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Affective priming of semantic categorisation responses

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Fazio, Sanbonmatsu Powell, & Kardes, (1986) demonstrated that less time is needed to affectively categorise a target as positive or negative when it is preceded by a prime with the same valence (e.g., summer-honest) compared to when the target is preceded by a prime with a different valence (e.g., cancer-honest). Such effects could be due to spreading of activation within a semantic network and/or to Stroop-like response conflicts. If a spreading of activation mechanism operates in priming tasks, primes should also facilitate nonaffective semantic processing of affectively congruent targets. In Experiment 1, we failed to observe affective priming when participants responded on the basis of whether the target referred to a person or animal. Experiment 2 revealed significant affective priming when participants responded on the basis of the valence of the targets but not when the semantic category of the targets (person or object) was relevant, despite the fact that apart from the task, both conditions were identical. The present results suggest that affective priming in the affective categorisation task is primarily due to the operation of a Stroop-like response conflict mechanism.

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In most priming studies, two stimuli are presented in a sequential manner and participants are asked to decide as quickly as possible whether the second stimulus is an existing word. Results typically show that reaction times are shorter when the relevant stimulus (i.e., the target) was preceded by an associatively related word (i.e., the prime) (e.g., BREAD-BUTTER) compared to when the relevant stimulus was preceded by an unrelated stimulus. The priming paradigm has been used in numerous studies (see Neely, 1991, for a review) that provided detailed information about the conditions under which an associative priming effect, that is, faster processing of a stimulus in the context of an associatively related compared to unrelated stimulus, can be observed.

Associative priming effects fitted well within the semantic network models that were introduced at the time the first priming studies were being conducted (e.g., Collins & Quillian, 1969). According to semantic network models, the representations of related concepts are connected by links through which activation can spread. In order to perform certain tasks (e.g., lexical decision, semantic categorisation), the semantic representation of the target needs to be activated. Responses to a target will be facilitated when the target is preceded by a related prime because the activation of the semantic representation of the prime increases the activation level of the semantic representation of the target. Because of this pre-activation, less time is needed to activate the target representation and retrieve the required information.

Rather than manipulating the associative or semantic relation between the prime and target and asking participants to determine the wordness (i.e., lexical decision task) or name (i.e., pronunciation task) of the target, Fazio, Sanbonmatsu, Powell and Kardes (1986) implemented an affective relation between the prime and target and asked participants to respond on the basis of the valence of the targets. They observed that affective categorisation responses were faster when a prime and target had the same valence (e.g., SUMMER-HONEST; congruent) compared to when they had a different valence (e.g., CANCER-HONEST; incongruent). This result has since then been replicated in numerous other studies (see Klauer, 1998, and Fazio, 2001, for a review).

The apparent similarity between affective priming and associative priming suggests that both phenomena rely on the same mechanism. For instance, one could assume that the evaluative meaning of a prime is automatically processed and that this allows activation to spread to the representations of other concepts with the same valence. In order to determine the valence of the target, its semantic representation needs to be activated (e.g., Bower, 1991; Fazio et al., 1986; Hermans, De Houwer, & Eelen, 1994). Because the activation level of the semantic representations of targets with the same valence as the prime is higher than the activation level of the representation of affectively incongruent targets, it will take less time for the activation level of the target concept to reach a threshold level that is necessary for identification and affective categorisation when target and prime are affectively congruent compared to incongruent. In other words, affective priming of affective categorisation responses occurs because primes are assumed to facilitate the semantic encoding of affectively congruent targets through spreading of activation.[1]

However, some researchers (Klauer, Rossnagel, & Musch, 1997; Rothermund & Wentura, 1998; Wentura, 1999) have noted that instead of or in addition to spreading of activation, affective priming of evaluation responses could also be due to a Stroop-like response conflict. In a Stroop colour-word task, participants see colour words that are written in an ink colour that either corresponds to the meaning of the word (e.g., the word GREEN written in green ink; congruent) or to a different colour (e.g., the word GREEN written in blue ink; incongruent). When they are asked to name the ink colour, responses are faster on congruent than on incongruent trials. According to the dominant models of the Stroop effect (e.g., Cohen, Dunbar, & McClelland, 1990; Glaser & Glaser, 1989), the to-be-ignored word automatically activates the response alternative that has a similar meaning. For example, the word GREEN will induce a tendency to give the response ‘‘green’’. This will slow down response selection on incongruent trials and facilitate response selection on congruent trials.

A similar process could underlie affective priming if one assumes that a prime automatically induces a tendency to give the response that is associated with its valence. For instance, when participants are instructed to say ‘‘POSITIVE’’ in response to positive targets and ‘‘NEGATIVE’’ in response to negative targets, a positive prime will automatically induce a tendency to say ‘‘POSITIVE’’. When the valence of the prime and target differ, the response activated by the prime will differ from the correct response. Because time is needed to resolve this response conflict, responses will be delayed. When the prime and target have the same valence, the response activated by the prime will be the same as the correct response and responding will be facilitated. As a result, reaction times will be shorter on affectively congruent than on affectively incongruent trials. The essential difference with the spreading of activation

[1] Because semantic network models usually incorporate the assumption that the amount of activation that can spread from one node to other nodes is limited, it seems implausible that activation from the representation of one concept will spread to the representations of all other concepts with the same valence. However, one could argue that only concepts that have a clear positive and negative meaning activate their associated evaluation in memory and that activation will only spread to other concepts with a clear positive or negative meaning (e.g., Fazio, 2001, but see Bargh, Chaiken, Raymond, & Hymes, 1996; Fazio et al., 1986). Also, one can think of ways to implement the basic idea of a spreading of activation account into a parallel distributed model. If stimuli are presented as a vector of interrelated nodes, the patterns that represent different stimuli with the same valence will partially overlap (e.g., Masson, 1995). Because a prime activates the subset of nodes that represent its valence, the semantic encoding of targets with the same valence will be facilitated (Wentura, 1999, p. 67). Such a parallel distributed model retains the essential assumption that affective priming is due to an impact of the primes on the semantic encoding of the targets.

account is that primes do not influence the semantic encoding of the targets but merely the selection of the correct response.

In the following sections, we will review some of the studies that provided evidence about the extent to which spreading of activation and response conflicts contribute to affective priming.

Evidence regarding the spreading of activation account

According to a spreading of activation account, primes facilitate the semantic encoding of affectively congruent targets. An important implication of this assumption is that primes should not only facilitate the affective categorisation of affectively congruent targets, but also all other responses that depend on the semantic encoding of targets. The results of a number of affective priming studies provide relevant information with regard to this prediction. First, several studies showed that the match between the valence of primes and targets influences the time needed to read the targets out loud (Bargh et al., 1996; De Houwer, Hermans, & Spruyt, 2001b; Giner-Sorolla, Garcia, & Bargh, 1999; Glaser & Banaji, 1999; Hermans et al., 1994; Hermans, De Houwer, & Eelen, 2001; but see Klauer & Musch, 2001). For instance, less time is needed to read the target HOSTILE when the word GARBAGE is presented as the prime than when the prime is the word FLOWER. This result cannot be due to a response conflict. When targets have to be read, the correct response on any given trial depends on the unique identity of the target. Because targets of the same valence are not assigned to one and the same response, a prime cannot induce a tendency to give a response that is appropriate for targets with the same valence as the prime, simply because there is no such appropriate response. A prime could automatically activate a response on the basis of its identity (e.g., the prime GARBAGE could induce a tendency to say ''GARBAGE''), but this automatically activated response will be different from the correct response regardless of whether the prime and target have the same valence (e.g., a tendency to say ''GARBAGE'' should not facilitate saying ''HOSTILE'' more than saying ''HAPPY''; but see Rothermund and Wentura, 1998). The spreading of activation account, however, does provide a possible explanation of affective priming of pronunciation responses. Assuming that reading a target word depends on the ease with which the target can be semantically encoded, a prime should facilitate the reading of affectively congruent targets because the prime pre-activates the semantic representations of such targets.

A second line of evidence comes from studies in which participants were asked to decide whether the target was a word. Assuming that such a lexical decision depends on a semantic encoding of the targets, a spreading of activation account would again predict that lexical decisions will be faster on affectively congruent than on affectively incongruent trials. The results of studies conducted by Wentura (1998, 2000) confirmed this prediction. Other aspects of the data of Wentura (1998, 2000), however, argued against a spreading of activation account. Wentura manipulated the way in which the participants approached the task. In one condition, participants were instructed to focus on whether the target was a word. When it was a word, they were to give a YES answer, when it was not a word, they were to give a NO answer. In the second condition, however, participants were encouraged to approach the task by trying to answer the question ''Is this stimulus a nonword?''. When the target was a nonword, they had to give a YES response, when the target was not a nonword, a NO response had to be emitted. According to a spreading of activation account, this manipulation should not influence the size or direction of the affective priming effect because in both cases, primes should facilitate the semantic encoding of affectively congruent targets.

Wentura (1998, 2000), however, showed that the manipulation did affect the direction of the priming effect. Whereas in the first condition, responses were faster on affectively congruent than on incongruent trials, in the second condition, participants were *slower* on congruent than on incongruent trials. Wentura explained these effects in terms of the judgemental tendency model of Klauer and Stern (1992). When the prime and target have the same valence, this automatically induces a tendency to give an affirmative response (e.g., say ''YES'') whereas a prime and target that differ in their valence induce a tendency to negate (e.g., say ''NO''). When participants focus on whether the target is a word, the correct response is affirmative for word targets. This response will be facilitated when the prime and target have the same valence (congruent trials) compared to when prime and target differ in valence (incongruent trials) thus resulting in a standard affective priming effect. When participants are asked to focus on whether the target is a nonword, however, the response for words is a negative response that will be pre-activated by incongruent prime-target pairs thus resulting in a reversed priming effect. The results of Wentura (1998, 2000) thus suggest that affective priming of lexical decision responses is not due to the fact that primes facilitate the semantic encoding of targets but is due to a conflict at the response selection stage.

Rothermund and Wentura (1998) adopted a different strategy to examine whether primes pre-activate the semantic representations of affectively congruent targets. Warren (1974) previously demonstrated that naming the ink colour of a target word is slowed down when the target is preceded by a prime word that is associatively related to the target word. According to Warren, the prime pre-activates the semantic representation of the associatively related target. Due to the increased activation level of the target's semantic representation, colour-naming latencies will increase. On the basis of these results, Rothermund and Wentura (1998) argued that if primes pre-activate semantic representations of affectively related targets, colour naming should be slower when a target is preceded by an affectively congruent compared to incongruent prime. Even though they did observe increased colour-naming latencies when prime and target were associatively related, thus replicating the results of Warren (1974), colour-naming latencies were not affected by whether the valence of the prime and target matched. Hermans, Van den Broeck, and Eelen (1998) also failed to obtain such effects.

Evidence regarding the response conflict account

One approach to test the hypothesis that Stroop-like response conflicts contribute to affective priming is to examine phenomena that are assumed to reflect the presence of such response conflicts. It has been well documented that the number of trials on which the prime and target are related does not influence associative priming when the delay between the onset of the prime and the target (i.e., Stimulus Onset Asynchrony; SOA) is shorter than 300 ms (e.g., de Groot, 1984; see Neely, 1991, for a review). However, the number of trials on which the irrelevant feature (e.g., word meaning) is related to the relevant feature (e.g., ink colour) of a Stroop stimulus (e.g., the word GREEN written in green ink) does influence the magnitude of the Stroop effect, even when the delay between the onset of the irrelevant and relevant feature is zero (e.g., Logan & Zbrodoff, 1979; Lowe & Mitterer, 1982). This suggests that an effect of the proportion of congruent trials with short SOAs can be regarded as an indicator for the presence of a Stroop-like response conflict. Importantly, Klauer et al. (1997) demonstrated that the magnitude of the affective priming effect increased with increasing proportions of congruent trials (i.e., trials on which the prime and target have the same valence) when the SOA was zero. On the basis of this result, Klauer et al. suggested that affective priming of affective categorisation responses is largely based on a Stroop-like response conflict mechanism.

Wentura (1999) examined a second phenomenon that is indicative of a Stroop-like response conflict. Negative priming refers to the fact that responding on trial n is delayed when the relevant stimulus feature on trial n is related to the irrelevant stimulus feature on trial n-1. Such effects are typically observed with Stroop-like stimuli. For instance, participants need more time to name a colour of a Stroop colour-word stimulus (e.g., the colour green) when that colour corresponds to the word that had to be ignored on the previous trial (e.g, the word GREEN written in blue ink) (e.g., Dalrymple-Alford & Budayr, 1966; see Fox, 1995, and May, Kane, & Hasher, 1995, for reviews). One explanation of negative priming is that a response conflict on trial n-1 leads to the inhibition of the semantic representations of the irrelevant information that caused the response conflict. If the information that was irrelevant on trial n-1 is relevant on trial n, this inhibition needs to be overcome and responses will be delayed (e.g., Tipper, 1985). Wentura (1999) showed that negative priming also occurs within an affective priming task. He observed that the time to respond to the valence of a target on trial n (e.g., a positive target) increased when the valence of the target corresponded to the valence of an incongruent prime on the previous trial (e.g., a positive prime and a negative target). Wentura interpreted this finding as support for a response conflict account of affective priming.

Outline of the experiments

Although the research summarised above sheds some light on the mechanisms that underlie affective priming, it does not allow one to make strong conclusions with regard to the relative role that spreading of activation and response conflicts play in affective priming. First, the hypothesis that spreading of activation does contribute to affective priming is strongly supported by the observation that affective priming effects can be found when participants are instructed to read words (e.g., Bargh et al., 1996; De Houwer et al., 2001b), but is questioned by the results of lexical decision (Wentura, 2000) and colour naming (e.g., Rothermund & Wentura, 1998) studies. Second, although there is some evidence to support the hypothesis that affective priming effects are at least partly due to a Stroop-like response conflict mechanism (Klauer et al., 1997; Wentura, 1999), one could argue that the evidence is rather indirect in that it is mainly based on the observation of certain analogies between findings in Stroop studies and findings in affective priming studies.

The aim of the present experiments was to further investigate the role of spreading of activation and response conflicts as determinants of affective priming effects. As we explained above, one of the most central predictions that can be derived from a spreading of activation account is that affective priming should not only occur when participants respond on the basis of the valence of the targets but should also occur in other tasks that depend on the semantic encoding of the targets. Assume that the prime HAPPY pre-activates the semantic representation of the target MOTHER. This pre-activation should not only make it easier to retrieve knowledge about the valence of the target MOTHER (and thus facilitate the affective categorisation of this target), it should also make it easier to retrieve any type of semantic information about that target, for instance, that the concept MOTHER refers to a person rather than an object. In the present experiments, we examined whether the semantic categorisation of targets is influenced by the match between the valence of the presented target and the valence of the preceding prime.

We chose the semantic categorisation task for a number of reasons. First, semantic categorisation is similar to affective categorisation in that both tasks require a semantic classification of the targets into predefined categories by selecting one of two responses (De Houwer & Hermans, 1994). As such, semantic categorisation is more similar to affective categorisation than pronunciation is to affective categorisation. Second, unlike the lexical decision task, the semantic categorisation task does not involve yes-no responses. Therefore, possible priming effects cannot be explained on the basis of the judgemental tendency model (Klauer & Stern, 1992; Wentura, 1998, 2000). Third, some have argued that pronunciation and, to a lesser extent, lexical decision only require the activation of nonsemantic lexical representations and do not necessarily depend on the activation of semantic representations (e.g., Glaser, 1992; Masson, 1995). Because spreading of activation only occurs between the semantic representations of concepts, task performance will be affected by spreading of activation to the extent that semantic representations are involved in the selection of the correct response. If the level of activation of semantic representations has little or no impact on pronunciation and lexical decision responses, it is thus possible that the role of spreading of activation was underestimated in these tasks. Semantic categorisation, however, does clearly depend on semantic encoding (e.g., Glaser, 1992). If primes facilitate the semantic encoding of targets with the same valence compared to targets with a different valence, one would thus predict that semantic categorisation of targets will be faster on congruent than on incongruent trials.

EXPERIMENT 1

Method

Participants

A total of 94 first year psychology students at the University of Leuven participated for partial fulfilment of course requirements. All were native Dutch-speakers.

Materials

All stimuli were Dutch words. Ten positive ($M = 6.11$, SD = 0.53) and ten negative ($M = 2.01$, SD = 0.28) nouns that did not refer to animals or persons (e.g., PEACE, DEATH) were selected as primes on the basis of the normative study of Hermans and De Houwer (1994) in which the valence of 740 Dutch nouns and adjectives were rated on a 1 (very negative) to 7 (very positive) scale by a group ($N = 145$) of Dutch-speaking first year psychology students. Primes had a mean word length of 5.01 (SD = 1.52) letters. Targets were 20 words that referred to animals (e.g., BUTTERFLY, COCKROACH) and 20 words that referred to persons (e.g., FRIEND, SNOB). These words were the same as those used in an affective Simon study conducted by De Houwer, Crombez, Baeyens, and Hermans (2001a, experiment 1). They showed that the valence of these words influenced the time to say POSITIVE or NEGATIVE on the basis of the semantic category (animal or person) of the targets, which shows that these targets evoked automatic positive or negative affective reactions (De Houwer & Eelen, 1998). De Houwer et al. asked participants to rate the valence of the targets on a 1 (very negative) to 7 (very positive) scale at the end of the experiment. The mean rating was 6.22 (SD = 0.60) for the positive person words, 1.61 (SD = 0.50) for the negative person words, 5.34 (SD = 0.32) for the positive animal words, and 2.85 (SD = 0.69) for the negative animal words. One can thus conclude that both the primes and the targets were either strongly positive or strongly negative. Person words had a mean word length of 5.35 (SD = 1.27), as did animal words (M = 5.35, SD = 1.50). The complete list of experimental stimuli can be found in Appendix A. During practice trials, different words were used as primes (20 nouns) and targets (10 animal words, 10 person words). Finally, another set of 6 nouns (primes) and 3 animal and 3 person words (targets) was used during warm-up trials.

All words were written in white upper-case letters on a black background and were presented on a 15 inch VGA screen connected to an IBM compatible 386 computer. A letter was 7 mm high and 5 mm wide. Presentations were controlled by a Turbo Pascal 5.0 program that operated in graphics mode. Participants were seated in front of the computer screen at a distance of approximately 40 cm. A keypress device was used to register responses. This device generated a signal that stopped a highly accurate (beyond 1 ms) Turbo Pascal Timer (Bovens & Brysbaert, 1990).

Procedure

All participants were tested individually. They were told that two words would appear on the screen in a sequential manner, only the second of which was important. Participants were asked to press a left or right key on the basis of whether the second word referred to a person or animal. For a random selection of 49 participants, person words were assigned to the right key and animal words to the left key whereas for the other participants, animal words were assigned to the right key and person words to the left key.

There were 80 experimental trials that were divided into two blocks of 40 trials. Twenty practice trials preceded the experimental trials, and each block of experimental trials started with three warm-up trials. Participants could take a brief break after the practice trials and after the first block of experimental trials. Practice and warm-up primes were randomly assigned to the practice and warm-up targets and the resulting pairs were presented in a random order that was determined separately for each participant. Experimental prime-target pairs were constructed in the following way. Each prime was assigned to one randomly chosen target of each of the four possible types of targets (2 valences × 2 semantic categories). As such, each prime and each target was presented four times, two times in an affectively congruent combination, two times in an affectively incongruent combination. The order in which the experimental prime-target pairs were presented was randomised for each participant separately with the following restrictions: (a) two consecutive presentations of the same target had to be separated by at least three trials; (b) a prime could not be repeated on two consecutive trials; (c) the semantic category of the target could not be the same on more than four consecutive trials. Each practice, warm-up, and experimental trial consisted of the following sequence of events: (a) a tone (1000 Hz, 200 ms); (b) fixation cross (500 ms); (c) the prime (200 ms); (d) a blank screen (50 ms); and (e) the target which remained on the screen until the participants pressed one of the two keys of the keypress device or 2000 ms elapsed since the beginning of the presentation of the target. If the response was incorrect, a tone (500 Hz) was presented for 500 ms. The next trial was initiated after 2000 ms.

Results and Discussion

For each participant, the mean reaction time on congruent (the valence of the prime and target matched) and incongruent (prime and target had a different valence) experimental trials were calculated. We first discarded trials on which the reaction time could be considered a far out value (i.e., three interquartile ranges above the third quartile, see Tukey, 1977) with respect to the individual distribution and afterwards discarded reaction times that were shorter than 150 ms or longer than 1500 ms (0.82% of all trials). Reaction times on trials where an incorrect response was given (1.88% of all remaining trials) were also discarded. Reaction time data were then analysed using a 2 (semantic category) $\times$ 2 (congruence) ANOVA with repeated measurements on both variables. As in all following experiments, the significance level was set at $p < .05$ (two-sided). p-Values will only be reported in the case of marginally significant ($.05 < p < .10$) effects.[2]

All relevant means can be found in Table 1. Contrary to what we predicted on the basis of a spreading of activation account of affective priming, the ANOVA of reaction times did not reveal a main effect of congruence, $F < 1$, $d = 0.009$. The interaction between semantic category and congruence also did not reach significance, $F < 1$. Only the main effect of semantic category proved to be significant: Responses were faster towards animals words than towards person words, $F(1, 93) = 8.44$, $MS_e = 2302$, $d = 0.29$.

The present results do not support a spreading of activation account of affective priming. According to such an account, activation spreads from the representation of the prime to the representations of targets with the same valence, thus facilitating the semantic encoding of affectively congruent compared to affectively incongruent targets. Because the semantic categorisation of a target depends on the semantic encoding of the target, spreading of activation from primes to affectively related targets should have facilitated the semantic categorisation of targets that were preceded by primes with the same valence

[2] As in Experiment 2, error data were not analysed because of the small number of incorrect responses. We also performed an ANOVA on the log-transformed reaction times. This analysis led to the same effects and conclusions, both in Experiment 1 and Experiment 2.

TABLE 1
Mean response times (in ms) and error rates (in %) for affectively polarised targets as a function of congruence and semantic category: Experiment 1

	Congruence		
	Congruent	*Incongruent*	*AP*[a]
Reaction times (ms)			
Person	576	579	3 (5)
Animal	591	594	3 (5)
Overall	584	587	3 (4)
Error rates (%)			
Person	1.8	1.8	0.0 (0.5)
Animal	2.1	2.3	0.1 (0.5)
Overall	1.9	2.0	0.1 (0.3)

[a] Affective priming: Mean of incongruent minus congruent prime condition; standard errors in parentheses.

compared to targets that were preceded by primes with a different valence. We were, however, unable to obtain such an affective priming effect when participants had to determine whether the target referred to a person or an animal.[3] Given our large sample size, it is unlikely that this null result was due to low statistical power. Power analysis showed that we were able to detect an effect of $d = 0.34$ with a probability of 95% and an effect of $d = 0.26$ with a probability of 80% (alpha was set to .05, one-tailed). Affective priming effects with the evaluation task typically have a larger effect size (see, e.g., Experiment 2 below).

One could argue that the absence of an affective priming effect in the present study was due to subtle procedural differences between our studies and previous affective priming studies in which significant priming effects were observed. Although this study was, apart form the task instructions, highly similar to previous successful affective priming studies (e.g., Bargh, Chaiken, Govender, & Pratto, 1992; De Houwer, Hermans, & Eelen, 1998; Fazio et al., 1986; Hermans, 1996; Hermans et al., 1994), such an alternative explanation of the present results cannot be excluded. We therefore decided to conduct another

[3] We also conducted two other studies in which we failed to observe affective priming of semantic categorisation responses. The procedure used in those studies was highly similar to the procedure used in the Experiment 1 except for the fact that participants were asked to determine whether the targets were nouns or adjectives (38 participants, $t(37) = 1.37$, $d = .20$ in the expected direction) or animate or inanimate objects (28 participants, $t(27) = -0.86$, $d = 0.16$ in the wrong direction).

experiment that consisted of two conditions that only differed with regard to the task instructions.

Experiment 2

In this experiment, we presented words that referred to positive or negative objects or persons. In one condition, participants were asked to determine the valence of the targets (affective categorisation task) whereas in the second condition they were to determine the semantic category of the targets (semantic categorisation task). If we observe a significant affective priming effect in the first but not in the latter condition, we can conclude that the absence of affective priming in the semantic categorisation condition was not due to procedural elements that interfered with affective priming.

Note that the present experiment can also be regarded as a test of the response conflict account of affective priming. When participants are asked to respond on the basis of the semantic category of the targets, responses are linked to the semantic category of the targets but are unrelated the valence of the targets. Therefore, regardless of whether the prime and target have the same valence or a different valence, primes will not be able to automatically activate a response alternative on the basis of their valence. As we explained above, the match between the valence of the primes and the targets could have an impact on response selection if participants respond on the basis of the valence of the targets. Therefore, on the basis of a response conflict account one would predict that affective congruence (i.e., the match between the valence of the prime and target) will only have an effect in the affective categorisation task but not in the semantic categorisation task. Assuming that semantic and affective categorisation depends on semantic encoding to the same extent, a spreading of activation account would lead to the prediction that affective congruence will have an equally strong effect in the semantic categorisation task than in the affective categorisation task.

Method

Participants

A total of 48 students, all of whom were native German-speakers, were recruited at the University of Trier. Both psychology students ($N = 43$) and students from other faculties who had psychology as a minor subject ($N = 5$) took part for partial fulfilment of course requirements. The data of three additional students were excluded because of extremely high error rates (above 20%).

Materials

All stimuli were German words. Thirty-two words denoting objects and 32 words referring to persons—half of each category positive, half negative—were used as targets. Person targets had a mean length of 6.38 letters (SD = 1.43), object targets had a mean length of 5.72 letters (SD = 1.59). Sixty-four verbs—half of them positive, half negative—were used as primes. They had a mean length of 7.55 letters (SD = 1.58). The mean affective rating (-10 = very negative; 10 = very positive) for these words in a pilot study in which 48 students at the University of Trier participated, was 5.96 (SD = 1.33) for positive verbs and -6.60 (SD = 1.84) for negative verbs. The complete list of experimental stimuli can be found in Appendix B.

Words were written in white upper-case letters on a black background and were presented on a 15 inch VGA screen connected to an IBM compatible 386 computer. Two almost identical computers were used in parallel. The assignment of task to computer was fixed but switched after 32 participants. A letter was 5 mm high and 3 mm wide. Presentations were controlled by a Turbo Pascal 6.0 program that operated in text mode. Participants were seated in front of the computer screen at a distance of approximately 40 cm. Responses were given by pressing either the ‘‘a’’ or ‘‘#’’ key on a German standard keyboard. Latency of response was recorded to the nearest millisecond (Haussmann, 1992).

Procedure

Participants were told that two words would be presented on each trial, the first of which would be presented only briefly. Depending on the condition, participants were instructed to classify the second word as ‘‘person’’ or ‘‘object’’ (semantic categorisation task) or as ‘‘positive’’ or ‘‘negative’’ (affective categorisation task). Both speed and accuracy were emphasised.

The experiment started with 8 practice trials. After a brief break, 16 warm-up trials were presented, followed by two blocks of 64 experimental trials. The experimental prime-target pairs were constructed in the following way. The target list was split into two sublists (balanced for semantic category and valence). For half of the participants in each condition, the first (second) subset was primed with a positive (negative) prime in the first block and with a negative (positive) prime in the second block. For the other participants, the assignment of prime valence to subsets and block was the other way round. The assignment of prime stimuli to targets was according to the following scheme. The prime list was split into four sublists (balanced for valence). Within each block, each sublist was assigned to one of the four (semantic category $\times$ valence) target categories according to a latin-square scheme. The two latin-squares for the two blocks made up a graeco-latin square. This scheme guarantees that the first versus second presentation of a given prime is uncorrelated with respect to the target category. Within a given prime subset, the assignment of primes to targets was randomised for each participant.

The sequence of stimuli within each block was randomised for each subject with the following restrictions. The first and second half of each block comprised four trials of each (semantic category × target valence × prime valence) condition. The semantic category and valence of a target could not be the same on more than seven successive trials. Also, the valence of a prime could not be the same on more than four successive trials. The practice and warm-up primes and targets were randomly selected from all possible primes and targets with the following restrictions. From each of the eight (semantic category × valence × balancing sublist) target categories, three target stimuli should be drawn and the number of positive and negative primes should be equal. Primes were randomly assigned to targets with the restriction that there would be an equal number of affectively congruent and incongruent combinations.

On each practice, warm-up, and experimental trial, a prime was presented for 200 ms, followed by a 100 ms blank interval before onset of the target. Therefore, the stimulus onset asynchrony (SOA) was 300 ms. The target disappeared as soon as the subject pressed a key. The interval between response and the beginning of the next trial was 3000 ms. ''Person'' and ''positive'' decisions were assigned to the right index finger, ''object'' and ''negative'' decisions to the left one.

Results and Discussion

As in Experiment 1, mean reaction times were derived from correct responses only. The average error rate across subjects was 3.6% for the affective categorisation task and 5.2% for the semantic categorisation task. Reaction times were trimmed in the same way as in Experiment 1 (1.2% of all affective categorisation responses and 1.8% of all semantic categorisation responses). The mean reaction times were subjected to a 2 (task: affective categorisation vs. semantic categorisation) × 2 (semantic category: person vs. object) × 2 (affective congruence: congruent vs. incongruent) ANOVA with repeated measures on the last two variables. The relevant means are displayed in Table 2.

The ANOVA of the reaction time data revealed a significant main effect of congruence, $F(1, 46) = 6.10$, $MS_e = 2455$, further specified by a significant interaction with task, $F(1, 46) = 5.70$, $MSe = 2293$. For the affective categorisation task, there was a significant affective congruency effect, $t(23) = 3.26$. With a mean of 14 ms and a standard deviation of 21 ms, this difference corresponds to an effect size of $d = 0.67$. For the semantic categorisation task, the main effect of congruence was not significant, $t(23) = 0.06$, $d = 0.01$.[4] The ANOVA also revealed a significant main effect of semantic category, $F(1, 46) = 6.89$, $MS_e = 7419$, further specified by a significant interaction with task,

[4] Additional item analyses also showed a significant interaction between task and congruence and a significant main effect of congruence in the affective categorisation but not in the semantic categorisation task.

TABLE 2
Mean response times (in ms) and error rates (in %) for affectively polarised targets as a function of congruence, semantic category, and task: Experiment 2

	Congruence		
	Congruent	*Incongruent*	*AP*[a]
Affective categorisation task			
Reaction times (ms)			
Person	615	630	15 (5)
Object	618	631	13 (7)
Overall	616	630	14 (4)
Error rates (%)			
Person	3.1	4.3	1.2 (0.9)
Object	2.9	4.3	1.4 (1.3)
Overall	3.0	4.3	1.3 (0.8)
Semantic categorisation task			
Reaction times (ms)			
Person	590	588	−2 (6)
Object	610	613	3 (4)
Overall	600	600	0 (4)
Error rates (%)			
Person	6.5	6.6	0.1 (1.2)
Object	3.3	4.4	1.2 (1.3)
Overall	4.9	5.5	0.7 (0.8)

[a] Affective Priming: Mean of incongruent minus congruent prime condition; standard errors in parentheses.

$F(1, 46) = 4.45$, $MS_e = 4795$. For the affective categorisation task, reaction times were not influenced by the semantic category of the targets, $t(23) = 0.50$, $d = 0.10$, whereas responses to object targets were 22 ms slower than responses to person targets in the semantic categorisation task, $t(23) = 2.76$, $d = 0.56$. Neither the main effect of task, nor any other effect was significant, Fs < 1.

As was the case in the previous experiment, we failed to observe an affective priming effect when participants were asked to determine the semantic category of the targets. Whereas the previous failure could be attributed to subtle procedural differences between that study and other studies in which significant priming effects were obtained, such an alternative explanation is less likely for the null effect that was obtained in the semantic condition of the present experiment. If procedural elements had been responsible for the present null finding, one would also have expected a null effect in the procedurally identical condition in which the targets had to be categorised affectively. The fact that a significant affective priming effect did occur in the latter condition thus lends more weight to the null effect that was obtained in the semantic condition.

Also, the interaction between task and congruence supports a response conflict account of affective priming. As was predicted on the basis of this account, affective congruence only had an impact in the affective categorisation task but not in the semantic categorisation task. This supports the assumption that affective priming in the affective categorisation task was due to the fact that primes automatically activated the correct response on congruent trials and the incorrect response on incongruent trials. Affective priming did not occur in the semantic categorisation task because the responses were unrelated to valence. As such, prime valence could not influence response selection.

GENERAL DISCUSSION

In the affective priming task that was introduced by Fazio et al. (1986), two stimuli are presented that either have the same or a different valence. It is now well established that the match between the valence of the prime and the valence of the target influences the time that is needed to affectively categorise the target as positive or negative. One can explain this effect if it is assumed that primes facilitate the semantic encoding of affectively congruent targets through spreading of activation (e.g., Bower, 1991; Fazio et al., 1986; Hermans et al., 1994). Affective priming, however, could also be partly due to the fact that primes influence the process of response selection (e.g., Klauer et al., 1997; Wentura, 1999).

We reported the results of two studies in which participants were asked to respond on the basis of a nonaffective semantic feature of the target. If primes facilitate the semantic encoding of targets with the same valence, and if retrieval of semantic category information depends on semantic encoding to the same extent than the retrieval of valence information, one would expect that affective priming effects would be equally strong when participants are asked to semantically categorise targets than when they are asked to affectively categorise those targets. On the basis of a response account of affective priming, one would expect affective priming effects only when the valence of the targets is relevant. With such a task, all positive targets are assigned to one response whereas all negative targets are assigned to a second response. Primes can therefore induce a tendency to give the response that was assigned to targets with the same valence, thus facilitating response selection on affectively congruent trials and inhibiting the selection of the correct response on affectively incongruent trials. In a semantic categorisation task, however, there is no fixed match between target valence and response. Therefore, prime valence cannot bias response selection differently on affectively congruent than incongruent trials.

Contrary to what could be expected on the basis of a spreading of activation account, we failed to observe significant affective priming when participants determined whether the target referred to a person or an animal (Experiment 1), or to a person or an object (Experiment 2). Whereas the absence of a significant affective priming effect in Experiment 1 could be attributed to procedural elements of these studies, such an explanation is less likely for the null effect in the semantic condition of Experiment 2 because a significant affective priming effect was found when the same procedure was used but participants were asked to respond on the basis of valence of the targets. The fact that affective priming did occur in the affective categorisation condition but not in the semantic categorisation condition of Experiment 2 suggests that affective priming of affective categorisation responses is due to processes that occur at the response selection stage rather than to processes that occur at the semantic encoding stage.

Klinger, Burton, and Pitts (2000, experiment 4) independently obtained results similar to ours. Klinger et al. (2000) asked their participants to either respond on the basis of the affective valence of the targes (positive or negative) or to respond on the basis of a semantic feature of the targets (animate or inanimate). Like us, they only found a significant affective priming effect in the affective categorisation condition but not in the semantic categorisation condition and concluded that their results support a response conflict account rather than a spreading of activation account. There were, however, two important differences between the present studies and the studies conducted by Klinger et al. (2000). First, in the studies of Klinger et al., primes were masked in such a way that participants did not consciously perceive them. Second, words that functioned as the prime on some trials were the target on other trials.

These differences are far from trivial. First, one could argue that because the primes were presented subliminally, less semantic activation and thus spreading of activation occurred. This could explain why no effects were found in the semantic categorisation condition. Second, Abrams and Greenwald (2000) demonstrated that affective priming with masked prime words only occurred when these words also served as targets or when perceptually similar words functioned as targets. They argued that when words are targets, responses become associated with the perceptual features of these words. Therefore, when a word that was previously a target functions as the prime on a subsequent trial, the response that was associated with that word when it was a target will be activated. Importantly, this response activation is not based on a semantic analysis of the (subliminally presented) prime but on a perceptual analysis. Abrams and Greenwald (2000) demonstrated this by showing that the prime word SMILE facilitated negative rather than positive responses if the words SMUT and BILE were previously categorised as being negative. Affective priming effects did not occur when the masked primes never functioned as targets or were perceptually different from the targets.

On the other hand, in virtually all affective priming studies with unmasked primes, primes never functioned as targets. As such, one can conclude that affective priming with masked primes is fundamentally different from affective priming with unmasked primes: Whereas the former is determined by a perceptual analysis of the primes, the latter is due to a true semantic analysis of the primes. Therefore, the results of Klinger et al. (2000) might not inform us about the relative contribution of spreading of activation and response conflicts to affective priming with unmasked primes. The results of the present studies, however, do provide valid information about the processes that underlie affective priming with unmasked primes.

Our conclusion that affective priming is due to processes that occur at the response selection stage rather than to processes that occur at the semantic encoding stage is in line with the conclusion reached by Wentura (1998, 2000). Although Wentura did observe affective priming effects when a nonaffective feature of the targets was relevant (i.e., wordness), he demonstrated that these effects were due to processes at the response selection stage rather than at the semantic encoding stage. On the other hand, the fact that reliable affective priming effects can be observed in the pronunciation task (e.g., Bargh et al., 1996; Hermans et al., 1994) does suggest that primes can influence the semantic encoding of affectively related targets (De Houwer et al., 2001b; Hermans et al., 2001). At present, we can only speculate about ways to reconcile the results of pronunciation studies with the results from lexical decision and semantic categorisation studies.

Perhaps these findings can be reconciled if one assumes that automatic affective processing is to a certain extent goal-dependent (Bargh, 1992). In a lexical decision and semantic categorisation task, participants are given the goal to process one particular nonaffective feature of the targets. Such a specific goal could interfere with the activation of task-irrelevant information about the primes such as their associated evaluation in memory. As a result, activation cannot spread to other concepts with the same valence. In a pronunciation task, however, participants do not have to focus on one feature of the targets but only have to identify the targets. This goal is less specific and might leave more room for an automatic evaluation of the primes and thus spreading of activation to affectively related concepts. However, the results of the lexical decision studies conducted by Wentura (1998, 2000) are at odds with such an explanation. His results suggested that affectively congruent prime-target pairs induced a tendency to give an affirmative response whereas affectively incongruent prime-target pairs activated a negative response. This implies that the valence of the primes was processed automatically even though participants had the specific goal of determining the wordness of the target. One can thus conclude that automatic affective processing does not depend on the task demands.

Why then does the affective priming effect depend on task demands? One important difference between the affective categorisation, semantic categorisation, and lexical decision task on the one hand and the pronunciation task on the other, is that there are only two possible response alternatives in the first three tasks whereas as in the pronunciation task, the set of possible responses is as large as the total number of different targets. The hypothesis that the number of response alternatives might have an important impact on the degree to which spreading of activation influences task performance is supported by the fact that associative priming of pronunciation responses increases in magnitude with increases in the number of possible targets and thus responses (La Heij, Van der Heijden, & Schreuder, 1985). Of course, associative priming does occur in the lexical decision task even though there are only two responses in this task. However, there is considerable evidence to support the hypothesis that associative priming in the lexical decision task is not due to spreading of activation but rather to response conflicts (e.g., Holender, 1992; Wentura, 2000; West & Stanovich, 1982) or to post-lexical checking mechanisms (e.g., Neely & Keefe, 1989; Ratcliffe & McKoon, 1988; Shelton & Martin, 1992). As such, one could argue that only associative priming of pronunciation responses is due to spreading of activation (e.g., Shelton & Martin, 1992). The fact that associative priming of pronunciation responses becomes stronger as the number of possible increases thus clearly suggests that the impact of spreading of activation on performance becomes stronger as the number of response alternatives increases.

Our analysis suggests that affective priming is a phenomenon that can be induced by several mechanisms, each of which only operates under a limited set of conditions (see also Klauer & Musch, in press). First, spreading of activation can facilitate responses on affectively congruent compared to incongruent trials provided that: (a) there are several possible response alternatives, and (b) the selection of the correct response depends on the semantic encoding of the targets. Second, a Stroop-like response conflict will produce affective priming if: (a) there is only a limited set of possible responses, and (b) all targets of the same valence are assigned to one response. Third, affective priming can be induced on the basis of judgemental tendencies (Klauer & Stern, 1992) provided that the response alternatives are linked to an affirmative or a nonaffirmative statement.

In the pronunciation task, spreading of activation can influence reaction times because there a many possible responses. Moreover, recent research shows that the magnitude of affective priming effects in the pronunciation task increases as the result of manipulations that increase the role of semantic encoding in pronunciation (De Houwer et al., 2001b; Spruyt, Hermans, De Houwer, & Eelen, 2001). In the affective categorisation task, spreading of activation will have little or no impact on performance because there are only two possible responses. However, because all targets of the same valence are mapped onto a single response, affective priming effects can arise as the result of a Stroop-like response conflict. In the lexical decision task, spreading of activation cannot operate because of the limited number of responses and Stroop-like response conflicts cannot induce affective priming because both positive and negative targets are assigned to the ''word''-response. However, one response is affirmative (e.g., YES this is a word) and the other response is nonaffirmative (e.g., NO this is not a word). Because affectively congruent prime-target pairs will automatically activate the affirmative response whereas affectively incongruent pairs will induce a tendency to give the nonaffirmative response, affective priming effects can arise. Finally, in the semantic categorisation task, spreading of activation cannot operate because of the limited set of responses, Stroop-like response conflicts cannot arise because their is no one-to-one link between target valence and responses, and judgemental tendencies can also not produce affective priming because the responses are not clearly affirmative or nonaffirmative. Note, however, that on the basis of our analysis, we predict that affective priming can occur in certain semantic categorisation tasks. For instance, spreading of activation might induce affective priming effects if the semantic categorisation task involves more than two possible semantic categories and thus responses. Judgemental tendencies can also produce priming effects if one encourages participants to focus on one category (e.g., YES this is a person vs. NO this is not a person).

Although our analysis acknowledges that spreading of activation can produce affective priming effects in certain tasks, this assumption is mainly based on the results of pronunciation studies. One should also consider the possibility that affective priming of pronunciation responses is not due to spreading of activation at the semantic encoding stage. For instance, Rothermund and Wentura (1998) pointed out that pronouncing a positive word typically involves other articulatory routines than pronouncing a negative word (see also, Gardner, 1985). Therefore, with incongruent prime-target pairs, a conflict might arise at the phonological or articulatory levels of the response production process. Also, there is some evidence that post-lexical processes could be responsible for associative priming effects in the pronunciation task (Balota, Boland, & Shields, 1989; Balota & Chumbley, 1985). However, at present there is no evidence to support the hypothesis that affective priming of pronunciation responses is due to processes other than spreading of activation. Moreover, Ferguson and Bargh (2001) recently demonstrated affective priming effects in a word-stem completion task and word definition task. They argue that their results also support the hypothesis that primes can influence the semantic encoding of targets with the same valence. One way to examine the role of spreading of activation further is to test our prediction that spreading of activation will produce affective priming effects in the semantic categorisation task if there are several possible categories and thus responses.

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APPENDIX A

Primes and targets presented in Experiment 1

Positive primes: VREDE (peace), BOEKET (bouquet), ZON (sun), HUMOR (humour), WENS (wish), BLOESEM (blossom), LENTE (spring), LIEFDE (love), KUS (kiss), GOUD (gold).

Negative primes: ZIEKTE (illness), VUILNIS (garbage), ANGST (fear), PANIEK (panic), DOOD (dead), ONGELUK (accident), PUIST (pustule), VET (lard), VERDRIET (sadness), PIJN (pain).

Positive animal targets: VLINDER (butterfly), PAARD (horse), VOGEL (bird), ZWALUW (swallow), EENDJE (duckling), KATJE (kitten), HERT (deer), PANDA (panda), DOLFIJN (dolphin), ZWAAN (swan).

Negative animal targets: RATTEN (rats), GIER (vulture), SLANG (snake), MUIS (mouse), HAGEDIS (lizard), MUG (gnat), KAKKERLAK (cockroach), KEVER (beetle), SLAK (slug), WORM (worm).

Positive person targets: VRIEND (friend), PEUTER (toddler), KIND (child), BROER (brother), GENIE (genius), MOEDER (mother), OPTIMIST (optimist), MEISJE (girl), HELD (hero), EXPERT (expert).

Negative person targets: TIRAN (tyrant), GANGSTER (gangster), BRUUT (brute), SNOB (snob), EGOIST (egoist), BEUL (torturer), DIEF (thief), SADIST (sadist), HOER (whore), VIJAND (enemy).

APPENDIX B

Primes and targets presented in Experiment 2

Positive primes: TANZEN (dance), KÜSSEN (kiss), LACHEN (laugh), LOBEN (praise), DANKEN (thank), SCHENKEN (give as a present), UMARMEN (embrace), FEIERN (celebrate), AUSRUHEN (have a rest), BELOHNEN (reward), SPIELEN (play), KUSCHELN (snuggle up to), SINGEN (sing), STREICHELN (caress), BEGEISTERN (inspire), FREUEN (be pleased), ENTSPANNEN (relax), BEGLÜCKEN (make someone happy), LIEBEN (love), JUBELN (cheer), BADEN (take a bath), TRÄUMEN (dream), EINLADEN (invite), ERHEITERN (amuse), MALEN (paint), VERREISEN (travel), FLIRTEN (flirt), GENIESSEN (enjoy), WÄRMEN (warm up), SCHMUSEN (cuddle), SCHERZEN (joke), SCHLAFEN (sleep)

Negative primes: SCHLAGEN (hit), WEINEN (cry), STREITEN (quarrel), ZERSTÖREN (destroy), BEISSEN (bite), ZERBRECHEN (break), QUÄLEN (torment), SCHIMPFEN (scold), LÜGEN (lie), STINKEN (stink), BETRÜGEN (cheat), FOLTERN (torture), TÖTEN (kill), STEHLEN (steal), VERRATEN (betray), BESTRAFEN (punish), VERZWEIFELN (despair), VERLIEREN (lose), LEIDEN (suffer), HEUCHELN (be hypocritical), HASSEN (hate), VERHUNGERN (starve to death), STERBEN (die), VERMISSEN (miss), ENTTÄUSCHEN (disappoint), ERTRINKEN (drown), VERACHTEN (despise), FÜRCHTEN (be afraid of), DEMÜTIGEN (humilate), FRIEREN (freeze), RÄUBERN (robber), EKELN (disgusted by something)

Positive person targets: BABY (baby), BRUDER (brother), FREUND (friend), MUTTER (mother), SIEGER (winner), PARTNER (partner), FREUNDIN (girl-friend), LIEBLING (darling), KIND (child), CLOWN (clown), KUMPEL (buddy), KAMERAD (companion), VORBILD (model), KÜNSTLER (artist), SPORTLER (athlete), SCHWEISTER (sister)

Negative person targets: SNOB (snob), FEIND (enemy), HENKER (hangman), LÜGNER (liar), RÄUBER (burglar), ANGEBER (braggart), DUMMKOPF (idiot), GEIZHALS (miser), Dieb (thief), NAZI (nazi), MÖRDER (murderer), SADIST (sadist), TYRANN (tyrant), SCHURKE (rogue), BETRÜGER (swindler), VERRÄTER (traitor)

Positive object targets: GOLD (gold), HONIG (honey), SEIDE (silk), SONNE (sun), FRUCHT (fruit), SCHMUCK (jewellery), EISCREME (icecream), GESCHENK (gift), RING (ring), ROSE (rose), BLUME (flower), ESSEN (food), BONBON (candy), SILBER (silver), DIAMANT (diamond), SCHOKOLADE (chocolate)

Negative object targets: KOT (faeces), MÜLL (garbage), TUMOR (tumour), VIRUS (virus), WAFFE (weapon), SCHMUTZ (dirt), SPRITZE (injection), GESCHWÜR (ulcer), MIST (dung), SARG (coffin), BOMBE (bomb), DRECK (muck), EITER (pus), GALGEN (gallows), UNKRAUT (weeds), BAKTERIE (bacterium)