Automatic non-associative semantic priming: Episodic affective priming of naming responses

Adriaan Spruyt a,*, Dirk Hermans a, Jan De Houwer b, Paul Eelen a

a Department of Psychology, University of Leuven, Tiensestraat 102, Leuven B-3000, Belgium
b Ghent University, Belgium

Received 29 September 2003; received in revised form 5 December 2003; accepted 9 December 2003

Abstract

Affective priming for associatively unrelated prime–target pairs was investigated using (a) the naming task, (b) a short stimulus onset asynchrony (250 ms), and (c) primes that had acquired their affective connotation during a differential evaluative conditioning procedure. Despite the fact that the primes and the targets were related on the affective dimension only, significant priming emerged. This finding indicates that mere affective overlap is sufficient to produce automatic priming. As such, our results are in line with theoretical accounts of automatic priming that are based on semantic relatedness.

© 2003 Elsevier B.V. All rights reserved.

PsycINFO classification: 2343; 2360; 3040

Keywords: Affective priming; Associative priming; Semantic priming

1. Introduction

Although most researchers agree that the priming paradigm is a valuable tool for studying how knowledge is represented in memory, strong disagreement exists concerning the specific nature of the automatic priming effect. Whereas some researchers have argued that automatic priming can be found for semantically related prime–target pairs that are associatively unrelated, many others have claimed that associative
relatedness is a prerequisite for automatic priming to be obtained. The reason for this issue to be a vexed question is that theoretical accounts of automatic priming tend to be based either on associative relatedness (e.g., McKoon & Ratcliff, 1989, 1992; Ratcliff & McKoon, 1988, 1995) or semantic relatedness (e.g., Kawamoto, 1988; Masson, 1995). As such, the uncovering of the underlying nature of the automatic priming effect might have strong implications for the plausibility of several models of priming in particular and memory in general.

**Associative relatedness** can be defined as the extent to which the activation of one concept (e.g., ‘Laurel’) will call to mind another concept (e.g., ‘Hardy’) due to their repeated temporal or spatial co-occurrence. **Semantic relatedness**, on the other hand, can be defined as the extent to which concepts are similar in meaning or overlap in featural description (e.g., ‘cat’–’lion’). Although associative and semantic relatedness often co-vary, it is possible to dissociate both types of relationships (Thompson-Schill, Kurtz, & Gabrieli, 1998): stimuli can be highly associated yet semantically unrelated (e.g., ‘wall’–’paper’) and vice versa (e.g., ‘whale’–’elephant’). It is thus possible to study the effects of associative and semantic relatedness independently. However, an investigation into the underlying nature of the automatic priming effect is complicated by the fact that priming effects can also be brought about by strategic processes. Therefore, to demonstrate that automatic semantic priming can be obtained with associatively unrelated stimulus materials, one needs to control for the effects of strategic processes.

Two types of strategies have been found to operate in priming experiments: expectancy generation and post-lexical relatedness checking (Neely, 1991). According to an **expectancy generation account of priming**, participants use the prime to generate an expectancy set that consists of potential targets that are semantically related to the prime. Within this framework, priming effects are assumed to arise because responses are faster when the target is part of the (related) expectancy set than when it is not (e.g., Becker, 1980; Neely, 1991). However, as participants need to have enough time to generate such expectancies, it has been argued that expectancy generation can be effective only at long stimulus onset asynchronies (SOA; de Groot, 1984; den Heyer, Briand, & Dannenbring, 1983; Neely, 1977; Stolz & Neely, 1995).

According to the **post-lexical checking account of priming**, participants assess the semantic relation between the prime and the target subsequent to the target’s presentation but prior to responding to the target. The information concerning the prime–target relatedness is then used as a cue for response selection (e.g., Balota & Lorch, 1986; de Groot, 1984; Neely, 1991). For example, it can be argued that, in the lexical decision task, participants are biased to indicate that the target of a semantically related prime–target pair is a word because the presence of a semantic relation between the prime and the target necessarily implies that the target is an existing word. On the other hand, when no semantic relation is found between a prime and a (word) target, participants are assumed to be (incorrectly) biased to indicate that the target is a non-word. As a result, responses on semantically related trials will be faster relative to responses on semantically unrelated trials. As the post-lexical relatedness checking mechanism can be effective only when the prime–target relatedness can be used as a cue for response selection, any experimental procedure that eliminates the cue value...
of the prime–target relatedness is assumed to prevent its use. For example, one could use the naming task to eliminate post-lexical relatedness checking because noticing a relation between a prime and a target provides no information about what naming response should be given (e.g., Balota & Lorch, 1986; de Groot, 1985; Pecher, Zee- lenberg, & Raaijmakers, 1998; Seidenberg, Waters, Sanders, & Langer, 1984). Other techniques for ruling out post-lexical relatedness checking have also been developed. We will discuss these techniques when we consider the studies that have implemented them.

2. Inconclusive evidence

Fischler (1977) was the first to address the issue of semantic priming for associatively unrelated words. Using the lexical decision task, Fischler (1977) found that associatively unrelated pairs of words that were semantically related were responded to faster than associatively unrelated pairs of words that were semantically unrelated. However, in the lexical decision task that was used by Fischler (1977), the primes and the targets were presented simultaneously and the participants were instructed to decide whether or not both letter strings were words. Clearly, this procedure may have encouraged participants to evaluate the prime–target relationship. For that reason, it has been argued that the priming effects that were observed by Fischler (1977) were due to post-lexical relatedness checking rather than to automatic non-associative semantic priming (e.g., Shelton & Martin, 1992).

Unfortunately, specific precautionary measures are required to eliminate the cue value of the prime–target relationship in the lexical decision task. Therefore, all non-associative semantic priming studies that have used the standard version of the lexical decision task (e.g., Chiarello, Burgess, Richards, & Pollock, 1990; Flores d’Arcais, Schreuder, & Glazenburg, 1985; Hodgson, 1991; Lupker, 1984; Moss, Ostrin, Tyler, & Marslen-Wilson, 1995; Pecher et al., 1998; Perea & Gotor, 1997; Schreuder, Flores d’Arcais, & Glazenburg, 1984; Seidenberg et al., 1984; Thompson-Schill et al., 1998) can also be criticized because of an inadequate control for post-lexical relatedness checking (Lupker, 1984; Seidenberg et al., 1984).

However, there are a few lexical decision studies of non-associative semantic priming that did succeed in eliminating post-lexical relatedness checking. Probably the best known examples are the lexical decision studies of McRae and Boisvert (1998) and Shelton and Martin (1992). They eliminated post-lexical relatedness checking in their lexical decision studies by using the single-presentation priming technique. This method avoids overt pairing of the primes and the targets by requiring participants to respond to each of a series of singly presented stimuli, with the lists constructed so that the primes precede their targets. Having established that the single-presentation technique reveals automatic associative priming effects (Experiments 1 and 2), Shelton and Martin (1992) investigated whether non-associative semantic priming could be observed when using this procedure (Experiments 3 and 4). They found that priming for unassociated, semantically related word pairs was non-significant whereas strong priming effects were obtained with associatively
related word pairs. Hence, Shelton and Martin (1992) concluded that “words that are very similar in meaning or sharing many features will not show automatic semantic priming if they are not also associated” (p. 1204). However, McRae and Boisvert (1998) later argued that the absence of non-associative semantic priming in the studies of Shelton and Martin (1992) might have been due to the fact that they used unassociated word pairs that were only semantically related to a moderate extent. In line with this reasoning, McRae and Boisvert (1998) demonstrated that significant non-associative semantic priming of lexical decisions can be obtained in the single-presentation procedure if prime–target pairs are used that are semantically highly related.

However, as pointed out by McRae and Boisvert (1998), questions can be raised concerning the effectiveness of the single-presentation priming procedure at ruling out strategic processes. Because the single-presentation procedure requires a response to every stimulus, it necessarily results in increased SOAs (approximately 850 ms in the experiments of McRae & Boisvert, 1998). Therefore, it could be argued that the priming effects that McRae and Boisvert (1998) obtained with the single-presentation priming procedure were due to expectancy generation. For that reason, McRae and Boisvert (1998) again implemented the paired presentation priming procedure and investigated whether they could replicate the non-associative semantic priming effect at the short SOA of 250 ms in a semantic categorization task (i.e., “Is it a concrete object?”). A semantic categorization task was used because this task effectively eliminates the use of post-lexical relatedness checking if the semantic relatedness provides no information about what the correct response is, that is, if $P(\text{"yes" response}|\text{relatedness}) = P(\text{"no" response}|\text{relatedness}) = 0.50$. In line with their expectations, McRae and Boisvert (1998) observed that the unassociated prime–target pairs that were highly semantically related produced significant priming at the short SOA of 250 ms in the concrete object decision task. Hence, they concluded that their study firmly established the existence of automatic non-associative semantic priming.

However, recent findings of Wentura (2000) suggest that prudence might be in order when interpreting the results of the concrete object decision studies of McRae and Boisvert (1998). Wentura (2000) demonstrated that reversed priming of lexical decisions (i.e., shorter response latencies for unrelated prime–target pairs than for related prime–target pairs) can be obtained with affectively related and affectively unrelated stimulus materials when participants are instructed to respond with an affirmative response (“yes”) to the non-word trials and with a negative response (“no”) to the legitimate word trials. Wentura (2000) explained this finding on the basis of the judgmental tendency model of Klauer and Stern (1992). According to this model, (affectively) related prime–target pairs induce a judgmental tendency to affirm whereas (affectively) unrelated prime–target pairs induce a tendency to reject. As a consequence, affirmative responses are assumed to be facilitated when the prime and the target are (affectively) related whereas negative responses are assumed to be inhibited when the prime and the target are (affectively) related. Conversely, negative responses are assumed to be facilitated when the prime and the target are (affectively) unrelated whereas affirmative responses are assumed to be inhibited when the prime and the target are (affectively) unrelated. Importantly, the judgmental ten-
dency mechanism is assumed to operate at a post-lexical level, that is, no congruency effect is assumed to occur until after the target is presented and its relatedness to the prime becomes available (Wentura, 2000).

Although Wentura (2000) focused on affective priming effects in the lexical decision task, there are no reasons to assume that the effect of judgmental tendencies would be restricted to a particular experimental task or to a particular type of semantic relatedness. In fact, Wentura (2000, p. 466) suggested that affectively neutral prime–target pairs with a high degree of semantic relatedness can also induce judgmental tendencies. Of course, insofar as judgmental tendencies operate in the concrete object decision task, no systematic difference between semantically related and semantically unrelated priming trials will be found when the data of the “yes” responses as well as the “no” responses are examined. Any effect of judgmental tendencies in the affirmative response condition will simply be nullified by a reversed effect of equal size in the negative response condition. However, McRae and Boisvert (1998) only analyzed the data that resulted from trials of which both the primes and the targets had concrete referents. All other trials, including trials with semantically related prime–target pairs of which the targets referred to abstract concepts, were considered to be fillers and were excluded from the analyses. Thus, only those trials to which participants were required to respond with an affirmative response were analyzed. It could therefore be argued that the non-associative semantic priming effects that were reported by McRae and Boisvert (1998) were a mere by-product of the judgmental tendency mechanism. Consequently, it is advisable to consider the findings of McRae and Boisvert (1998) to be suggestive rather than conclusive.

In light of these considerations, the results that have been obtained with the naming task are of major importance. The naming task is believed to be less sensitive to strategic processing in general, and to post-lexical checking in particular (e.g., Balota & Lorch, 1986; de Groot, 1984; Forster, 1981; Lupker, 1984; Pecher et al., 1998; Seidenberg et al., 1984; Shelton & Martin, 1992; Thompson-Schill et al., 1998; West & Stanovich, 1982). Unfortunately, the results that have been obtained with the naming task are far from straightforward. Although some authors observed a significant non-associative semantic priming effect in the naming task with a short SOA (e.g., Ober, Vinogradov, & Shenaut, 1995; Perea & Gotor, 1997; Thompson-Schill et al., 1998), many other experimenters failed to observe significant non-associative semantic priming effects under conditions that are assumed to rule out expectancy generation (e.g., Hodgson, 1991; Irwin & Lupker, 1983; Lupker, 1984; Pecher et al., 1998). Furthermore, other naming studies that did show significant non-associative semantic priming effects used rather long SOAs (e.g., 500 ms in Seidenberg et al., 1984, Experiment 4) and hence failed to rule out the possibility that these priming effects were due to expectancy generation (see also, for other examples of naming studies that have used long SOAs, Huttenlocher & Kubicek, 1983; Sperber, McCauley, Ragain, & Weil, 1979).

To summarize, although the issue of non-associative semantic priming has been extensively studied over the past 25 years, the corpus of empirical evidence that has been obtained so far is insufficient to unequivocally substantiate the existence of automatic non-associative semantic priming.
3. Affective priming

Although overlooked in the literature on semantic priming, an impressive series of studies exists that might shed light on the underlying nature of the automatic priming effect. Within the field of affective priming, numerous studies (see Klauer & Musch, 2003, for an overview of more than 80 studies) have shown that a valenced target stimulus is responded to more quickly after the presentation of an affectively congruent prime stimulus than after the presentation of an affectively incongruent prime stimulus. For two reasons, these affective priming studies are highly relevant for the discussion concerning the underlying nature of the automatic priming effect.

First, as affective information is stored within the semantic system (e.g., Bower, 1991; De Houwer & Hermans, 1994; De Houwer & Randell, in press; Fiske & Pavelchak, 1986), affective priming can be considered to be a specific subtype of semantic priming. Thus, provided that associative relatedness can be controlled for, the affective priming paradigm can be used to study the conditions under which automatic non-associative semantic priming can be obtained.

Second, affective priming research has provided strong evidence for the claim that the affective priming effect is based on an unconditional and automatic process. More specifically, it has been demonstrated that the affective priming effect does not depend on the conscious identification of the primes (e.g., Draine & Greenwald, 1998), nor on the presence of ample processing resources (e.g., Hermans, Crombez, & Eelen, 2000) or an explicit evaluative processing goal (e.g., Bargh, Chaiken, Raymond, & Hymes, 1996; Spruyt, Hermans, De Houwer, & Eelen, 2002). Moreover, the affective priming effect has also been demonstrated in the naming task at very short SOAs (e.g., Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Hermans, De Houwer, & Eelen, 2001). For example, in a fine-grained analysis of the temporal characteristics of the affective priming effect, Hermans et al. (2001, Experiment 2) showed that affective priming effects in the naming task are most pronounced at short SOAs and even disappear at longer SOAs. If affective congruency effects were due to strategic processes, one would expect stronger, or at least similar, results when longer SOAs are used. However, the opposite is true. These findings thus suggest that affective congruency effects are based on a fast-acting automatic process that does not depend on post-lexical relatedness checking (naming task) or expectancy generation (short SOA). However, in none of the published affective priming studies that have used the naming task associative relatedness was explicitly controlled for. Therefore, these studies can be criticized because of a possible confounding between affective relatedness and associative relatedness. The present study was designed to empirically address this issue.

4. The present research

In the present study, we examined affective priming in the naming task for prime–target pairs that shared nothing more than their affective connotation. In order to rule out any degree of associative relatedness between the primes and the targets,
we experimentally created the affective connotation of the primes during an evaluative conditioning phase (see De Houwer, Thomas, & Baeyens, 2001, for a review). Evaluative conditioning refers to changes in the liking of a stimulus (conditioned stimulus, CS) that are due to the fact that this stimulus has been paired with other, positive or negative stimuli (unconditioned stimulus, US). In this experiment, we consistently paired one neutral picture (CS+) with an electric shock (US) whereas a second neutral picture (CS−) was never followed by an electric shock (see Hermans, Spruyt, & Eelen, 2003, for a similar procedure). This differential evaluative conditioning procedure ensured that the CS+ and the CS− became affectively related with negative targets and positive targets respectively, without an associative relation being present. Assuming that mere affective overlap is sufficient in order to observe automatic priming, we expected to observe a significant affective priming effect under conditions that are assumed to prevent expectancy generation (SOA 250) and post-lexical relatedness checking (naming task).

5. Method

5.1. Participants

Forty first-year psychology students (5 men, 35 women) at the University of Leuven participated in partial fulfillment of course requirements. All participants were native speakers of Dutch.

5.2. Materials

Six prime pictures were selected on the basis of a preliminary rating study in which participants (N = 23) had to rate 61 randomly presented color pictures of human faces on two dimensions. First, participants were instructed to rate the affective connotation of the pictures on an 11-point rating scale ranging from −5 (very negative) to +5 (very positive). Next, they were asked to indicate the extent to which they felt aroused by the pictures on a separate 11-point rating scale ranging from 0 (very calm) to 10 (very aroused). The pictures that were selected to serve as primes were rated as affectively neutral (M = 0.02, SD = 0.31) and not arousing (M = 1.17, SD = 0.36).

Twelve target pictures were selected on the basis of a second rating study in which participants (N = 51) had to rate the affective connotation of 215 real life color pictures on an 11-point rating scale ranging from −5 (very negative) to +5 (very positive). Some of these pictures originated from the International Affective Picture System (IAPS; Center for the Psychophysiological Study of Emotion and Attention, 1994). IAPS numbers: 1120, 1300, 1302, 1930, 2053, 2057, 2070, 2120, 2165, 2800, 4250, 4611, 6250, 6550, 6560, 7000, 7009, 7090, 7034, 7004, 9040, 9340, 9410, 9561.
(SD = 0.20), $M_{\text{positive}} = 2.67$ (SD = 0.45), $t(10) = 26.35$, $p < 0.05$. All pictures were presented against the black background of an SVGA computer monitor and were 512 pixels wide and 384 pixels high (24 bits, screen resolution 800 × 600).

Electric shocks were delivered by Fukuda standard Ag/AgCl electrodes (1.2 cm diameter). The electrodes were filled with K-Y Lubricating Jelly (© Johnson & Johnson, UK).

Stimulus presentation as well as the registration of the response latencies were controlled by an Affect 1.0 program that was developed with C++ for the Windows platform (Hermans, Clarysse, Baeyens, & Spruyt, 2001). The experiment was run on a Pentium III 650 MHz computer.

5.3. Procedure

Participants were tested individually in a dimly lit and sound-proof room. Before the experiment started, the experimenter explained the procedure and the use of the electric shocks in detail. It was stressed that being present was sufficient to fulfill course requirements and that further participation was not obligatory. In addition, it was emphasized that the experiment could be aborted at any time. The experiment only started after the participant had filled out and signed an informed consent form. The experiment consisted of four consecutive phases: the US calibration phase, the evaluative conditioning phase, the affective priming phase and the rating phase. However, at the start of the experiment, participants were not informed of the fact that there were four experimental phases. The instructions for each experimental phase were only given after the previous phase was completed.

During the **US calibration phase**, the intensity of the electric shock was determined. After the electrodes were attached to the left wrist of the participant, the experimenter increased the level of the electric shock gradually until the participant reported that it was ‘unpleasant and demanding some effort to tolerate’.

Next, during the **evaluative conditioning phase**, two pictures that were randomly selected from the prime set were presented eight times in a randomized order. The offset of one of these two pictures (CS+) was immediately followed by a 1500 ms presentation of the US which had the intensity that was selected in the preceding US calibration phase. Likewise, the offset of the other picture (CS−) was followed by a delay of 1500 ms. The inter-trial interval (ITI) varied randomly between 2 and 5 s, but the mean ITI was fixed at 3.5 s. Participants were informed that two pictures would be repeatedly presented. They were told that one of these two pictures would always be followed by the electric shock, while the other stimulus would never be followed by the electric shock. They were asked to watch this series of presentations attentively.

The **affective priming phase** started with instructions that were presented on the computer screen. These instructions informed the participants that they were about to participate in a picture recognition task and that two series of practice trials would be presented prior to the start of the experimental trials. During the first series of practice trials, participants were asked to watch a random presentation of the 12 target pictures with the corresponding names of the pictures written underneath them.
Participants were asked to look closely at the pictures and at the corresponding names because they would need to use these words to name the pictures correctly during the experimental phase of the experiment. The pictures remained on the screen until the participant pressed the space bar of the keyboard. During the second series of practice trials, the 12 targets were again presented in a random order, but this time without the corresponding names written underneath them. Participants were instructed to name the pictures as fast as possible. They were instructed to use the names that were learned during the preceding series of practice trials. After completing these two series of practice trials, the instructions for the experimental trials were displayed on the computer screen. Participants were told that pairs of pictures would be presented on the computer screen. They were instructed to attend to the second picture only and to name this picture as fast as possible.

The experimental priming phase consisted of 72 trials in which each of the six prime pictures was presented once together with each target picture. As only the prime pictures that had served as CS+ and CS− during the evaluative conditioning phase were assumed to have an affective connotation, the affective priming phase consisted of 12 affectively congruent test trials, 12 affectively incongruent test trials and 48 filler trials. Each filler trial thus consisted of one of the four prime pictures that were not shown during the evaluative conditioning phase and a positive or negative target.

Each trial started with a 500 ms presentation of a fixation cross in the center of the screen. Five hundred milliseconds after the offset of the fixation cross, the prime was presented for 200 ms. Target pictures followed the offset of the prime pictures after an inter stimulus interval of 50 ms, resulting in an SOA of 250 ms. The target pictures stayed on the screen until the participant gave a response or 2000 ms elapsed. By pressing one of three keys on the computer keyboard, the experimenter coded whether the microphone was accurately triggered and whether the participant’s response was correct. The ITI varied between 1.5 and 2.5 s, but the mean ITI was fixed at 2 s.

Finally, during the rating phase, participants were asked to rate the presented stimuli on several dimensions. For each rating, the instructions, the relevant picture and the appropriate rating scale were presented on the computer screen. First, they were instructed to think back about the acquisition phase and to indicate the extent to which they had expected an electric shock following the presentation of the CS+ and the CS− on a 101-point rating scale ranging from 0 (never) to 100 (always). Next, the participants were asked to rate the extent to which they had felt fearful or anxious during the presentation of the CS+ and the presentation of the CS− on a 101-point rating scale ranging from 0 (not anxious at all) to 100 (very anxious). Finally, the participants were asked to rate the affective connotation of the CS+ and the CS− on a 101-point rating scale ranging from −50 (very negative) over 0 (neutral) to +50 (very positive).

In addition, the participants were asked to rate the US for three characteristics. First, participants were instructed to rate the (un)pleasantness of the US on a 101-point rating scale ranging from −50 (unpleasant) to +50 (pleasant). Next, they were asked to rate the intensity of the US on a 101-point rating scale ranging from 0
(weak) over 50 (intense) to 100 (unbearable). Finally, the extent to which they were startled by the US was appraised on a similar rating scale ranging from 0 (not) over 50 (moderately) to 100 (very strongly).

After completing the rating phase of the experiment, the electrodes were removed and participants were thanked for their participation.

6. Results

6.1. Rating data

Participants rated the US as unpleasant, $M = -33.95$, $t(39) = 8.88$, $p < 0.05$, and intense, $M = 65.20$, $t(39) = 33.60$, $p < 0.05$, and indicated that they were startled by the US, $M = 66.83$, $t(39) = 23.45$, $p < 0.05$. We can thus conclude that participants experienced the US as an aversive stimulus.

Overall, the picture ratings showed that the differential evaluative conditioning procedure was successful (see Table 1 for summary statistics). Participants indicated that they expected the US to a larger extent when the CS+ was presented than when the CS− was presented, $t(39) = 20.35$, $p < 0.05$. In addition, fear ratings showed that the CS+ elicited significantly more fear than the CS−, $t(39) = 23.76$, $p < 0.05$.

Most importantly, the evaluative conditioning procedure also led to significant shifts in the overall evaluation of the CS+ and the CS−: Overall, participants evaluated the CS+ as being more negative than the CS−, $t(39) = 7.23$, $p < 0.05$. However, three participants rated the CS+ as being more positive than the CS−. As the evaluative conditioning procedure was designed to experimentally create a positive affective connotation for the CS− and a negative affective connotation for the CS+, the data from these participants were excluded from further analyses.

6.2. Affective priming data

Data analyses were performed using both participants (referred to by $F_1$ and $MSE_1$) as well as items (referred to by $F_2$ and $MSE_2$ as the random factor (Clark, 1973). The data from trials on which the voice key was not appropriately activated (6.41%) or an incorrect response was given (0.68%) were excluded from the analyses. In addition, in case participants were treated as the random factor, response latencies

<table>
<thead>
<tr>
<th>Table 1 Mean US-expectancy ratings, mean fear ratings, and mean evaluative ratings for CS+ and CS− (SD in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>US-expectancy</td>
</tr>
<tr>
<td>Fear</td>
</tr>
<tr>
<td>Evaluation</td>
</tr>
</tbody>
</table>

Note: For the expectancy ratings and the fear ratings, the range was 0–100. For the evaluative ratings, the range was −50 to 50.
that deviated more than 2.5 standard deviations from a participant’s conditional mean latency (0.68%) were discarded. In case items were treated as the random factor, response latencies that deviated more than 2.5 standard deviations from an item’s conditional mean latency (2.14%) were discarded. The remaining data were, after computing mean response latencies for each cell of the design, analyzed by means of a one-way repeated measures ANOVA (affectively congruent trials vs. affectively incongruent trials).

The ANOVA showed that response latencies were significantly affected by the affective relation between the primes and the targets, $F_{1}(1, 36) = 6.25, p_{1} < 0.05, MSE_{1} = 602.93, F_{2}(1, 11) = 5.80, p_{2} < 0.05, MSE_{2} = 151.66$: Response latencies were shorter for affectively congruent priming trials as compared to the affectively incongruent priming trials (see Table 2).

### 7. Discussion

The present study revealed significant episodic affective priming of naming responses under conditions that prevented post-lexical relatedness checking (naming task) and expectancy generation (SOA 250 ms). Neutral pictures that had acquired their affective connotation during a differential evaluative conditioning procedure facilitated responding to target pictures with a similar affective connotation. This finding is important for several reasons.

First, the fact that the affective connotation of the primes was experimentally created guarantees that the observed priming effects were not due to associative relatedness. The present experiment thus unequivocally demonstrates that automatic semantic priming can be obtained with associatively unrelated stimulus materials. As such, our data are in line with distributed models of semantic priming (e.g., Masson, 1995) according to which semantically related prime–target pairs give rise to similar patterns of activation across a large number of semantic processing units. These models naturally predict semantic priming because the primes are assumed to cause the semantic processing units to begin to form a pattern of activation that is similar to the patterns of activation of semantically related target stimuli. When a target is then presented, relatively fewer updates are needed to form the semantic pattern of the target when that target is semantically related to the prime than when it is not. However, it should be noted that our findings are not entirely compatible with current versions of distributed models of semantic priming. According to a

<table>
<thead>
<tr>
<th>Random variable</th>
<th>Congruency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Congruent</td>
<td>Incongruent</td>
</tr>
<tr>
<td>Participants</td>
<td>556 (60.41)</td>
<td>570 (50.61)</td>
</tr>
<tr>
<td>Items</td>
<td>561 (19.30)</td>
<td>573 (19.08)</td>
</tr>
</tbody>
</table>

Table 2

Mean response latencies in ms as a function of affective congruency and the variable that was treated as random (SD in parentheses)
distributed model of semantic priming, the extent to which automatic semantic priming can be found is directly related to the degree of similarity between the patterns of activation of two stimuli. That is, the more overlap between the patterns of activation of the primes and the targets, the stronger the semantic priming effects are assumed to be. Some observations seem to corroborate this assumption. For example, McRae & Boisvert (1998) only obtained reliable non-associative semantic priming effects if the primes were highly similar to the targets (but see above). However, in our experiment the primes and the targets were related on the affective dimension only. An interpretation in terms of distributed representations thus implies that the similarity in the pattern of activation of the primes and the targets was restricted to the unit(s) that represent affective information. As it is typically assumed that a substantial amount of overlap between the patterns of activation of the prime and the target is required for priming effects to emerge, it is somewhat difficult to explain the present findings on the basis of distributed models of semantic memory.

However, several alterations can be implemented so as to allow affective information to exert a considerable influence on the activation pattern in the network. For example, it could be assumed that, when the network is trained, the absolute value of the connection weights between the semantic processing units that represent affective information and other (non-affective) semantic processing units are increased to a larger extent than the connection weights between non-affective semantic processing units. Or, as an alternative, it could simply be assumed that affective information is represented by a relatively large amount of processing units. Both alterations will result in affective information exerting a considerable influence on the activation pattern in the network. Interestingly, such a version of a distributed memory model implicitly assumes that affective information is of primordial importance to the human perceiver. This conclusion is far from implausible as numerous authors have argued that the affective dimension has a unique status among semantic features (e.g., Bargh, 1997; Martin & Levy, 1978; Osgood, Suci, & Tannenbaum, 1957; Zajonc, 1980). Therefore, it would be interesting to replicate the simulation studies of Mason (1995) to assess the specific characteristics that need to be incorporated in these distributed models of semantic memory in order to account for affective priming effects.

Second, from an affective priming point of view, it is also important to stress that the present experiment provides additional evidence for the hypothesis that mere affective overlap between the primes and the targets is sufficient in order to observe affective priming of naming responses (e.g., Bargh et al., 1996). Although in none of the published affective priming studies non-affective semantic overlap between the primes and the targets was explicitly controlled for, several affective priming studies already suggested that affective priming effects can be obtained with primes and targets that share (or do not share) valence and no other semantic feature. For example, in a study that was designed to demonstrate that the affective priming effect can be generalized to non-visual stimuli, Hermans, Baeyens, & Eelen (1998) demonstrated that evaluative decision responses can be affectively primed by positive and negative odors (e.g., pure civet). Clearly, it is difficult to explain this finding on the basis
of (unintended) non-affective semantic relations between the olfactory primes and the visual targets. However, our experiment is the first rigorous experimental test of the hypothesis that mere affective overlap between the primes and the targets is a sufficient precondition in order to observe affective priming of naming responses.

Third, our experiment is also highly relevant for the research that focuses on the use of the affective priming paradigm as an implicit attitude measure (see Fazio & Olson, 2003; for a comprehensive review). Previous affective priming studies have already established (a) that automatic stimulus evaluation can occur even if participants do not have the goal of evaluating stimuli in their environment (e.g., Bargh et al., 1996; Hermans, De Houwer, & Eelen, 1994; Spruyt et al., 2002), and (b) that the affective priming paradigm can be used to measure newly learned stimulus valence (e.g., De Houwer, Hermans, & Eelen, 1998; Hermans et al., 2003). However, the present experiment is the first demonstration of episodic affective priming in the naming task. This finding suggests that the naming variant of the affective priming paradigm can be successfully used to measure an individual’s preferences in an unobtrusive and demand-free manner.

Finally, it is important to note that researchers who want to study other types of semantic relations should control for affective relatedness. For example, Moss et al. (1995) reported significant priming effects for word pairs that were functionally related. However, a close inspection of their stimulus materials shows that their word pairs were not only ‘functionally’ related but also affectively related (e.g., ‘restaurant’–‘wine’, ‘war’–‘army’). Therefore, it might be argued that their results were due to affective relatedness rather than functional relatedness. Future studies will need to exclude such possible confounding.

Acknowledgements

Adriaan Spruyt, research assistant of the Fund for Scientific Research—Flanders (Belgium), Dirk Hermans, Department of Psychology, University of Leuven (Belgium), Jan De Houwer, Department of Psychology, Ghent University (Belgium); Paul Eelen, Department of Psychology, University of Leuven (Belgium). We would like to thank Mario Pandelaere for his comments on an earlier version of this manuscript.

References


