 ms) (p = .02) and to neutral primes (348.8 ms) (p = .04), and showed no significant differences between positive primes and neutral primes (p = .92). We also found a main effect for Target

Table 4
Means of valence (1, negative to 9, positive), arousal (1, calming to 9, arousing), and concreteness (1, abstract to 9, concrete).

	Valence	Arousal	Concreteness	Familiarity	Strokes
Neutral concrete primes	5.15	4.06	7.24	5.31	16.0
neutral abstract primes	5.01	4.00	4.63	5.29	15.4
One-way ANOVA on each factor	F(1,16) = 0.33, p = .57,n.s	F(1,16) = 0.03, p = .86,n.s	F(1,16) = 179.81, $p < .000$	F(1,16) = 0.02, p = .89,n.s	F(1,16) = 0.11, p = .75,n.s

n.s. = nonsignificant. ANOVA = analysis of variance.

concreteness type (F_1 (1, 39) = 19.06, $p < .001$; F_2 (1, 35) = 19.92, $p < .001$), with longer RTs to abstract pairs (361.4 ms) than concrete pairs (350.2 ms). There was a significant Prime affect × Target concreteness type interaction (F_1 (2,78) = 4.39, $p = .021$; F_2 (2,70) = 8.84, $p = .03$), for positive primes, which showed faster RTs to concrete primes than abstract primes (F_1 (1,39) = 7.09, $p = .011$; F_2 (1,35) = 5.4, $p = .03$), for neutral primes, which also showed faster RTs to concrete primes than abstract primes (F_1 (1,39) = 19.5, $p < .001$; F_2 (1,35) = 21.63, $p < .001$), but for negative primes, there was no significant difference between negative concrete primes and negative abstract primes (F_1 (1,39) = 1.19, $p = .28$; F_2 (1,35) = 1.31, $p = .26$). For RTs on each prime type see Table 5 and Fig. 5.

The findings of this experiment are important because they support the data from Experiments 1 and 2, thereby proving the existence of a reliable difference in the affective association between PC and PA words, and finding no difference between NC and NA words. Neutral words, as we hypothesized, showed a traditional concreteness effect.

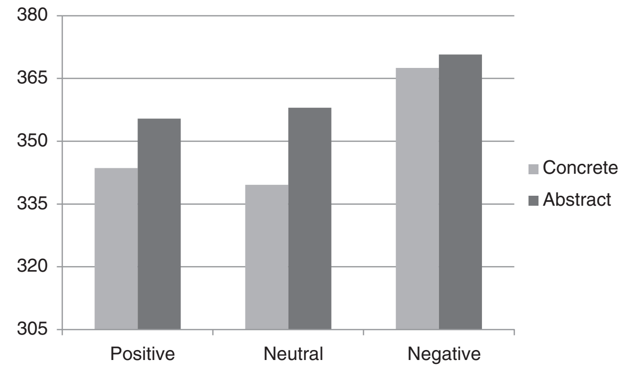

Fig. 5. Response times of six types primes. In this experiment, concrete and abstract words of positive, neutral, and negative valences as primes as well as neutral concrete and abstract words as targets.

5. General discussion

The present study investigated whether the concreteness of words have influences on affective priming effect and considered the role of priming valence in this process. The concreteness of positive primes was found to contribute to affective priming; negative primes, however, were not found to be influential in affective priming. Our findings indicate that the greater affective associations underlying positive abstract words have a facilitated effect for the processing of subsequent related stimuli, but affective associations underlying negative words may be hindered by their negative bias in this process. In short, unlike the direct effect of arousal and valence on affective priming, concreteness of words indirectly contributes to affective priming by means of affective associations for concrete and abstract words.

The priming effects of the PA prime obtained in Experiment 1 support the views of Kousta et al. (2011), who address a novel hypothesis that abstract words tend to be more affectively associated, or have a higher emotional load. According to the method of spreading activation (Fazio, 2001), activation is considered to have spread from a prime to a target if the two share an affective association in semantic memory, thereby influencing decisions on targets (Bower, 1981; Klauer & Musch, 2003). Moreover, Storbeck and Clore (2008) claimed that in lexical decision tasks, if affective relations between primes and targets are more accessible, then an affective priming effect should be evident. Our study has found that an affective priming effect was observed in PA prime–target pairs but not in PC pairs. One possible explanation is that, in terms of the spreading activation theory (Fazio, 2001), PA words can better facilitate activation from PA primes to PA targets in the semantic network. The affective relations between PA primes and PA targets are more accessible, so PA primes produce an evident affective priming effect compared with PC condition. As mentioned above, the differences between concrete and abstract concepts come about because of a statistical preponderance of sensorimotor information underlying concrete word meanings and a statistical preponderance of affective information underlying abstract word meanings. This pattern of our results suggests that a word's affective information exerts a more crucial role than its sensorimotor information in the processing of affective priming, and greater affective associations have been shown to facilitate word processing. In other words, due to the fact that positive-abstract words have more affective information, consequently, PA as primes facilitates the processing of subsequent related stimuli in the priming context. Additionally, unlike the direct effect of arousal and valence on affective priming, the concreteness of positive words, by means of differences in affective associations for concrete and abstract words, indirectly contributes to affective priming.

Table 5
Mean response times (ms) and SDs of six prime type pairs.

Type of the prime–target	Example	Mean RT	SD
Positive concrete–neutral concrete	Jewelry–train	343.6	11.8
Positive abstract–neutral abstract	Sublime–method	355.4	13.5
Neutral concrete–neutral concrete	Ant–freezer	339.6	12.6
Neutral abstract–neutral abstract	Topic–norm	358.0	14.8
Negative concrete–neutral concrete	Quarrel–lion	367.5	16.4
Negative abstract–neutral abstract	Tussle–rule	370.7	16.7

However, the advantage of PA primes was not observed in NA prime–target pairs, which is consistent with the results of previous studies on the facilitatory priming of positive prime and inhibitory priming of negative prime (Rossell & Nobre, 2004; Rossell et al., 2000; Sass et al., 2012). The lack of observed priming effects for negative primes can be explained by the reduced accessibility and use of affective association between a prime and a target. The result shows that negative primes, whether concrete or abstract, do not impact the speed of word recognition for subsequent items, it is may be due to the property of negative stimuli. The property of negatively valenced stimuli has been termed as the "negativity bias" and has been explained in terms of the automatic vigilance model of emotion. This model proposes that humans preferentially attend to negative stimuli, and this attention to negative valence disrupts the processing of the negative stimulus itself, such as its color, its lexical status, and its pronunciation (see Estes & Adelman, 2008a). The lack of priming effect for negative prime words in this present study is also explained by the automatic vigilance model of emotion. According to this model, stimuli are automatically evaluated as negative or positive (Fazio, 2001; Klauer & Musch, 2003). Specifically, following the prime stimulus presentation, attention is disengaged more slowly from negative stimuli than from neutral or positive stimuli (Estes & Adelman, 2008a). This prolonged attention to negative valence may hinder the ability to respond to the affective information underlying negative-abstract word meanings. In other words, an enhanced attention to valence of negative prime words diverts processing resources away from other properties of words. Consequently, a statistical preponderance of affective information underlying negative abstract word meanings may exert a weak or an insignificant influence on the processing of affective priming. Specifically, more accessible affective information between primes and targets was restricted, leading to no significant priming effect when negative words were used as primes, regardless of negative abstract or concrete words.

The present study focused on the role of concreteness in affective priming, helping us clarify the mixed conclusions on affective priming in both behavior and electrophysiology studies. In further confirming whether affective priming was modulated by the concreteness of differently valenced words, we established a neutral condition as baseline in Experiment 3, similar to Rossell and Nobre's (2004), who also used affective words as primes and neutral words as targets. Their results showed that three affective primes (*happy*, *sad*, and *fearful*) did not influence the RTs to neutral targets. However, in our study, only the PA primes facilitated target processing when followed by neutral abstract primes. The dissimilar results suggest that positive words were divided into PA and PC words. In addition, previous studies on event-related potentials (ERPs) that examine affective priming also reported inconsistent results. Several studies found evidence that affective priming influences the N400 (The N400 is a negative component that generally peaks around 400 ms after the onset of a stimulus. It has been extensively used in language and memory research, owing to variations in its amplitude according to the associative relationship between a target and the context in which the target appears (Kounios & Holcomb, 1994)), whereas others found evidence that proves the opposite. For example, Zhang et al. (2006) used ERPs to investigate the underlying neural mechanisms of visual affective priming, eventually finding evidence of an N400 that was sensitive to prime–target affective incongruity. By contrast, Herring, Taylor, White, and Crites (2011) used word pairs in their third experiment and found no evidence of the N400 in response to affective incongruity. An important difference in their studies may have arisen from items that mixed both the emotionality and concreteness of words. The words used in Zhang et al. (2006) were selected from the Affective Norms for English Words, including concrete and abstract words. The words used in the study by Herring and colleagues included 20 words (10 pleasant, 10 unpleasant) describing animals (e.g., *butterfly*, *snake*) and 20 words (10 pleasant, 10 unpleasant) describing people (e.g., *champion*, *thief*), which are considered concrete words, by definition. The lack of the N400 priming effect in the study of Herring et al. reveals that abstract primes could provide more affective association and sufficient context for targets compared with concrete primes. Therefore, the inconsistent results in literature on affective priming suggest that emotion words should be divided according to concreteness.

In fact, Altarriba et al. (1999) were the first to note that the affective association of emotion words may be confused with concreteness. They thus proposed that emotion words should not be treated as abstract words in investigating concreteness effects. Altarriba and Bauer (2004) proposed that instead of treating concreteness as a dichotomous variable (concrete vs. abstract), it should be treated as a trichotomy (concrete vs. abstract vs. emotion words). However, in the tables of Altarriba and Bauer (2004), we observed a mixed relation between emotionality and concreteness of words. For example, abstract items included "*culture*," "*win*," "*chaos*," and "*nonsense*," while concrete items consisted of "*jewel*," "*poison*," "*dragon*," "*burglar*," and so on. Remarkably, these abstract items, per se, carry certain positive or negative affective information. Thus, we believe that further evidence is required to support or verify trichotomy. Our results demonstrate an essential distinction between emotional concrete words and emotional abstract words. Emotional concrete words refer to emotion-laden words denoting emotional meanings (e.g., *baby*, *relic*), and emotional abstract words refer to the emotion-laden words denoting emotional states (e.g., *joy*, *grief*). As such, the dichotomous variable may be a reasonable classification of words (concrete words vs. abstract words), and emotionality may be used as the second layer of word category underlying the dichotomy (emotional concrete words vs. emotional abstract words).

Additionally, recent studies on the emotion effects of single word processing established that emotional valence plays a role in word processing, although no consistent conclusion was reached. Larsen, Mercer, Balota, and Strube (2008) analyzed the stimuli from 32 published studies and found that high arousal negative stimuli (threatening words) slow down lexical decision-making. Estes and Adelman (2008b) analyzed a new set of words and revealed a small but reliable valence effect for negative words. They claimed that all negative stimuli should be treated as threatening; thus, automatic vigilance is sensitive to the degrees of negativity and is generalized across all levels of arousal. By contrast, controlling for a large number of additional lexical factors and extending analyses to a larger set of words, Kousta, Vinson and Vigliocco (2009) found that both negative and positive words have a processing advantage over neutral words. We inferred that a possible reason for the different patterns of results in literature is the lack of a control variable for concreteness, as the concreteness of differently valenced words plays a different role in the processing of emotion words.

In conclusion, we demonstrated that the concreteness of differently valenced words influences affective priming in lexical decision tasks. In our experiments, PA words showed a noticeable priming effect, and suggested that the greater affective associations underlying positive abstract word meanings have a facilitated effect for the processing of subsequent related stimuli. However, NC and NA primes were not found to have a significant priming effect, as the prolonged attention to negative valence may hinder the processing of affective associations underlying negative word meanings in terms of the model of automatic vigilance. The findings suggest that the concreteness of positive words indirectly influences on affective priming effect.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.actpsy.2013.04.008.

Acknowledgments

This research was supported by grants from the Nature Science Foundation of China 402(30970912), the National Social Sciences of China (Educational Science, grant # BBA090030) to Zhenghong Wang and the Innovation Funds of Graduate Program of the Shaanxi Normal University (grant # 2012CXB002) to Zhao Yao.

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