Social Cognition, Vol. 20, No. 3, 2002, pp. 227-256

ON THE NATURE OF THE AFFECTIVE PRIMING EFFECT: AFFECTIVE PRIMING OF NAMING RESPONSES

Adriaan Spruyt and Dirk Hermans
University of Leuven, Belgium

Jan De Houwer
University of Ghent, Belgium

Paul Eelen
University of Leuven, Belgium

Bargh, Chaiken, Raymond and Hymes (1996) showed that participants need less time to name a target word if that target word is preceded by a prime word with the same valence compared to when that target word is preceded by a prime word with a different valence. However, recent studies raise serious doubts about the robustness and the reliability of the affective priming effect in the word–word naming task. We report three affective priming studies in which the modality of the primes and the targets was manipulated (words vs. pictures). Results show that replicable affective priming of naming responses can be obtained when pictures are used as primes but not when words are used as primes. These findings are interpreted in light of the hypothesis that the primes influence the identity encoding of the targets.

Since Fazio, Sanbonmatsu, Powell, and Kardes (1986) demonstrated that participants need less time to evaluate a target stimulus if that target is

Adriaan Spruyt, research assistant for the Fund for Scientific Research (Flanders, Belgium); Dirk Hermans, Department of Psychology, University of Leuven (Belgium); Jan De Houwer, Department of Psychology, University of Ghent (Belgium); Paul Eelen, Department of Psychology, University of Leuven (Belgium).

The authors wish to thank Katrien Schellekens for her help at various stages of the study and Karl Christoph Klauer for his critical and constructive comments on an earlier version of this manuscript.

Correspondence concerning this article should be addressed to Adriaan Spruyt, Department of Psychology, University of Leuven, Tiensestraat 102, B–3000 Leuven, Belgium; E-mail: Adriaan.Spruyt@psy.kuleuven.ac.be.

preceded by a prime stimulus with the same valence compared to when the target stimulus is preceded by a prime stimulus with a different valence, the affective priming task has become the preferred tool to investigate the conditions under which attitudes can be activated. Using the affective priming effect as an index of attitude activation, affective priming studies have provided strong evidence for the claim that automatic stimulus evaluation is a fast–acting process (e.g., Fazio et al., 1986; Hermans, De Houwer, & Eelen, 1994; Hermans, De Houwer, & Eelen, 2001; Klauer, Roβnagel, & Musch, 1997) that does not depend on the conscious identification of the attitude objects (e.g., Draine & Greenwald, 1998; Greenwald, Klinger, & Liu, 1989; Greenwald, Klinger, & Schuh, 1995), nor on the presence of ample processing resources (e.g., Hermans, Crombez, & Eelen, 2000) or the presence of an explicit evaluative goal (e.g., Bargh et al., 1996; Hermans et al., 1994). Hence, the general conclusion of this research is that the process underlying attitude activation is unconditional and automatic in the sense that it is efficient and can occur independently of the presence of an evaluative intention and independently of awareness of the instigating stimulus.

However, despite the fact that affective priming research has provided considerable insight into the nature of the stimuli that are automatically evaluated and the conditions that have to be fulfilled to observe automatic activation of attitudes, little is known about the processes that are responsible for the observed affective priming effects themselves (Hermans, Van den Broeck, & Eelen, 1998). At present, it is sufficiently established that a stimulus (e.g., the prime word 'FRIEND') can be automatically evaluated, but there is still much debate concerning the question by means of what mechanism (or mechanisms) participants respond faster to target stimuli that are preceded by affectively related prime stimuli compared to target stimuli that are preceded by affectively unrelated prime stimuli.

Nevertheless, at least two possible processes underlying the affective priming effect can be identified (see De Houwer, Hermans, Rothermund, & Wentura, in press; Fazio, 2001; Klauer, 1998; Klauer & Musch, in press). First, one can assume that the prime stimuli automatically activate the response nodes that correspond to the overt responses that are mapped onto the valence of the presented stimuli by means of the instructions. According to this *response level account of affective priming*, the response node that is activated by a prime will differ from the response node that is activated by an incongruent target, resulting in a Stroop–like response conflict which does not arise when prime and target are affectively congruent (see Klauer et al., 1997; Rothermund & Wentura, 1998; Wentura, 1999, 2000). For example, when participants are asked to press one of two keys in order to indicate the valence of the target stimuli, primes are assumed to facilitate the responses towards affectively related targets because the primes induce a tendency to press the key that is the same as the one that is needed to respond correctly to the target. On the other hand, when the target and the prime differ with regard to their affective connotation, responses are, according to this model, assumed to be slowed down because there is a competition between the response alternative that is implicitly activated by the prime and the response alternative that should be used to respond correctly to the target.

Although processes that operate at a response level certainly play a part in the emergence of affective priming effects (e.g., De Houwer et al., in press; Fazio, 2001; Klauer et al., 1997; Wentura, 1998, 1999, 2000), another process might also be involved (Fazio, 2001). According to *a spreading of activation account of affective priming*, all concepts with the same valence are interconnected in semantic memory by links through which activation can spread (see Anderson, 1983; Collins & Loftus, 1975; Collins & Quillian, 1969). As a result, the concept nodes of targets which are preceded by an affectively congruent prime will already be pre–activated at the time the targets are actually being presented, facilitating the identification and the semantic processing of the target and, hence, reducing the time that is needed to respond to it (e.g., Bower, 1991).

There is, however, one theoretical consideration which suggests that a spreading of activation account of affective priming might not be adequate to explain affective priming effects. Undoubtedly, the number of positively and negatively valenced concepts in memory is very large, whereas the amount of available activation is limited. Therefore, it is rather implausible to believe that the activation of one concept would activate all similarly valenced concepts and inhibit all other concepts to an extent that this would facilitate or hinder subsequent responding towards one of these concepts (Hermans, De Houwer, & Eelen, 1996; Hermans et al., 1998). This is known as cue overload or fanning effect (Anderson & Bower, 1973), and poses a general problem for all models that use the notion of spreading of activation to account for the role of affect and emotion in memory.

This problem, however, can be sidestepped if one adopts a distributed memory model according to which the activation or retrieval of a known concept entails establishing a specific pattern of activation across a set of distributed semantic processing units (Masson 1995, 1999; McClelland & Rumelhart, 1986; Seidenberg, 1993; Smith, 1996). Within such a distributed memory model, affective priming effects are a natural consequence of the assumption that affectively related stimuli consist of similar patterns of activation across the semantic units (Masson, 1995, 1999; Smith, 1996). Because fewer changes need to be made to the semantic units to form the semantic pattern of the target stimulus when there is overlap between the patterns of activation in the semantic units of the prime and the target, participants will be faster in responding to a target which is preceded by an affectively related prime as compared to the case where the valence of the prime and the target are different (see Sharkey 1989, 1990, for a similar account of semantic priming).

Although the model of Masson (1995, 1999) and traditional models of spreading of activation (e.g., Anderson, 1983; Anderson & Bower, 1973; Bower, 1981, 1991; Collins & Loftus, 1975; Collins & Quillian, 1969) differ with regard to the way they describe how knowledge is representated (distributed versus localized representations), the essence of both models is that affective priming is assumed to be a result of the fact that the processing of the very identity of the targets is facilitated or inhibited by the presentation of the primes. In this respect, the pronunciation studies of Bargh et al. (1996) and Hermans et al. (1994, 2001) are of major importance. In contrast with the lexical decision task or the evaluative decision task, in the pronunciation task participants are not instructed to respond on the basis of the valence or the wordness of the targets. Participants merely have to pronounce these words. Using such a paradigm, Bargh et al. (1996) as well as Hermans et al. (1994, 2001) observed significant affective priming of pronunciation responses.

These findings are important for two reasons. First, they suggest that attitudes can be activated even if participants do not have the explicit goal of evaluating stimuli in their environment. Second, the fact that significant affective priming of pronunciation responses can be observed indicates that the prime words automatically pre–activate the memory representations of (at least some) target words with the same valence (De Houwer et al., in press; De Houwer, Hermans, & Spruyt, 2001; Klauer et al., 1997; Klauer & Musch, in press, 2001; Wentura, 1999). As participants merely have to pronounce the target words, in the pronunciation task, each target is linked with a unique response (i.e., its pronunciation). Therefore, regardless of whether primes and targets have the same valence, they will always elicit different responses. As such, observing an affective priming effect in the pronunciation task can only be explained if one assumes that the primes influence the encoding of the targets (e.g., De Houwer et al., in press; De Houwer et al., 2001; Klinger, Burton, & Pitts, 2000; Musch & Klauer, 1997; Wentura, 1999). Likewise, one has to conclude that a Stroop–like response conflict is not the only crucial factor to account for affective priming effects.

However, more recent studies raised serious doubts about the reliability of the affective priming effect in the word–word naming paradigm (but see Glaser & Banaji, 1999). Despite ensuring adequate statistical power and using procedures that were highly similar to the procedure used by Bargh et al. (1996), Klauer and Musch (2001) failed to replicate affective priming of pronunciation responses in five recent studies (see also Klauer, Roβnagel, & Musch, 1995). Irrespective of stimulus onset asynchrony (SOA, Experiment 3) and irrespective of prime–set size and target–set size (Experiments 1 and 2), they failed to observe affective priming of word pronunciation responses. Even a nearly exact replication of Bargh et al. (1996) did not yield any significant results (Experiment 4): With language (German) being the only difference between the procedure employed by Bargh et al. (1996) and the procedure used by Klauer and Musch (2001), no difference in mean response latencies was observed between affectively related and affectively unrelated trials. Finally, to rule out the possibility that these diverging results were due to differences in language, Klauer and Musch (2001) tested bilingual German/English speakers in both the English as well as the German language (Experiment 5). Once again, no significant affective priming effects were observed.

Interestingly, this result coincides with the results of a study by Spruyt, Hermans, De Houwer, and Eelen (2002) in which native speakers of American English were tested in an exact replication of the procedure that was used by Bargh et al. (1996, Experiment 2). Despite their efforts to follow the procedure of Bargh as closely as possible, no affective priming was observed. Furthermore, Hermans, De Houwer and Eelen also failed to replicate their initial results in a number of studies. In a study that was designed to investigate the time course of the affective priming effect in the pronunciation task, Hermans (1996, Experiment 8) varied the SOA as a within–subjects factor (450 ms, 300 ms, 150 ms, 0 ms, and –150 ms). No main effect of affective congruency emerged, nor did it interact with the factor SOA. In addition, De

Houwer, Hermans and Eelen (1998) failed to observe affective priming of word naming responses when using non–words of which the meaning had been learned in a previous learning phase as primes (Experiment 2). Only when the target words had to be categorized as positive or negative, significant affective priming was observed (Experiments 1, 3, and 4).

It should be noted, however, that there are reasons to doubt that the word–word pronunciation task is a sufficiently adequate and sensitive research tool to investigate automatic retrieval of affective information. According to Glaser and Glaser (1989), the perception and production of spoken and written language is carried out by the lexical executive system which is closely linked with the lexicon (see also Glaser, 1992). As the lexicon can be conceived of as a processing device without any semantic capability (Glaser & Glaser, 1989; Potter, Kroll, Yachzel, Carpenter, & Sherman, 1986), it should not be surprising that affective priming of naming responses is so hard to replicate in a word–word paradigm. Word stimuli simply activate their phonemic representation without prior activation of semantic attributes being required (Bajo, 1988; Bajo & Ca as, 1989; Glaser, 1992; Nelson, Reed, & McEvoy, 1977). Hence, as affective information is stored within the semantic system (Bower, 1991; De Houwer & Hermans, 1994; Fiske & Pavelchak, 1986), it might be argued that failures to replicate affective priming in the word–word pronunciation task should be related to the use of word stimuli of which in–depth semantic processing is assumed to be less likely to occur.

However, pictures (as opposed to words) do have privileged access to the semantic system (Glaser, 1992; Glaser & Glaser, 1989; Seifert, 1997; Seifert & Johnson, 1994). Numerous studies have shown that understanding of pictures is very fast and that semantic processing of pictures is far more effective than semantic processing of words (De Houwer & Hermans, 1994; Kinjo & Snodgrass, 2000; Paivio, 1975; Pellegrino, Rosinski, Chiesi, & Siegel, 1977; Potter, 1976; Smith & Magee, 1980; Stenberg, Radeborg, & Hedman, 1995). As such, two reasons can be identified why affective priming is more likely to occur in a picture–picture naming task as compared to the standard word–word pronunciation task (see also Carr, McCauley, Sperber, & Parmelee, 1982; Glaser, 1992). First, pictures are more effective as *targets* because pictures first have to activate their concept nodes within the semantic system before they can be named (Glaser & Glaser, 1989; Glaser, 1992). Second, pictures are more effective as *primes* because they have privileged access to the semantic system (Glaser, 1992) and, consequently, to the affective information stored within it (Bower, 1991; De Houwer & Hermans, 1994; Fiske & Pavelchak, 1986).

In line with this idea, several non–affective semantic priming studies report no significant priming of naming responses when pairs of semantically related words were used as stimuli (e.g., Biggs & Marmurek, 1990; Chiarello, Burgess, Richards, & Pollock, 1990, Experiment 2; Hodgson, 1991; Huttenlocher & Kubicek, 1983; Lupker, 1988) whereas naming latencies for pairs of pictures did prove to be significantly affected by the semantic relation between the primes and the targets (e.g., Huttenlocher & Kubicek, 1983). Furthermore, when a direct comparison is made between words and pictures, it consistently found that pictures are more effective as primes and more susceptible to priming as targets (e.g., Bajo, 1988; Biggs & Marmurek, 1990; Carr et al., 1982; Durso & Johnson, 1979; Glaser, 1992; McCauley, Parmelee, Sperber, & Carr, 1980; Sperber, McCauley, Ragain, & Weil, 1979). In line with this reasoning, Giner–Sorolla, Garcia, and Bargh (1999) recently observed significant affective priming of word pronunciation responses when using black–and–white line drawings as primes (Experiment 2). However, as they didn't manipulate the modality of the primes and the targets, their results do not allow to make any comparison between the affective processing of pictures and the affective processing of words.

Therefore, the aim of the present research was to investigate the affective processing of both pictures and words. In Experiment 1, participants were asked to name pictures as quickly a possible in a picture–picture priming paradigm. In light of the fact that pictures are considered to be more effective as primes and more susceptible to priming as targets, we expected to observe a clear affective priming effect in this experiment. In Experiment 2 and 3, the modality of the primes and the targets was manipulated (words versus primes).

EXPERIMENT 1

METHOD

Participants. Nineteen students from various departments at the University of Leuven (8 men, 11 women) volunteered to participate in the experiment. All participants were native speakers of Dutch and had normal or corrected–to–normal vision.

Materials. Prime pictures (4 positive, 4 negative) and target pictures (4 positive, 4 negative) were selected on the basis of a preliminary rating study in which participants ($N = 75$) had to rate the affective connotation of 110 real life colour pictures (24 bits per pixel) on a 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; Centre for the Psychophysiological Study of Emotion and Attention, 1994).[1] Pictures that were selected as targets were all nameable with a single word (see Appendix) whereas pictures that were selected as primes portrayed more complex real life scenes that could not be named with a single word (e.g., a young kissing couple, a man pressing a gun into the face of a woman). Positive and negative targets differed significantly on the affective dimension, $M_{\text{negative}} = -3.15$ ($SD = 0.73$), $M_{\text{positive}} = 2.85$ ($SD = 0.30$), $t(3) = 14.91$, $p < .0005$. Likewise, the positive primes were rated significantly more positive than the negative primes, $M_{\text{negative}} = -3.04$ ($SD = 0.64$), Mpositive = 3.07 ($SD = 0.20$), $t(3) = 15.78$, $p < .0005$. The pictures varied in height and width, but the longest side of each picture was always fixed at either 11 cm (height) or 15 cm (width). All pictures were presented against the black background of a SVGA computer monitor.

Stimulus presentation as well as the registration of the response latencies were controlled by an object–oriented, pool–based, real–time and millisecond accurate Affect 1.0 program that was developed with C++ for the windows platform (Hermans, Clarysse, Baeyens, & Spruyt, 2001). The experiment was run on an IBM compatible Pentium III 650 Mhz computer.

Procedure. All participants were tested individually in a dimly lit room. Instructions that were presented on the computer screen informed the participants that they were about to participate in a picture recognition experiment and that two series of practice trials were to 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 eight 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

1. IAPS numbers: 1030, 1050, 1120, 1201, 1300, 1301, 1302, 1500, 1610, 1750, 1930, 1931, 2070, 2120, 2220, 2565, 2800, 4490, 4611, 4534, 4651, 4672, 4680, 5030, 6250, 6350, 6550, 6560, 7350, 9040.

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 eight 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 using the corresponding names of 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 only the second picture and to name this picture as fast as possible.

The experimental priming phase consisted of 128 trials, subdivided in two blocks of 64 trials in which each prime picture was presented once together with each target picture. Each possible prime–target pair was thus presented two times. In order to reduce the monotonous nature of the task to some extent, participants were given the possibility to take a small break after every 32 trials. During this break, a message on the computer screen stressed the importance of naming the pictures as fast as possible.

Each trial started with a 500 ms presentation of a fixation cross in the centre 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 (ISI) of 50 ms, resulting in a stimulus onset asynchrony (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 inter trial interval (ITI) varied between 3.5 seconds and 4.5 seconds, but the mean ITI was fixed at 4 seconds.

RESULTS

Data from one subject were excluded from the analysis because the number of trials on which the microphone failed to accurately register the response exceeded our outlier criterion which was set on 2.5 standard deviations above the mean number of voice key failures. Data of the trials on which the microphone failed to accurately register the response (13.19 %)[2] and data of trials on which an incorrect response was given (0.95 %) were also excluded from the analysis. Finally, for each level of affective congruency per block, response latencies that fell above or below 2.5 standard deviations from a person's mean latency were discarded (1.3 % of the remaining trials).

For each participant and for each block separately, we calculated the mean reaction time for affectively congruent and affectively incongruent trials. Means were then analysed in a 2 × 2 (block × affective congruency) analysis of variance with repeated measures for all variables. The ANOVA revealed a clear effect of affective congruency in the predicted direction, $F(1,17) = 13.78$, $p < .005$, $MSE = 239.77$: Participants needed less time to respond on affectively congruent trials than on affectively incongruent trials (mean response latencies are presented in Table 1). The effect of block did not reach significance ($F < 1$), nor did it interact with affective congruency, $F(1,17) = 1.17$, $p = .29$, $MSE = 235.23$.

DISCUSSION

The present study revealed significant affective priming of naming responses in a picture–picture naming task. Target pictures that were preceded by affectively congruent prime pictures were named faster than target pictures that were preceded by affectively incongruent prime pictures. This result is important for two reasons. First, it allows one to conclude that attitudes can be activated even if participants do not have the explicit goal of evaluating stimuli in their environment. Whereas in most affective priming studies, participants need to determine the valence of the target stimuli, valence is of no importance when participants are asked to name the target pictures. Second, the fact that significant affective priming of pronunciation responses can be observed indicates that prime pictures automatically pre–activate the memory representations of target pictures with the

2. Experiment 1 and 2 showed a high amount of voice key failures. However, these voice key failures were evenly distributed across affectively congruent and incongruent trials in both Experiment 1, $F(1,17) = 2.79$, $p = .11$, $MSE = 4.47$ ($M_{congruent} = 3.8$; $M_{incongruent} = 4.6$), and Experiment 2, ($F < 1$, $M_{congruent} = 3.2$; $M_{incongruent} = 3.3$).

TABLE 1. Mean response latencies (in ms) and mean affective priming effects (*SD* in parentheses) as a function of condition and congruence in Experiments 1, 2, and 3

	Congruency		
Condition	Congruent (*SD*)	Incongruent (*SD*)	APE (*SD*)
Experiment 1			
Picture–picture	584 (73.41)	598 (71.29)	14 (15.48)**
Experiment 2			
Picture–picture	577 (55.75)	588 (56.69)	11 (19.09)**
Word–picture	553 (62.57)	556 (61.10)	3 (13.36)
Experiment 3			
Picture–picture	607 (58.11)	614 (57.74)	7 (14.08)***
Picture–word	418 (37.22)	423 (37.94)	5 (7.80)*
Word–picture	596 (48.34)	600 (43.79)	4 (12.53)
Word–word	459 (37.44)	459 (37.31)	0 (6.84)

Note. APE = Affective Priming Effect: Mean reaction time on incongruent trials minus mean reaction time on congruent trials. ***$p < .001$; **$p < .005$; *$p < .01$.

same valence (De Houwer et al., in press, 2001; Klauer et al., 1997; Klauer & Musch, in press, 2001; Wentura, 1999). As is the case in the word–word naming task, in our experiment each target is linked with a unique response (i.e., pronouncing the name of the picture). Therefore, our results cannot be interpreted in terms of Stroop–like response competition. Even if one assumes that an experimental setting in which participants are asked to name the second of two consecutive stimuli results in a tendency to name any stimulus (including the first stimulus), a response conflict between the response alternative that is activated by the prime and the response alternative that is activated by the target could not account for the presented data because such a conflict would be equally present in all (affectively congruent and affectively incongruent) trials. Therefore, affective priming of picture naming responses can only be explained if one assumes that the very identification of the targets is being influenced by the presentation of the primes. As such, doubts that were raised concerning the hypothesis that affective priming is (at least partially) based upon the pre–activation of the semantic representations of the target (e.g., Klauer, 1998, p. 95; Wentura, 1999, p. 85; De Houwer et al., in press, p. 21) seem to have been a little premature.[3]

However, given the fact that pictures (as compared to words) are not only more effective as primes but also more susceptible to priming as targets (Carr et al., 1982; Glaser, 1992, p. 99), one might argue that our experimental design doesn't allow one to draw any conclusions regarding the extent to which our results should be attributed to the use of pictures as primes, as targets, or the combination of both. Therefore, we decided to conduct another experiment that consisted of two conditions that only differed with regard to the modality of the primes (pictures versus words).

EXPERIMENT 2

In this experiment we varied the modality of the primes: In one condition the primes were pictures whereas in the second condition the primes were words. To ensure that possible differences between the two conditions could not be attributed to differences in meaning of the primes, prime pictures and prime words were selected in such a manner that they referred to the same concept (e.g., the word SPIDER and a picture of a spider). In line with the idea that in–depth semantic processing of the primes is more likely to occur in the picture–prime condition but not in the word–prime condition, we predicted a significant affective priming effect in the first but not in the latter condition.

3. Klauer and Musch (2001) argued that in the case of a limited target–set size, the naming task becomes similar to decision tasks for which explanations in terms of response competition rather than in terms of identity encoding is in order (see also Klauer, 1998; Wentura, 1999). Given the fact that affective priming effects are easily and consistently found when participants are tested in a decision task in which only a limited number of response alternatives is available (as in the evaluative decision task or the lexical decision task), Klauer and Musch (2001) predicted an inverse relation between the target–set size and the size of the affective priming effect. Given the fact the target–set size of Experiment 1 and 2 was limited (8), one might argue that our experimental procedure does not rule out the possibility that our results were due to effects of response competition. However, Klauer and Musch (2001) failed to obtain supporting evidence for their hypothesis: When they orthogonally manipulated the prime–set size (infinite vs. 10) and the target set–size (infinite vs. 10 vs. 2) as between–subjects factors (Experiments 1 and 2), no affective priming effects emerged, not even in the condition with only two response alternatives. Therefore, it seems unlikely that target set–size would be the crucial factor to account for the conflicting findings that are obtained with the word–word naming paradigm.

METHOD

Participants. Forty–nine first–year psychology students (7 men, 42 women) at the University of Leuven participated in partial fulfilment of course requirements. All participants were native speakers of Dutch and had normal or corrected–to–normal vision.

Materials. Based on the same rating study as described in the method section of Experiment 1, four positive and four negative pictures that could be unambiguously named were selected as primes for the picture–picture naming condition. Their corresponding names (see Appendix) served as primes in the word–picture naming condition. Target pictures (4 positive, 4 negative) were the same as in Experiment 1. Positive and negative target pictures differed significantly on the affective dimension, $M_{\text{negative}} = -3.15$ ($SD = 0.73$), $M_{\text{positive}} = 2.85$ ($SD = 0.30$), $t(3) = 14.91$, $p < .0005$. Likewise, the positive prime pictures were rated significantly more positive than the negative prime pictures, $M_{\text{negative}} = -2.08$ ($SD = 0.21$), Mpositive $= 2.52$ ($SD = 0.23$), $t(3) = 21.27$, $p < .0005$.

Procedure. Participants were randomly allocated to one of two conditions that only differed with regard to the modality of the primes. In one condition the primes were pictures ($N = 24$) whereas in the second condition the primes were the corresponding names of these pictures ($N = 25$). In all other aspects, both conditions of Experiment 2 were exactly the same as in Experiment 1.

RESULTS

On 9.10 % of the test trials, the voice key was not appropriately activated. The data of these trials, together with the data of the practice trials, were excluded from all analyses. Data of the trials on which an incorrect response was given (0.85 %) were also excluded from the analysis. Finally, for each level of affective congruency per block, response latencies that fell above or below 2.5 standard deviations from a person's mean latency were discarded (1.80 % of the remaining trials).

For each participant and for each block separately, we calculated the mean reaction times for affectively congruent and affectively incongruent trials which were then analysed using a $2 \times 2 \times 2$ (prime modality $\times$ block $\times$ affective congruency) analysis of variance with repeated measures for the last two variables. The ANOVA revealed a significant main effect of affective congruency, $F(1,47) = 8.46$, $p < .01$, *MSE* = 269.50. One–degree–of–freedom contrasts showed that the effect of affective congruency was significant in the picture–picture condition, $F(1,47) = 10.59$, $p < .005$, $MSE = 269.50$, whereas the effect of affective congruency was not significant in the word–picture condition ($F < 1$). As shown in Table 1, in the picture–picture condition, responses on affectively congruent trials were faster than responses on affectively incongruent trials, whereas in the word–picture condition there was no significant difference between mean latencies of affectively congruent and affectively incongruent trials. In line with this pattern of results, the interaction between prime modality and affective congruency was marginally significant, $F(1,47) = 3.03$, $p = .09$, $MSE = 269.50$.

In addition, the ANOVA revealed a significant effect of block, $F(1,47) = 7.34$, $p < .01$, $MSE = 1164.37$. However, no interaction was observed between the main effect of affective congruency and the main effect of block $F(1,47) = 1.22$, $p < .28$, $MSE = 229.49$. The three–way interaction between block, prime type and affective congruency on the other hand proved to be significant, $F(1,47) = 5.33$, $p < .05$, $MSE = 229.49$. Further analyses showed that the interaction between prime type and affective congruency was significant in the first block, $F(1,47) = 6.49$, $p < .05$, $MSE = 310.90$, but not in the second block, $F < 1$. Whereas the effect of affective congruency decreased from the first to the second block in the picture–prime condition, no effect of affective congruency was observed for both blocks of the word–prime condition.

DISCUSSION

The data presented above revealed significant affective priming of picture naming responses, but only in the condition in which pictures were used as primes. Despite the fact that the word primes referred to exactly the same concepts as the picture primes, no affective priming in the word–picture condition was observed ($F < 1$). Notwithstanding the fact that the interaction between prime modality and affective congruency was significant only in the first block, this result clearly indicates that affective priming of naming responses can easily be obtained when pictures are used as primes instead of words. This interpretation is in line with the idea that understanding of pictures is very fast and that semantic processing of pictures is more effective than semantic processing of words (e.g., De Houwer & Hermans, 1994; Kinjo

& Snodgrass, 2000; Paivio, 1975; Pellegrino et al., 1977; Potter, 1976; Smith & Magee, 1980; Seifert, 1997; Stenberg et al., 1995). Furthermore, the present findings indicate that, at least in the picture–picture naming task, the pre–activation of subordinate semantic representations of the targets contributes to the emergence of affective priming effects.

Nevertheless, one might be tempted to attribute the absence of a significant affective priming effect in the word–prime condition to the fact that the primes and the targets of the word–prime condition differed in modality (words versus pictures). However, two arguments can be identified that contradict this alternative interpretation. First, the fact that Giner–Sorolla et al. (1999) observed significant affective priming of naming responses when using pictures as primes and words as targets indicates that a modality match between the prime and the target is not a necessary precondition in order to observe affective priming of pronunciation responses (affective priming of naming responses without modality match). Second, recent failures to replicate the affective priming effect in the word–word pronunciation task (e.g., De Houwer & Hermans, 1999; De Houwer et al., 1998; Klauer & Musch, 2001) indicate that a modality match between the prime and the target is not a sufficient precondition in order to observe affective priming of naming responses (no affective priming of naming responses despite modality match). Nevertheless, a direct experimental comparison of these presentation conditions would provide a more stringent test of this alternative hypothesis. Therefore, we decided to conduct a final experiment in which the modality of the primes and targets was manipulated.

EXPERIMENT 3

In this experiment, the modality of the primes and the modality of the targets were orthogonally manipulated as two between–subjects factors (pictures vs. words). Combinations of these two variables yielded all possible prime–target modality combinations (picture–picture, picture–word, word–picture, word–word). To ensure that possible differences between the four conditions could not be attributed to differences in the meaning of the words and the pictures, the same concepts were always used in all prime–target conditions (e.g., the word BABY and a picture of a baby). In line with the idea that the semantic (and thus affective) processing of pictures is considered to be more effective than the semantic processing of words, we expected significant affective priming to occur in both the picture–picture condition (replication of Experiment 1 and 2) and the picture–word condition (replication of Experiment 2 and Giner–Sorolla et al., 1999) but not in the word–picture condition (replication of Experiment 2) and the word–word condition (replication of De Houwer et al., 1998; Hermans, 1996; Klauer & Musch, 2001). In addition, we increased the prime–set size and the target–set size: Whereas only 8 primes and 8 targets were used in Experiments 1 and 2, we used 16 primes and 12 targets in this experiment. As a result, the total number of prime–target pairs was tripled relative to Experiment 1 and 2. Observing significant affective priming in this experiment, would thus indicate that the observed effects in Experiment 1 and 2 were not dependent on the fact that only a small set of possible prime–target pairs was presented.

METHOD

Participants. One hundred and eleven first–year psychology students (11 men, 100 women) at the University of Leuven participated in partial fulfilment of course requirements. All participants were native speakers of Dutch and had normal or corrected–to–normal vision.

Materials. All pictures were selected on the basis of a preliminary rating study in which participants (N = 51) had to rate the affective connotation of 215 real life colour pictures (512 pixels high, 384 pixels wide, 24 bits per pixel) on a 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; Centre for the Psychophysiological Study of Emotion and Attention, 1994).4

Sixteen pictures (8 positive, 8 negative) that could be unambiguously named with a single word were selected as primes for the two picture–prime conditions. Their corresponding names (see Appendix) served as primes in the two word–prime conditions. Likewise, twelve pictures (6 positive, 6 negative) that could be unambiguously named with a single word were selected as targets for the two picture–target conditions. Their corresponding names (see Appendix) served as targets

4. 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.

in the two word–target conditions. Positive and negative targets differed significantly on the affective dimension, $M_{negative}$ = –2.88 (SD = 0.66), $M_{positive}$ = 2.22 (SD = 0.32), $t(5) = 15.34$, $p < .0001$. Likewise, the positive prime pictures were rated significantly more positive than the negative prime pictures, $M_{negative}$ = –1.84 (SD = 0.87), $M_{positive}$ = 2.56 (SD = 0.54), $t(7) = 16.49$, $p < .00001$. All pictures were presented against the black background of a SVGA computer monitor.

Procedure. Participants were randomly allocated to one of the four conditions: picture–picture (N = 27), picture–word (N = 29), word–picture (N = 27), word–word (N = 28). In the picture–target conditions, instructions that were presented on the computer screen informed the participants that they were about to participate in a picture recognition experiment and that two series of practice trials were to 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 picture 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 using the corresponding names of 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. In the picture–picture condition, participants were told that pairs of pictures would be presented on the computer screen. They were instructed to attend only to the second picture and to name this picture as fast as possible. In the word–picture condition, participants were told that all pictures would be preceded by a word. They were instructed to attend only to the pictures and to name these pictures as fast as possible.

In the word–target conditions, instructions that were presented on the computer screen informed the participants that they were about to participate in a word recognition experiment and that a series of practice trials was to be presented prior to the start of the experimental trials. During this series of practice trials, the 16 word targets were presented in a random order and participants were instructed to read the words aloud as fast as possible. After completing this series of practice trials, the instructions for the experimental trials were displayed on the computer screen. In the word–word condition, participants were told that pairs of words would be presented on the computer screen. They were instructed to attend only to the second word and to pronounce this word as fast as possible. In the picture–word condition, participants were told that all words would be preceded by a picture. They were instructed to attend only to the words and to pronounce these words as fast as possible.

The experimental priming phase consisted of 192 trials in which each prime stimulus was presented once together with each target stimulus. For each participant, the computer randomized the presentation order of the trials. In order to reduce the monotonous nature of the task to some extent, participants were given the possibility to take a small break after every 48 trials. During this break, a short message on the computer screen stressed the importance of naming the pictures as fast as possible.

In order to shorten the total duration of the experiment, the variable ITI was reduced to a mean ITI of 1500 ms with a maximum deviation of 500 ms. In all other aspects, all conditions of Experiment 3 were exactly the same as in Experiment 1.

RESULTS

On 3.94 % of the test trials, the voice key was not appropriately activated. The data of these trials, together with the data of the practice trials, were excluded from all analyses. Data of the trials on which an incorrect response was given (0.45 %) were also excluded from the analysis. Finally for each level of affective congruency separately, response latencies that fell above or below 2.5 standard deviations from a person's mean latency were discarded (2.37 % of the remaining trials).

For each participant, we calculated the mean reaction times for affectively congruent and affectively incongruent trials which were then analysed using a $2 \times 2 \times 2$ (prime modality $\times$ target modality $\times$ affective congruency) analysis of variance with repeated measures for the last variable. Most importantly, the ANOVA revealed a highly significant main effect of affective congruency, $F(1,107) = 16.56$, $p < .00001$, $MSE = 57.04$, which interacted significantly with prime modality, $F(1,107) = 4.44$, $p <$

.05, $MSE = 57.04$. One–degree–of–freedom contrasts showed that the effect of affective congruency was significant in the picture–picture condition, $F(1,107) = 11.56$, $p < .001$, $MSE = 57.04$, and the picture–word condition, $F(1,107) = 7.80$, $p < .01$, $MSE = 57.04$, whereas the effect of affective congruency was not significant in the word–picture condition, $F(1,107) = 3.14$, $p = .079$, $MSE = 57.04$, and the word–word condition, $F < 1$. As shown in Table 1, responses on affectively congruent trials were faster than responses on affectively incongruent trials in the picture–picture condition, in the picture–word condition and in the word–picture condition. In the word–word condition there was no difference between the mean latencies of affectively congruent and affectively incongruent trials.

In addition, the ANOVA also revealed a significant main effect of target type, $F(1,107) = 368.8112$, $p < .000001$, $MSE = 4051.77$: Reaction times were faster in the word–target conditions ($M = 439$; $SD = 41.73$) than in the picture–target conditions ($M = 604$; $SD = 51.81$). Furthermore, this main effect of target type interacted significantly with prime modality, $F(1,107) = 8.81$, $p < .005$, $MSE = 4051.77$. All other interactions as well as the main effect of prime type failed to reach significance.[5]

DISCUSSION

The results are clear cut. The fact that we observed a significant interaction between prime modality and affective congruency unarguably confirms our prediction that more reliable affective priming of naming responses can be observed when pictures are used as primes than when words are used as primes: Affective priming was significant in both the picture–picture condition and the picture–word condition whereas in the word–picture condition and the word–word condition no significant

5. Due to the presentation of all trials in a true random order, an even distribution of congruent and incongruent trials over the first and second half of the experiment was not guaranteed. Therefore, no block variable was included in the ANOVA. Nevertheless, we conducted an additional analysis of variance in which an a posteriori partition of the experiment into two blocks was introduced as a second within subjects variable. However, this $2 \times 2 \times 2 \times 2$ (prime modality $\times$ target modality $\times$ block $\times$ affective congruency) analysis of variance did not yield any different results. No reliable main effect of block emerged, $F(1,107) = 2.33$, $p = .12$, $MSE = 589.29$, nor did the main effect of block interact with affective congruency, $F(1,107) = 2.64$, $p = .11$, $MSE = 139.30$. The interaction between block, prime modality and affective congruency also failed to reach significance, $F(1,107) = 2.57$, $p = .11$, $MSE = 139.30$. Furthermore, the crucial interaction between prime modality and congruency remained unaltered, $F(1,107) = 4.63$, $p < .05$, $MSE = 106.18$.

priming effects were observed. This pattern of results replicates the findings of Experiment 1 and 2 (affective priming of picture–naming responses by pictures but not by words) as well as the findings of Giner–Sorolla et al. (1999, affective priming of word–naming responses by pictures) and Klauer and Musch (2001), De Houwer et al. (1998), and Hermans (1996, Experiment 8, no affective priming of word–naming responses by words). Again, this result is in line with the repeatedly reported finding that the semantic processing of pictures is more effective than the semantic processing of words (De Houwer & Hermans, 1994; Kinjo & Snodgrass, 2000; Paivio, 1975; Pellegrino et al., 1977; Potter, 1976; Smith & Magee, 1980; Seifert, 1997; Stenberg et al., 1995). In addition, because the total number of prime–target pairs in this experiment was tripled relative to Experiment 1 and 2, the present results also indicate that it is unlikely that our previous results were due to the fact that only a very limited set of possible prime–target pairs was used. Finally, our results indicate that a modality match between the primes and the targets is neither a necessary nor a sufficient condition for affective priming effects to occur because no affective priming was observed in the word–word condition (no affective priming despite modality match) whereas significant affective priming emerged in the picture–word condition (affective priming despite modality mismatch).

However, it should be stressed that the priming effect in the word–picture condition was marginally significant ($p = .079$). Although this result seems to go against the results of Experiment 2, this finding is not at odds with the logic underlying our hypotheses. On the contrary, according the model of Glaser and Glaser (1989), we reasoned that pictures have privileged access to the semantic system and that pictures have to activate their concept nodes within the semantic system before they can be named (Bajo, 1988; Bajo & Ca as, 1989; De Houwer et al., 1994; Glaser, 1992; Glaser & Glaser,1989). As a result, pictures are not only considered to be more effective as primes but also as targets. The observation that picture–naming responses tend to be affected by the preceding presentation of a word only corroborates this hypothesis. Moreover, the fact that we observed a marginally significant affective priming effect in the word–picture condition whereas not even the slightest indication of a priming effect was observed in the word–word condition ($F < 1$), is completely in accordance with a recent study that was conducted by De Houwer et al. (2001). They observed significant affective priming in a word–word naming paradigm, but only when the target words were degraded by placing a percent sign before and after each letter of each target word (e.g., %U%G%L%Y%). The authors explained the absence of affective priming in the condition with undegraded targets by assuming that reading a word requires a translation from orthography (i.e., the way in which a word is written) to phonology (i.e., the way in which a word is pronounced) and that this translation process proceeds too efficiently and too quickly for semantic information to feed into it. The same interpretation can be applied to the results of our word–word condition. However, when the orthographic information is impoverished, for instance by degrading the word, De Houwer et al. (2001) argued that the translation process is more complicated and will be slowed down, thus leaving more room for an impact of the information that is available in the semantic system (see also Strain, Patterson, & Seidenberg, 1995). Likewise, as pictures always have to activate their concept nodes within the semantic system before they can be named (Glaser, 1992; Glaser & Glaser,1989), the generation of pictures–naming responses will always be semantically mediated. As a consequence, it is not unlikely that semantic priming effects can be observed in the word–picture naming task.

Nevertheless, not all our data can be parsimoniously interpreted within this framework. In accordance with Giner–Sorolla et al. (1999), we observed significant affective priming in the picture–word condition. As the translation process from orthography to phonology is assumed to be virtually unaffected by the semantic system when orthographic information is not degraded, this finding is not easily explained. However, a recent study by De Houwer and Randell (in press) might shed light on this matter. They observed significant affective priming of naming responses in a word–word naming task when attention was directed to the primes by instructing their participants to attend to the primes and by including filler trials on which the prime and the target were identical (Experiment 2). In contrast, when the participants were instructed to ignore the primes and to mentally counteract the disruptive influence of the primes, no affective priming effects emerged. Likewise, it might be argued that, in our experiment, the modality mismatch between the primes and the targets (pictures vs. words) caused the participants to pay extra attention to the primes, thus giving rise to significant affective priming of word–naming responses. Note, however, that regardless of the precise theoretical position one is willing to take to account for the observed effect in the picture–word condition, one can only conclude that the results of the picture–word condition provide additional support for our claim that significant affective priming of naming responses can be obtained when pictures are used as primes.

GENERAL DISCUSSION

Despite the fact that more than ten years of intensive affective priming research has provided considerable insight into the nature of the stimuli that are automatically evaluated and the conditions that have to be fulfilled to observe automatic activation of attitudes, there is still much debate concerning the nature of the underlying mechanisms which are responsible for the affective priming effects themselves. It has been argued that the primes influence the encoding of the targets, but due to recent failures to replicate affective priming of word–word naming responses (e.g., De Houwer & Hermans, 1999; De Houwer et al., 1998; Klauer & Musch, 2001) this account has been seriously questioned by several authors (e.g., Klauer, 1998, p. 95; Wentura, 1999, p. 85). However, the fact that we repeatedly observed significant affective priming of both picture–naming responses and word–naming responses when pictures were used as primes strongly suggests that these doubts are unfounded. Whereas affective priming of evaluation responses could be due either to the fact that the primes influence the encoding of the targets or the fact that the primes influence response selection without influencing the encoding of the targets (De Houwer et al., in press; Klauer et al., 1997; Wentura, 1999), affective priming of naming responses can only be due to the first process (De Houwer et al., 2001; Klauer & Musch, in press, 2001; Klinger et al., 2000; Wentura, 1999). Therefore, it should be concluded that our results strongly suggest that the primes influence the identification of the targets. In addition, our results support the idea that attitudes can be activated even if participants do not have the explicit goal of evaluating stimuli in their environment (e.g., Bargh et al., 1996; De Houwer et al., 2001; Hermans et al., 1994).

It should be noted however, that this interpretation might, at first sight, seem difficult to reconcile with the priming effects that were observed by Glaser and Banaji (1999). Glaser and Banaji (1999) report a series of studies in which no affective priming effects in the word–word naming task were observed when moderately valenced words were used as primes whereas reversed affective priming effects (i.e., shorter response latencies on affectively incongruent trials than on affectively congruent trials) emerged when extremely valenced primes were used

(Experiments 4, 5, and 6). On the other hand, standard priming effects (i.e., shorter response latencies on affectively congruent trials than on affectively incongruent trials) were observed for moderately valenced primes when words with racial connotations were included in the prime set (Experiments 1, 2, and 3). Even though we don't want to put too much weight on this (so far) isolated finding, we believe that the results of Glaser and Banaji (1999) are not at odds with the hypothesis that the primes influence the encoding of the targets. Glaser and Banaji (1999) attributed their pattern of results to an automatic correction process that comes into play when the extremity of the primes or the presence of racial stimuli causes participants to perceive the potential of the primes to bias their responses towards the targets (see also Stapel, Martin, & Schwarz, 1998; Strack, 1992; Strack & Hannover, 1996; Strack, Schwarz, Bless, Kübler, & Wänke, 1993). However, as such a correction process can only occur *after* the identity of both the primes and the targets has been processed, reversed priming effects should not be considered to be contradictive to the hypothesis that the primes influence the encoding of the targets. On the contrary, we believe that identity encoding and automatic correction are two distinct and temporally distinguishable processes and that the procedural factors (e.g., the kind of stimuli that are used, stressing the importance of speed) determine the extent to which the second process comes into play.[6]

The fact that our results are contradictory to the results of so many recent non–significant word–word naming studies (De Houwer & Hermans, 1999; De Houwer et al., 1998; Hermans, 1996; Klauer, 1998; Klauer & Musch, 2001; Klauer et al., 1995) should be related to the use of pictures of which in–depth semantic processing is thought to be more likely to occur. Indeed, numerous studies have shown that semantic processing of pictures is far more effective than semantic processing of words (e.g., Kinjo & Snodgrass, 2000; Paivio, 1975; Pellegrino et al., 1977; Potter, 1976; Smith & Magee, 1980; Stenberg et al., 1995) and that pictures are more effective as primes and more susceptible to priming as targets (e.g., Carr et al., 1982; Glaser, 1992). As such, it appears that future affec-

6. Assuming that the process of automatic correction can only take place after the identity of both the primes and the targets is processed, the activation of this additional process should be reflected in higher overall mean response latencies. In this respect it is very interesting to note that the mean response latencies that are reported by Glaser and Banaji (1999) are indeed relatively slow (e.g., 598 ms in Experiment 5) compared to the mean reaction time that we observed in the word–word condition of Experiment 3 (459 ms).

tive priming research would derive benefit from the use of pictures as primes and targets.

In this respect, it might be interesting to replicate our experiments with native speakers of German because none of the pronunciation studies that were carried out with native speakers of German yielded any significant results so far (Klauer & Musch, 2001). It has been argued (e.g., De Houwer et al., 2001; Hermans, 2000) that this might be due to the fact that the German language is a shallow orthographic language. Shallow orthographic languages are characterized by a fairly good match between how a word is written and how it is pronounced (see also Frost, Katz, & Bentin, 1987; Lukatela, Popadic, Ognjenovic, & Turvey, 1980). As a result, in these orthographic shallow orthographic languages, phonology can be determined quickly on the basis of the orthographic information only, thus leaving little room for semantic information to exert an influence on the translation process from orthography to phonology. In languages with a deep orthography on the other hand (such as English), it is more difficult to determine how one should pronounce a word on the basis of how it is written, which allows for a bigger impact of semantic information on the translation process from orthography to phonology. However, recent failures to replicate affective priming of pronunciation responses when testing German–English bilinguals (Klauer & Musch, 2001) or native speakers of English (Spruyt et al., 2002) in an English word–word priming paradigm suggest that differences in orthographical depth exert only a very subtle influence on the pronunciation of a word and that other, yet unidentified, variables might be involved that cancel out this alleged influence of orthographical depth. Consequently, one has to conclude that this line of research takes a high risk of getting snarled up in a cluttered mixture of variables which are no longer relevant to affective priming research. Therefore, it seems to be more fruitful to use the picture–picture naming paradigm as a more powerful research tool if one wants to investigate to what extent the pre–activation of semantic representations plays a part in affective priming. As such, all research in which the affective priming procedure is used as a demand–free alternative to evaluative ratings (e.g., Fazio, Jackson, Dunton, Williams, 1995; Hermans, Spruyt, & Eelen, in press; Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2001) might derive benefit from the use of pictures instead of words.

Nevertheless, we have to conclude that our results make affective priming research even more into a Sisyphean task. Our data indicate that it was a little premature to question the involvement in affective priming of processes that operate at an encoding level, but they do no more than that. At the present it remains unclear (a) to what extent different possible mechanisms contribute to the materialization of affective priming effects, (b) to what extent these mechanisms interact mutually, and (c) to what extent these mechanisms interact with procedural and situational variables (see, e.g., De Houwer et al., in press). Therefore, future research should be aimed at further disentangling this complex set of interacting mechanisms that underlie affective priming in particular and automatic information processing in general.

APPENDIX

Prime names of Experiment 2	Target names of Experiment 1 and 2
regenboog (rainbow)	poesje (kitten)
eekhoorn (squirrel)	zon (sun)
teddybeer (teddy bear)	dolfijn (dolphin)
konijn (rabbit)	baby (baby)
spin (spider)	Hitler (Hitler)
pistool (pistol)	explosie (explosion)
schorpioen (scorpion)	hond (dog)
haai (shark)	schedels (skulls)

Prime names of Experiment 3	Target names of Experiment 3
ballon (balloon)	baby (baby)
vlinder (butterfly)	bruid (bride)
bloem (flower)	kerstboom (Christmas tree)
hondje (puppy)	dolfijn (dolphin)
regenboog (rainbow)	poesje (kitten)
eekhoorn (squirrel)	teddybeer (teddy)
zon (sun)	lijk (corpse)
waterval (waterfall)	explosie (explosion)
prikkeldraad (barbwire)	Hitler (Hitler)
brand (fire)	vuilnis (litter)
gasmasker (gasmask)	schedels (skulls)
pistool (pistol)	wormen (worms)
haai (shark)	
soldaat (soldier)	
slang (snake)	
spin (spider)	

REFERENCES

Anderson, J. R. (1983). *The architecture of cognition.* Cambridge, MA: Harvard University Press.

Anderson, J. R., & Bower, G. H. (1973). *Human associative memory*. Washington, DC: V. H. Winston.

Bajo, M.–T. (1988). Semantic facilitation with pictures and words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14,* 579–589.

Bajo, M. –T., & Ca as, J. J. (1989). Phonetic and semantic activation during picture and word naming. *Acta Psychologica, 72,* 105–115.

Bargh, J. A., Chaiken, S., Raymond, P., & Hymes, C. (1996). The automatic evaluation effect: unconditional automatic attitude activation with a pronunciation task. *Journal of Experimental Social Psychology, 32,* 104–128.

Biggs, T. C., & Marmurek, H. H. C. (1990). Picture and word naming: Is facilitation due to processing overlap? *American Journal of Psychology, 103,* 81–100.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36,* 129–148.

Bower, G. H. (1991). Mood congruity of social judgements. In J. P. Forgas (Ed.), *Emotion and social judgements* (pp. 31–54). Oxford: Pergamon Press.

Carr, T. H., McCauley, C., Sperber, R. D., & Parmelee, C. M. (1982). Words, pictures, and priming: On semantic activation, conscious identification, and the automaticity of information processing. *Journal of Experimental Psychology: Human Perception and Performance, 8,* 757–777.

Centre for the Psychophysiological Study of Emotion and Attention (1994). *The International Affective Picture System* [photographic slides]. FL: Centre for Research in Psychophysiology, University of Florida.

Chiarello, C., Burgess, C., Richards, L., & Pollock, A. (1990). Semantic and associative priming in the cerebral hemispheres: Some words do, some words don't … sometimes, some places. *Brain and Language, 38,* 75–104.

Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review, 82,* 407–428.

Collins, A. M., & Quillian, M. R. (1969). Retrieval from semantic memory. *Journal of Verbal Learning and Verbal Behavior, 8,* 240–248.

De Houwer, J., & Hermans, D. (1994). Differences in the affective processing of words and pictures. *Cognition and Emotion, 12,* 1–20.

De Houwer, J., & Hermans, D. (June, 1999). Nine attempts to find affective priming of pronunciation responses: Effects of SOA, degradation, and language. Paper presented at the Tagung der Fachgruppe Sozialpsychologie, Kassel, Germany.

De Houwer, J., Hermans, D., & Eelen, P. (1998). Affective and identity priming with episodically associated stimuli. *Cognition and Emotion, 12,* 145–169.

De Houwer, J., Hermans, D., Rothermund, K., & Wentura, D. (in press). Affective priming of semantic categorization responses. *Cognition and Emotion.*

De Houwer, J., Hermans, D., & Spruyt, A. (2001). Affective priming of pronunciation responses: Effects of target degradation. *Journal of Experimental Social Psychology, 37,* 85–91.

De Houwer, J., & Randell, T. (in press). Attention to primes modulates affective priming of pronunciation responses. *Experimental Psychology*.

Draine, S. C., & Greenwald, A. G. (1998). Replicable unconscious semantic priming. *Journal of Experimental Psychology: General, 127,* 286–303.

Durso, F. T., & Johnson, M. K. (1979). Facilitation in naming and categorizing repeated pictures and words. *Journal of Experimental Psychology: Human Learning and Memory, 13,* 104–115.

Fazio, R. H. (2001). On the automatic activation of associated evaluations: An overview. *Cognition and Emotion, 15,* 115–141.

Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology, 69,* 1013–1027.

Fazio, R. H., Sanbonmatsu, D., Powell, M., & Kardes, F. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology, 50,* 229–238.

Fiske, S. T., & Pavelchak, M. A. (1986). Category–based versus piecemeal–based affective responses: Developments in schema–triggered affect. In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition* (pp. 167–203). New York: Wiley.

Frost, R., Katz, L., & Bentin, S., (1987). Strategies for visual word recognition and orthographical depth: A multilingual comparison. *Journal of Experimental Psychology: Human Perception and Performance, 13,* 104–115.

Giner–Sorolla, R., Garcia, M., & Bargh, J. A. (1999). The automatic evaluation of pictures. *Social Cognition, 17,* 76–96.

Glaser, J., & Banaji, M. R. (1999). When fair is foul and foul is fair: Reverse priming in automatic evaluation. *Journal of Personality and Social Psychology, 77,* 669–687.

Glaser, W. R. (1992). Picture naming. *Cognition, 42,* 61–105.

Glaser, W. R., & Glaser, M. O. (1989). Context effects in Stroop–like word and picture processing. *Journal of Experimental Psychology: General, 118,* 13–42.

Greenwald, A. G., Klinger, M. R., & Liu, T. J. (1989). Unconscious processing of dichoptically masked words. *Memory and Cognition, 17,* 35–47.

Greenwald, A. G., Klinger, M. R., & Schuh, E. S. (1995). Activation by marginally perceptible ("subliminal") stimuli: Dissociation of unconscious from conscious cognition. *Journal of Experimental Psychology: General, 124,* 22–42.

Hermans, D. (1996). *Automatische stimulusevaluatie. Een experimentele analyse van de voorwaarden voor evaluatieve stimulusdiscriminatie aan de hand van het affectieve–primingparadigma [Automatic stimulus evaluation. An experimental analysis of the preconditions for evaluative stimulus discrimination using an affective priming paradigm].* Unpublished doctoral dissertation, University of Leuven, Belgium.

Hermans, D. (2000). *Affective priming of pronunciation responses in relation to the orthographical depth of the language. A critical study of affective priming in English/Welsh bilinguals.* Unpublished internal research report, University of Leuven, Belgium.

Hermans, D., Clarysse, J., Baeyens, F., & Spruyt, A. (2001). *Affect (Version 1.0) [Computer software; retrieved from http://www.psy.kuleuven.ac.be/leerpsy/affect].* University of Leuven, Leuven, Belgium.

Hermans, D., Crombez, G., & Eelen, P. (2000). Automatic attitude activation and efficiency: The fourth horseman of automaticity. *Psychologica Belgica, 40,* 3–22.

Hermans, D., De Houwer, J., & Eelen, P. (1994). The affective priming effect: automatic activation of evaluative information in memory. *Cognition and Emotion, 8,* 515–533.

Hermans, D., De Houwer, J., & Eelen, P. (1996). Evaluative decision latencies mediated by induced affective states. *Behaviour Research and Therapy, 34,* 483–488.

Hermans, D., De Houwer, J., & Eelen, P. (2001). A time course analysis of the affective priming effect. *Cognition and Emotion, 15,* 143–165.

Hermans, D., Spruyt A., & Eelen, P. (in press). Automatic affective priming of recently acquired stimulus valence: Priming at SOA 300 but not at SOA 1000. *Cognition and Emotion.*

Hermans, D., Van den Broeck, A., & Eelen, P. (1998). Affective Priming using a colour–naming task: a test of an affective–motivational account of affective priming effects. *Zeitschrift für Experimentelle Psychologie, 45,* 136–148.

Hermans, D., Vansteenwegen, D., Crombez, G., Baeyens, F., & Eelen, P. (2001). Expectancy–learning and evaluative learning in human classical conditioning: Affective priming as an indirect and unobtrusive measure of conditioned stimulus valence. *Behaviour Research and Therapy, 40,* 217–234

Hodgson, J. M. (1991). Informational constraints on pre-Perical priming. *Language and Cognitive Processes, 6, 169-205.*

Huttenlocher, J., & Kubicek, L. F. (1983). The source of relatedness effects on naming latency. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9,* 486–496.

Kinjo, H., & Snodgrass, J. G. (2000). Is there a picture superiority effect in perceptual implicit tasks? *European Journal of Cognitive Psychology, 12,* 145–164.

Klauer, K. C. (1998). Affective priming. In W. Stroebe & M. Hewstone (Eds.), *European Review of Social Psychology* (pp. 67–103). New York: John Wiley and Sons.

Klauer, K. C., & Musch, J. (2001). Does sunshine prime loyal? Affective priming in the naming task. *Quarterly Journal of Experimental Psychology, 54,* 727–751.

Klauer, K. C., & Musch, J. (in press). Affective Priming: Findings and Theories. In J. Musch & K. C. Klauer (Eds.), *The Psychology of Evaluation: Affective Processes in Cognition and Emotion.* Mahwah, NJ: Lawrence Erlbaum.

Klauer, K. C., Roβnagel, R. & Musch, J. (1995). Mechanismen affektiven Primings *[Mechanisms of affective priming].* Unpublished manuscript, University of Heidelberg, Heidelberg, Germany.

Klauer, K. C., Roβnagel, R. & Musch, J. (1997). List–context effects in evaluative priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 246–255.

Klinger, M. R., Burton, P. C., & Pitts, G. S. (2000). Mechanisms of unconscious priming: I. Response competition, not spreading activation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 441–455.

Lukatela, G., Popadic, D., Ognjenovic, P., & Turvey, M. T. (1980). Lexical decision in a phonologically shallow orthography. *Memory and Cognition, 8,* 124–132.

Lupker, S. J. (1988). Picture naming: An investigation of the nature of categorical priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14,* 444–455.

Masson, M. E. J. (1995). A distributed model of semantic priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 3–23.

Masson, M. E. J. (1999). Interactive processes in word identification: Modelling context effects in a distributed memory system. In Klein, R. M. & McMullen, P. A. (Eds.), *Converging methods for understanding reading and dyslexia. Language, speech, and communication.* (pp. 373–411). Cambridge, MA: Mit Press.

McClelland, J. L., & Rumelhart, D. E. (1986). A distributed model of human learning and memory. In J. L. McClelland & D. E. Rumelhart (Eds.), *Parallel distributed processing* (Vol. 2, pp. 170–215). Cambridge, MA: MIT Press.

McCauley, C., Parmelee, C. M., Sperber, R. D., & Carr, T.H. (1980). Early extraction of meaning from pictures and its relation to conscious identification. *Journal of Experimental Psychology: Human Perception and Performance, 6,* 265–276.

Musch, J., & Klauer, K. C. (1997). Der Anteilseffect beim affectiven Priming: Replikation und Bewertung einer theoretischen Erklärung [The proportion effect in affective priming: Replication and evaluation of a theoretical framework]. *Zeitschrift für Experimentelle Psychologie, 44,* 266–292.

Nelson, D. L., Reed, V., & McEvoy, C. L. (1977). Learning to order pictures and words: A model of sensory and semantic coding. *Journal of Experimental Psychology: Human Learning and Memory, 3,* 485–497.

Paivio, A. (1975). Perceptual comparisons through the mind's eye. *Memory and Cognition, 3,* 635–647.

Pellegrino, J. W., Rosinski, R. R.; Chiesi, H. L., & Siegel, A. (1977). Picture–word differences in decision latency: An analysis of single and dual memory models. *Memory and Cognition, 5,* 383–396.

Potter, M. C. (1976). Short–term conceptual memory for pictures. *Journal of Experimental Psychology: Human Learning and Memory, 2,* 509–522.

Potter, M. C., Kroll, J. F., Yachzel, B., Carpenter, E., & Sherman, J. (1986). Pictures in sentences: Understanding without words. *Journal of Experimental Psychology: General, 115,* 281–294.

Rothermund, K., & Wentura, D. (1998). Ein fairer Test für die Aktivationsausbreitungs hypothese: Untersuchung affektiver Kongruenzeffekte in der Stroop–Aufgabe [An unbiased test of a spreading of activation account of affective priming: Analysis of affective congruency effects in the Stroop task]. *Zeitschrift für Experimentelle Psychologie, 45,* 120–135.

Seidenberg, M. S. (1993). Connectionist models and cognitive theory. *Psychological Science, 4,* 228–235.

Seifert, L. S. (1997). Activating representations in permanent memory: Different benefits for pictures and words. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 1106–1121.

Seifert, L. S., & Johnson, N. F. (1994). On the naming of color words and color patches. *Memory and Cognition, 22,* 169–180.

Sharkey, N. E. (1989). The lexical distance model and word priming. In G. M. Olsen & E.E. Smith (Eds.), *Proceedings of the Eleventh Annual Conference of the Cognitive Science Society* (pp. 860–867). Hillsdale, NJ: Erlbaum.

Sharkey, N. E. (1990). A connectionist model of text comprehension. In D. A. Balota, G. B. Florais d'Arcais, & K. Rayner (Eds.), *Comprehension processes in reading* (pp. 487–514). Hillsdale, NJ: Erlbaum.

Smith, E. R. (1996). What do connectionism and social psychology offer each other? *Journal of Personality and Social Psychology, 70,* 893–912.

Smith, M. C., & Magee, L. E. (1980). Tracing the time course of picture–word processing. *Journal of Experimental Psychology: General, 109,* 373–392.

Sperber, R. D., McCauley, C., Ragain, R. D., & Weil, C. M. (1979). Semantic priming effects on picture and word processing. *Memory and Cognition, 7,* 339–345.

Spruyt, A., Hermans, D., De Houwer, J., & Eelen, P. (2002). *Affective priming in the word–word naming paradigm: It is not the reliable phenomenon that you think it is.* Unpublished manuscript, University of Leuven, Belgium.

Stapel, D. A., Martin, L. L., & Schwarz, N. (1998). The smell of bias: What instigates correction processes in social judgments? *Personality and Social Psychology Bulletin, 24,* 797–806.

Stenberg, G., Radeborg, K., & Hedman, L. R. (1995). The picture superiority effect in a cross–modality recognition task. *Memory and Cognition, 23,* 425–441.

Strack, F. (1992). The different routes to social judgments: Experiential versus informational strategies. In L. L. Martin & A. Tesser (Eds.), *The construction of social judgments* (pp. 249–275). Hillsdale, NJ: Erlbaum.

Strack, F., & Hannover, B. (1996). Awareness of influence as a precondition for implementing correctional goals. In P. M. Gollwitzer & J. A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 579 – 596). New York: Guilford.

Strack, F., Schwarz, N., Bless, H., Kübler, A., & Wänke, M. (1993). Awareness of the influence as a determinant of assimilation versus contrast. *European Journal of Social Psychology, 23,* 53–62.

Strain, E., Patterson, K., & Seidenberg, M. S. (1995). Semantic effects in single–word naming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 1140 –1154.

Wentura, D. (1998). Affectives Priming in der Wortentscheidungsaufgabe: Evidenz für postlexicalische Urteilstendenzen. [Affective priming in the lexical decision task: evidence for post–lexical judgements tendencies]. *Sprache und Kognition, 17,* 125–137.

Wentura, D. (1999). Activation and inhibition of affective information: Evidence for negative priming in the evaluation task. *Cognition and Emotion, 13,* 65–91

Wentura, D. (2000). Dissociative affective and associative priming effects in the lexical decision task: Responding with "yes" vs. "no" to word targets reveals evaluative judgement tendencies. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 456–469.