Modulation of automatic semantic priming by feature-specific attention allocation

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ABSTRACT
We argue that the semantic analysis of task-irrelevant stimuli is modulated by feature-specific attention allocation. In line with this hypothesis, we found semantic priming of pronunciation responses to depend upon the extent to which participants focused their attention upon specific semantic stimulus dimensions. In Experiment 1, we examined the impact of feature-specific attention allocation upon affective priming. In Experiment 2, we examined the impact of feature-specific attention allocation upon nonaffective semantic priming. In Experiment 3, affective relatedness and nonaffective semantic relatedness were manipulated orthogonally under conditions that either promoted selective attention for affective stimulus information or selective attention for nonaffective semantic stimulus information. In each of these experiments, significant semantic priming emerged only for stimulus information that was selectively attended to. Implications for the hypothesis that the extraction of word meaning proceeds in an automatic, unconditional fashion are discussed.

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Introduction

It is a widespread assumption that any encounter with a word results in the automatic retrieval of its meaning (for a discussion, see Stolz & Besner, 1999). According to this viewpoint, the extraction of meaning (semantics) from words will take place obligatorily, regardless of the perceiver's intentions and regardless of how attention is focused. Supporting evidence for this viewpoint comes from semantic priming studies showing that the processing of a target word (e.g., 'WHALE') is facilitated by the preceding presentation of a semantically related prime word (e.g., 'PANDA') relative to an unrelated prime word (e.g., 'BICYCLE'). To account for such a semantic priming effect, it is typically argued that the presentation of a prime word (partially) activates its own semantic representation as well as the semantic representations of semantically related concepts (but see Ratcliff & McKoon, 1988, for another account). As a result, semantically related target words are assumed to be semantically encoded more quickly and responded to faster than semantically unrelated target words (e.g., Collins & Loftus, 1975; Neely, 1977; Neely, 1991; Posner & Snyder, 1975; Valdés, Catena, & Marí-Beffa, 2005).

In line with the hypothesis that semantic activation occurs automatically, semantic priming effects have been found across a wide variety of experimental variations (for reviews, see Hutchison, 2003; Lucas, 2000; McNamara, 2005; Neely, 1991), including the use of parafoveally (e.g., Fuentes, Carmona, Agis, & Catena, 1994; Fuentes & Tudela, 1992) and subliminally (e.g., Draine & Greenwald, 1998; Kiefer & Brendel, 2006; Klaer, Eder, Greenwald, & Abrams, 2007; Marcel, 1983) presented prime stimuli. However, there is also evidence showing that the semantic priming effect is reduced if attention is allocated to lower level features of the primes. Henik, Friedrich, Tzelgov, and Tramer (1994), for example, failed to obtain significant semantic priming when participants performed a letter-search task on the primes. Similar findings were also reported by...
Smith (1979) and many others (e.g., Chiappe, Smith, & Besner, 1996; Henik, Friedrich, & Kellogg, 1983; Maxfield, 1997; Smith, Bentin, & Spalek, 2001; Stolz & Besner, 1996; but see Heil, Rolke, & Pecchinenda, 2004; Hutchison & Bosco, 2007; Tse & Neely, 2007; Valdés et al., 2005). More recently, it has also been argued that the semantic priming effect depends on temporal and spatial attention (Kouider & Dehaene, 2007). For example, in two event-related potentials (ERP) studies, Kiefer and Brendel (2006) found masked semantic priming (N400 modulation) to be significantly reduced when the primes did not appear at temporally predictable moments (see also Naccache, Blanzin, & Dehaene, 2002). In the domain of spatial attention, the impact of selective attention on the semantic priming effect was convincingly established, among others, by Musch and Klauer (2001). They presented primes and targets at different locations of a computer screen and found semantic priming only if locational uncertainty about the target location required participants to distribute their attention across different locations. If certainty about the target location induced focused spatial attention, semantic priming vanished completely (see also Lachter, Forster, & Ruthruff, 2004).

In summary, a large number of studies suggest that semantic priming is dependent upon attentional control. This hypothesis does not logically imply, however, that all semantic features of task-irrelevant prime concepts will be accessed to the same extent under conditions that promote semantic stimulus processing. We propose that selective attention may also operate at the level of individual semantic stimulus dimensions. This hypothesis was inspired by studies of Nosofsky (1986) showing that participants can selectively weigh component dimensions of perceptually confusable stimuli (i.e., semicircles varying in size and angle of orientation of a radial line drawn from the center of the semicircle to the rim) so as to optimize performance in categorization tasks. Nosofsky (1986) had predicted this finding on the basis of his Generalized Context Model (GCM) of classification (Nosofsky, 1986, 1987). In the GCM, stimuli are represented as points in a multidimensional psychological space, the structure of which is systematically modified by selective-attention processes. More specifically, attending selectively to a dimension serves to stretch the space along that dimension and shrink the space along unattended dimensions (Nosofsky & Palmeri, 1997; see also Caroll & Wish, 1974; Medin, 1983; Medin & Schaffer, 1978; Nosofsky, 1984; Reed, 1972; Tversky, 1977). As a result of this attentional weighting, variations on attended stimulus dimensions become more salient relative to unattended stimulus dimensions (Medin & Schaffer, 1978).

Typically, the GCM of Nosofsky (1986) is applied to account for response patterns in categorization studies employing sets of stimuli that vary along perceptual dimensions (e.g., schematic faces, random dot patterns, luminance). We propose, however, that feature-specific attention allocation can also modulate the semantic priming effect. More specifically, we assume that the semantic analysis of task-irrelevant stimuli is much more pronounced for features and feature dimensions that are selectively attended to than for features and feature dimensions that are not selectively attended to. For example, if an individual is required to respond on the basis of semantic stimulus dimension A, the analysis of task-irrelevant stimuli will be more pronounced for semantic stimulus dimension A than for semantic stimulus dimension B. Conversely, if an individual is required to respond on the basis of semantic stimulus dimension B, the analysis of the same set of task-irrelevant stimuli will be more pronounced for semantic stimulus dimension B than for semantic stimulus dimension A. As suggested by this example, we expect feature-specific attention allocation to vary flexibly as a function of an individual’s goals and task demands. However, subtle characteristics of the context in which one interacts with certain stimuli and/or characteristics of the stimuli themselves may also define the features and feature dimensions that are selectively attended to. For example, an individual participating in a semantic priming experiment may be encouraged to attend to affective stimulus information when he or she notices that all target words refer to either positive or negative concepts, irrespective of the nature of the target task.

To our knowledge, the hypothesis that the semantic analysis of task-irrelevant stimuli is modulated by feature-specific attention allocation has never been tested. However, strong hints of the existence of feature-specific attentional modulation of semantic priming can be found in literature. Consider, for instance, the studies of Schreuder, Flores d’Arcais, and Glazenborg (1984) and Flores d’Arcais, Schreuder, and Glazenborg (1985). These authors reported significant priming effects for word pairs that were ‘perceptually related’ – that is, word pairs that were related because they referred to objects with the same shape (e.g., ‘pizza – coin’). Because it is difficult to account for such a finding in terms of associative relations between the primes and the targets, the findings of Schreuder et al. (1984) and Flores d’Arcais et al. (1985) are frequently referred to as examples of pure semantic priming (see Lucas, 2000; McAue & Boisvert, 1998; Perea & Gotor, 1997; Shelton & Martin, 1992). However, Pecher, Zeelenberg, and Raaijmakers (1998) later reported that they were unable to replicate this semantic priming effect unless participants were instructed to make explicit judgments about the perceptual properties of the word’s referents prior to the priming task. Because such a procedure must have induced selective attention for the perceptual characteristics of the presented concepts, the findings of Pecher et al. (1998) are consistent with our framework.

Recent studies on the affective priming effect (Fazio, Sanbonmatsu, Powell, & Kardes, 1986) also suggest that feature-specific attention allocation can modulate semantic priming. Affective priming refers to the observation that affectively polarized targets are typically responded to faster after the presentation of affectively congruent primes as compared to affectively incongruent primes (for reviews, see Fazio, 2001; Musch & Klauer, 2003). Crucially, it has been demonstrated that affective priming effects are exclusively driven by the evaluative relation between the primes and the targets (Hermans, Smeesters, De Houwer, & Eelen, 2002; Spruyt, Hermans, De Houwer, & Eelen, 2004). Therefore, affective priming can be regarded as an
instance of pure (nonassociative) semantic priming (see Hutchison, 2003). It is somewhat problematic from this point of view, however, that the affective priming effect appears to depend upon the nature of response task (De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer & Musch, 2002; Klinger, Burton, & Pitts, 2000; Spruyt, 2005). Whereas affective priming effects are readily obtained if participants respond on the basis of the affective connotation of the targets (i.e., evaluative categorization task), the affective priming effect typically fails to replicate if participants respond on the basis of nonaffective semantic features of the targets concepts (i.e., nonaffective semantic categorization task) or pronounce the targets (i.e., pronunciation task; see De Houwer, Hermans, & Eelen, 1998; Klauer & Musch, 2001; Spruyt, Hermans, Pandelaere, De Houwer, & Eelen, 2004).

Recent studies conducted at our lab suggest, however, that this task-dependency of the affective priming effect may be due to feature-specific attention allocation (Spruyt, De Houwer, Hermans, & Eelen, 2007). More specifically, we were able to obtain reliable affective priming of nonaffective semantic categorization responses under conditions that promoted selective attention for affective stimulus information. In Experiment 1 of Spruyt, De Houwer, et al. (2007) this precondition was realized by implementing a task-switching procedure. Participants were presented with target pictures that portrayed positively and negatively valenced exemplars of the categories ‘animals’ and ‘objects’ (primes were also positively and negatively valenced pictures, but none of them portrayed an animal or an object). As for the response assignments, they were asked to switch between two tasks, depending on a cue that was presented at target onset: Either they were required to respond on the basis of the valence of the targets or they were required to respond on the basis of nonaffective semantic category membership. Crucially, evaluative categorization responses were required on 75% of all trials in one group of participants, whereas the proportion of evaluative categorization trials was restricted to just 25% in a second group. Results showed that, irrespective of the nature of the response task, significant affective priming emerged in the 75% evaluation condition whereas no affective priming emerged in the 25% evaluation condition. In Experiment 2 of Spruyt, De Houwer, et al. (2007), words were used as primes and targets and selective attention for affective stimulus information was induced by a totally different experimental procedure. In this experiment, participants were asked to keep a mental tally of how many of the primes were positive and negative while performing a nonaffective semantic categorization task. Again significant affective priming emerged. In conformity with the theoretical framework outlined above, these findings show that reliable affective priming of nonaffective semantic categorization responses can be obtained if attention is assigned to the affective stimulus dimension. More specifically, it might be argued that participants adopted a conservative response criterion in order to deal with the complexity of having to switch between two binary tasks (Experiment 1) or to perform two tasks at the same time (Experiment 2). Under such conditions, the use of a binary response task can be a disadvantage because verifying whether an (internally) activated response is indeed the correct response can be facilitated/inhibited at a post-access level by the evaluative match/mismatch between the primes and the targets (see Klauer & Musch, 2002; Klauer & Musch, 2003; Wentura, 2000, for such post-lexical accounts, and Norris, 1986, for related arguments). Second, it is a troublesome aspect of Spruyt et al.’s Experiment 1 that participants were always switching between two categorization tasks (i.e., affective categorization vs. nonaffective semantic categorization). As a result, the absence of an evaluative processing goal in the 25% evaluation condition was confounded with the activation of a nonevaluative processing goal. It is thus impossible to determine whether the absence of affective priming in the 25% evaluation condition resulted from the absence of an evaluative processing mindset, the activation of a nonaffective processing mindset, or the combination of both. Finally, the studies of Spruyt et al. focused on the affective priming effect only. Although the targets used in their studies were pictures portraying (Experiment 1) or words referring to (Experiment 2) exemplars of two nonaffective semantic categories, nonaffective semantic relatedness of the primes and the targets was not manipulated. It thus remains to be seen whether their findings generalize to the domain of nonaffective semantic priming.

In the present series of studies, we sought to overcome each of these weaknesses. First of all, we examined the impact of feature-specific attention allocation on semantic priming in a pronunciation task. The likelihood that conscious response strategies and/or post-access processes are operative in the pronunciation task is relatively minimal (e.g., Balota & Lorch, 1986; de Groot, 1984; Neely, 1991; Pecher et al., 1998; see also Spruyt et al., 2004). Therefore, the use of the pronunciation task adequately deals with the first limitation of the studies of Spruyt, De Houwer, et al. (2007). Moreover, unlike the nonaffective semantic categorization task, the pronunciation task does not induce a particular semantic processing mindset. It is in some sense semantically neutral. Therefore, the use of the pronunciation task also deals with the second limitation of Spruyt, De Houwer, et al. (2007). Finally, in order to deal with the third limitation of Spruyt, De Houwer, et al. (2007), we examined the impact of feature-specific attention allocation on both affective (Experiments 1 and 3) and nonaffective semantic priming (Experiments 2 and 3).

In each of these studies, pronunciation trials were embedded in a context of either affective or nonaffective semantic categorization trials in order to manipulate feature-specific attention allocation. In Experiment 1, we looked at affective priming. Similar to Experiment 1 of Spruyt, De Houwer, et al. (2007), the extent to which participants assigned attention to the affective stimulus dimension was manipulated by embedding the pronunciation trials in a list of either 25% or 75% evaluative categori-
zation trials. In Experiment 2, we examined the impact of a similar manipulation in a nonaffective semantic priming procedure. In Experiment 3, we manipulated affective and nonaffective semantic congruence simultaneously and induced selective attention for either affective stimulus information or nonaffective semantic information. In each of these studies, we expected to find significant priming only for stimulus dimensions that were selectively attended to.

**Experiment 1**

**Method**

**Participants**

A total of 48 undergraduates at Ghent University (21 men, 27 women) participated for course credit or were paid €8 for their help in this experiment and an unrelated other experiment. As in all other experiments, they were native Dutch-speakers who had normal or corrected-to-normal vision.

**Materials**

Sixty adjectives were used as primes (30 positive, 30 negative). Targets were 30 positive and 30 negative nouns (see “Appendix”). All stimuli were presented in white capitals (font Arial, font size 48) against the black background of a 19 in. computer monitor (100 Hz, screen resolution 1024 × 768). An Affect 3.0 program (Hermans, Clarysse, Baeyens, & Spruyt, 2003) controlled the presentation of the stimuli as well as the registration of the response latencies. An external voice key that was connected to the parallel port of the computer was used to register the response latencies.

**Procedure**

Participants were randomly assigned to either the 25% evaluation condition (n = 24) or the 75% evaluation condition (n = 24). In both conditions, participants were asked to pronounce targets words as fast as possible unless a green rectangle appeared around it. Whenever the response-defining cue appeared on the computer screen, participants were to evaluate the targets by saying the Dutch word for ‘positive’ or ‘negative’. On pronunciation trials, no cue was presented. Crucially, a pronunciation response was required on 25% of the trials in the 75% evaluation condition. In the 25% evaluation condition, a pronunciation response was required on 75% of the trials. Within each response task, different trial types (positive-positive, negative-positive, positive-negative, and negative-negative) occurred equally often. Thus, the evaluative consistency proportion (Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007), was .50 in each experimental condition. Each target stimulus and each prime stimulus appeared at least two times and at most four times. Within the boundaries of these restrictions, primes and targets were randomly combined for each participant separately.

Before the start of the experiment, both groups completed a practice phase consisting of 24 target-only trials (12 positive, 12 negative). Depending on the experimental condition, a pronunciation response was required on either 25% or 75% of these practice trials. On the remaining target-only trials, participants were to respond on the basis of the affective meaning of the targets. Equal numbers of positive and negative targets were presented within each task condition (either 3 or 9, depending on the experimental condition).

Before the start of the priming phase, participants were informed about the fact that each target word would be preceded by a prime word during the actual experiment. They were told that: (a) these prime stimuli were merely presented to make their task more difficult, (b) they were not supposed to respond to the prime stimuli, and (c) they were allowed to ignore the prime stimuli if they wanted to. To familiarize the participants with the priming procedure, eight warm-up trials were presented. These warm-up trials consisted of randomly selected primes and targets. For each of these warm-up trials, a pronunciation response was required.

The experimental phase consisted of 192 trials. In the 25% evaluation condition, 144 trials required a pronunciation response and 48 trials required an evaluative categorization response. In the 75% evaluation condition, 48 trials required a pronunciation response and 144 trials required an evaluative categorization response. Pronunciation trials and evaluative categorization trials were randomly intermixed. Each trial started with a 500-ms-presentation of a fixation cross. Next, after an interstimulus interval of 500 ms, the prime was presented for 200 ms. Finally, 50 ms after the offset of the prime (SOA 250 ms), the target was presented until the participant gave a response or 2000 ms elapsed. The response-defining cue was presented on evaluative categorization trials only. It appeared simultaneously with the targets and was also presented until the participant gave a response or 2000 ms elapsed. The experimenter coded whether the microphone was accurately triggered and whether the participant’s response was correct by pressing one of three keys on the computer keyboard. After the experimenter entered the code, the next trial was initiated after a time interval that varied randomly between 500 ms and 1500 ms.

**Results**

**Data reduction and analyses**

Only the data of the pronunciation trials were analyzed. Data of trials on which the voice key was not appropriately activated (5.77%) or an incorrect response was given (2.99%) were discarded. The impact of outlying values was reduced by excluding all response latencies (2.54%) that deviated more than 2.5 standard deviations from a participant’s mean latency in a particular condition (see Ratcliff, 1993). Three types of analyses were performed. First, we subjected the data to a 2 (evaluation condition: 25% vs. 75%) × 2 (affective congruence: related vs. unrelated) ANOVA. Second, we performed additional analyses in which individual reaction time distributions for each priming condition were first divided into three 1/3-bins (see De Jong, Liang, & Lauber, 1994; see also Balota, Yap, Cortese, & Watson, 2008). The motivation for this procedure was straightforward. Because different proportions
of pronunciation trials and evaluative categorization trials were presented in a random order, participants may have been biased to apply the dominant task on all trials. In the 75% evaluation condition, for example, participants may have been inclined to respond on the basis of the valence of the targets before actually pronouncing them. As a result, affective priming of pronunciation responses might have come about as a by-product of the internal evaluative categorization being affectively primed. Moreover, if it is assumed that the affective priming effect dissipates rather quickly, the same mechanism would lead one to predict reduced affective priming of pronunciation responses in the 25% evaluation condition. This reasoning implies, however, that affective priming in the 75% evaluation condition should be confined to trials on which participants responded (relatively) slowly. Conversely, significant affective priming of pronunciation responses might be found on pronunciation trials of the 25% evaluation condition on which participants responded relatively (relatively) fast. To shed light on this issue, the data were subjected to a 2 (evaluation condition: 25% vs. 75%) × 3 (bin: 1 vs. 2 vs. 3) × 2 (affective congruence: related vs. unrelated) ANOVA. Finally, following the recommendations of Locker, Hoffman, and Bovaird (2007), we adopted multilevel modeling techniques in which subjects and items were modeled as random effects within the same analysis to assess whether our findings generalize across items as well as subjects (see also Baayen, Davidson, & Bates, 2008; Baayen, Tweedie, & Schreuder, 2002).

ANOVA

The crucial interaction between affective congruence and condition reached significance, \( F(1, 46) = 4.24, p < .05, MSE = 312.74 \). As expected, the effect of affective congruence was reliable in the 75% evaluation condition, \( F(1, 23) = 4.93, p < .05, MSE = 517.01, \) but not in the 25% evaluation condition, \( F < 1 \) (see Table 1). The overall ANOVA also revealed a main effect of condition, \( F(1, 46) = 16.66, p < .005, MSE = 9576.07 \): Participants were faster to name target words in the 25% evaluation condition (\( M = 485 \) ms) as compared to the 75% evaluation condition (\( M = 566 \) ms).

Bin analyses

The results of a 2 (evaluation condition: 25% vs. 75%) × 3 (bin: 1 vs. 2 vs. 3) × 2 (affective congruence: related vs. unrelated) ANOVA were clear-cut. The crucial interaction between affective congruence and condition again reached significance, \( F(1, 46) = 4.62, p < .05, MSE = 937.69, \) and none of the effects involving affective congruence were moderated by the bin variable, \( Fs < 1 \). Follow-up analyses confirmed that: (a) the nonsignificant priming effect in the 25% evaluation condition did not result from a crossover interaction with the bin variable, and (b) that the significant priming effect in the 75% evaluation condition was not confined to the slowest response latencies. Mean affective priming effects in the 75% evaluation condition were 14 ms (SD = 31.68 ms), 11 ms (SD = 27.97 ms), and 21 ms (SD = 71.84 ms) in bins 1–3, respectively. Mean affective priming effects in the 25% evaluation condition were −4 ms (SD = 10.52 ms), 0 ms (SD = 13.22 ms), and −6 ms (SD = 28.40 ms) in bins 1–3, respectively.

Multilevel analyses

Both the random effect of subjects, \( \chi^2(1) = 2684.38, p < .001, \) and the random effect of items \( \chi^2(1) = 102.59, p < .001, \) were reliable. To assess the relative contribution of variance in response time due to items vs. variance due to subjects, we calculated intraclass correlations for each effect (see Locker et al., 2007; Snijders & Bosker, 1999). The proportion of total variance in response time due to subjects was 50.60% and the proportion of total variance in response time due to items was 2.31%, leaving 47.09% of total variance in response time unexplained.

After identifying the presence of random effects of subjects and items, we examined the effects of affective congruence and evaluation condition, as well as their interaction. In line with the analyses reported above, the interaction between affective congruence and evaluation condition was reliable, \( F(1, 4005.09) = 7.20, p < .01 \). Follow-up analyses confirmed that the effect of affective congruence was significant in the 75% evaluation condition, \( F(1, 1031.52) = 4.39, p < .05, \) but not in the 25% evaluation condition, \( F < 1 \).

Discussion

The results are clear-cut. When participants were encouraged to selectively allocate attention to the affective stimulus dimension (75% evaluation condition), significant affective priming of pronunciation responses emerged. In contrast, when focusing on affective stimulus information was less critical to comply with task demands (25% evaluation condition), no reliable affective priming of pronunciation responses emerged. This finding coincides with recent findings of Spruyt, De Houwer, et al. (2007) who showed that significant affective priming of nonaffective semantic categorization response can be found only if and to the extent that participants focus their attention on affective stimulus dimension. Unlike the findings of Spruyt, De Houwer et al. (2007), however, the present findings cannot easily be attributed to: (a) the operation of post-target decisional processes or (b) differences in the extent to which a nonaffective semantic processing mindset was active in different selective attention conditions (see above). Therefore, the present experiment provides a more rigorous test of the hypothesis that the affective priming effect can be modulated by feature-specific attention allocation.

It should be noted, though, that the pronunciation trials were more likely to be preceded by an affective categorization trial in the 75% evaluation condition than in the 25% evaluation condition. The observed difference in priming between the two groups could thus be due to priming being greater on trials that required a task-shift than on trials that did not require a task-shift. To shed light on this issue, we examined whether priming was a function of

\[^{1}\text{Estimated denominator degrees of freedom using the Satterthwaite method; no mean squares estimated.}\]
whether the trial immediately preceding a pronunciation trial required a pronunciation response (and thus no task-shift) or an evaluation response (and thus a task-shift). Neither in the 25% evaluation condition, \( F(1, 23) = 1.69, p > .20, \text{MSE} = 355.18, \) nor in the 75% evaluation condition, \( F < 1, \) did priming depend on the nature of the preceding trial. Mean affective priming effects in the 25% evaluation condition were 2 ms (\( SD = 11.35 \text{ ms} \)) and \(-8 \text{ ms} (\text{SD} = 38.56 \text{ ms}) \) for nonswitch trials and switch trials, respectively. Mean affective priming effects in the 75% evaluation condition were 15 ms (\( SD = 65.32 \text{ ms} \)) and 18 ms (\( SD = 37.85 \text{ ms} \)) for nonswitch trials and switch trials, respectively. We can thus conclude that the present findings did not emerge as a by-product of priming being greater for task-shift trials than for nonshift trials.

Affective priming can be conceived of as a pure instance of semantic priming (see above). Therefore, the findings of Experiment 1 support the general hypothesis that semantic priming can be modulated by feature-specific attention allocation. Nevertheless, in order to conceptually replicate and extend the findings of Experiment 1, we decided to examine the impact of feature-specific attention allocation on the semantic priming effect in the nonaffective domain. In Experiment 2, participants were presented with prime and target words that referred to either animals or objects. As in Experiment 1, participants were asked to pronounce the target words on either 25% or 75% of the trials. On the remaining trials, nonaffective semantic categorization responses were required.

**Experiment 2**

**Method**

**Participants**

A total of 30 undergraduates at Ghent University (5 men, 25 women) participated for course credit or were paid €8 for their help in this experiment and an unrelated other experiment.

**Materials**

For each participant, 20 prime words and 20 targets words were randomly sampled from a list of 40 words (20 animals, 20 objects; see “Appendix”). Both the prime set and the target set always consisted of 10 animal names and 10 object names. The apparatuses used this experiment were identical to those used in Experiment 1.

**Procedure**

Participants were randomly assigned to either the 25% semantic categorization condition \((n = 15)\) or the 75% semantic categorization condition \((n = 15)\). In both conditions, participants were asked to pronounce targets words as fast as possible unless a green rectangle appeared around it. Whenever the cue appeared on the computer screen, participants were to categorize targets by saying the Dutch word for ‘animal’ or ‘object’. On pronunciation trials, no cue was presented. Crucially, a pronunciation response was required on 25% of the trials in the 75% semantic categorization condition. In the 25% semantic categorization condition, a pronunciation response was required on 75%. Within each response task, different trial types (animal–object, object–animal, object–object, animal–animal) occurred equally often. Thus, the semantic consistency proportion was .50 in each experimental condition. Each target stimulus and each prime stimulus appeared at least eight times and at most 10 times. Within the boundaries of these restrictions, primes and targets were randomly combined for each participant separately.

Akin to Experiment 1, both groups completed a practice phase consisting of 24 target-only trials (12 animals, 12 objects). Depending on the experimental condition, a pronunciation response was required on either 25% or 75% of these practice trials. On the remaining target-only trials, participants were to respond on the basis of nonaffective semantic category membership. Equal numbers of animal and object names were presented within each task condition (either 3 or 9, depending on the experimental condition).

The actual priming procedure started with the presentation of four randomly generated warm-up trials for which a pronunciation response was required. The stimuli that were presented on these warm-up trials were drawn from the pool of experimental items. Pronunciation trials and nonaffective semantic categorization trials were randomly intermixed. The experimental phase consisted of 192 trials. In the 25% semantic categorization condition, 144 trials required a pronunciation response and 48 trials.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Affective congruence</th>
<th>Nonaffective congruence</th>
<th>APE</th>
<th>NASPE</th>
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<tbody>
<tr>
<td></td>
<td>Congruent</td>
<td>Incongruent</td>
<td></td>
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<tr>
<td>Experiment 1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>25% Evaluative categorization</td>
<td>485 (2.54)</td>
<td>485 (1.62)</td>
<td>0 [-7,6]</td>
<td></td>
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<tr>
<td>75% Evaluative categorization</td>
<td>559 (6.59)</td>
<td>574 (4.86)</td>
<td>15 [1,28]</td>
<td></td>
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<tr>
<td>Experiment 2</td>
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<tr>
<td>25% Semantic categorization</td>
<td>–</td>
<td>–</td>
<td>–3 [-9,3]</td>
<td></td>
</tr>
<tr>
<td>75% Semantic categorization</td>
<td>–</td>
<td>–</td>
<td>–18 [1,35]</td>
<td></td>
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<tr>
<td>Experiment 3</td>
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<tr>
<td>75% Evaluative categorization</td>
<td>566 (2.78)</td>
<td>574 (2.08)</td>
<td>14 [7,21]</td>
<td>3 [-6,10]</td>
</tr>
<tr>
<td>75% Semantic categorization</td>
<td>601 (1.93)</td>
<td>604 (1.08)</td>
<td>10 [3,17]</td>
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</tbody>
</table>

Note. APE = affective priming effect and NASPE = nonaffective semantic priming effect.
required a semantic categorization response. In the 75% semantic categorization condition, 48 trials required a pronunciation response and 144 trials required a semantic categorization response. Pronunciation trials and semantic categorization trials were randomly intermixed. In all other aspects, the procedure of Experiment 2 was identical to that of Experiment 1.

Results

ANOVA

Only the data of the pronunciation trials were analyzed. Data of trials on which the voice key was not appropriately activated (7.29%) or an incorrect response was given (3.05%) were discarded. In order to reduce the impact of outliers, response latencies that deviated more than 2.5 standard deviations from a participant’s mean latency in a particular condition were also excluded (2.53%). After computing mean response latencies for each cell of the design, the remaining data were subjected to a 2 (categorization condition: 25% vs. 75%) × 2 (nonaffective semantic congruence: related vs. unrelated) ANOVA.

The crucial interaction between nonaffective semantic congruence and condition did reach significance, \( F(1, 28) = 6.27, p < .05 \), \( \text{MSE} = 259.18 \). As expected, the effect of nonaffective semantic congruence was reliable in the 75% nonaffective semantic categorization condition, \( F(1, 14) = 5.22, p < .05 \), \( \text{MSE} = 462.71 \), but not in the 25% nonaffective semantic categorization condition, \( F < 1 \) (see Table 1). Finally, the overall ANOVA also revealed a main effect of condition, \( F(1, 28) = 32.19, p < .001 \), \( \text{MSE} = 10664.96 \); participants were faster to name target words in the 25% nonaffective semantic categorization condition (\( M = 472 \) ms) as compared to the 75% nonaffective semantic categorization condition (\( M = 624 \) ms).

Bin analyses

To examine whether the nonaffective semantic priming effect in the 75% nonaffective semantic categorization condition was confined to trials on which participants responded (relatively) slowly, we performed additional analyses in which individual reaction time distributions for each priming condition were first divided into three 1/3-bins (see Experiment 1). The data were then subjected to a 2 (categorization condition: 25% vs. 75%) × 3 (bin: 1 vs. 2 vs. 3) × 2 (nonaffective semantic congruence: related vs. unrelated) ANOVA.

Similar to Experiment 1, none of the effects involving affective congruence were moderated by the bin variable, Fs < 1, whereas the interaction between nonaffective semantic congruence and condition did reach significance, \( F(1, 28) = 5.56, p < .05 \), \( \text{MSE} = 882.88 \). Follow-up analyses confirmed that: (a) the nonsignificant priming effect in the 25% evaluation condition did not result from a crossover interaction with the bin variable, and (b) that the significant priming effect in the 75% nonaffective semantic categorization condition was not confined to the slowest response latencies. Mean nonaffective semantic priming effects in the 75% nonaffective semantic categorization condition were 11 ms (\( SD = 23.65 \) ms), 12 ms (\( SD = 34.28 \) ms), and 21 ms (\( SD = 59.97 \) ms) in bins 1–3, respectively. Mean nonaffective semantic priming effects in the 25% nonaffective semantic categorization condition were 0 ms (\( SD = 12.57 \) ms), −4 ms (\( SD = 7.89 \) ms), and −5 ms (\( SD = 21.91 \) ms) in bins 1–3, respectively.

Multilevel analyses

Both the random effect of subjects, \( \chi^2(1) = 2292.27, p < .001 \), and the random effect of items \( \chi^2(1) = 14.94, p < .001 \), were reliable. Intraclass correlations revealed that the proportion of total variance in response time due to subjects was 64.77%. The proportion of total variance in response time due to items was 0.66%. The proportion of residual variance was 42.84%.

After identifying the presence of random effects of subjects and items, we examined the effects of nonaffective semantic congruence and categorization condition, as well as their interaction. In line with the analyses reported above, the interaction between nonaffective semantic congruence and categorization condition was reliable, \( F(1, 2466.03) = 9.29, p < .001 \). Follow-up analyses confirmed that the effect of affective congruence was significant in the 75% evaluation condition, \( F(1, 6102.31) = 3.90, p < .05 \), but not in the 25% evaluation condition, \( F < 1 \).

Discussion

As expected, nonaffective semantic priming reached significance in the 75% nonaffective semantic categorization condition. In contrast, the 25% nonaffective semantic categorization condition revealed no priming whatsoever. This pattern of results conceptually replicates the findings of Experiment 1 and corroborates our thesis that semantic priming (affective or nonaffective) is dependent upon the extent to which participants assign attention to the stimulus dimension of interest.

Similar to Experiment 1, however, pronunciation trials were more likely to be task-shift trials in the 75% nonaffective semantic categorization condition than in the 25% nonaffective semantic categorization condition. Accordingly, one might again argue that the observed difference in priming between the two categorization groups may have resulted from priming being greater for task-shift trials than for nonshift trials. To rule out such an explanation, we re-analyzed our data and examined whether priming depended on whether the immediately preceding trial required a pronunciation response or a nonaffective semantic categorization response. Neither in the 25% nonaffective semantic categorization condition nor in the 75% nonaffective semantic categorization priming depended on the nature of the preceding trial, both Fs < 1.

Mean nonaffective priming effects in the 25% nonaffective semantic categorization condition were 0 ms (\( SD = 10.26 \) ms) and −5 ms (\( SD = 45.90 \) ms) for nonswitch trials and switch trials, respectively. Mean affective priming effects in the 75% nonaffective semantic categorization condition were 38 ms (\( SD = 95.53 \) ms) and 13 ms (\( SD = 47.22 \) ms) for nonswitch trials and switch trials, respectively. We can thus conclude that the present findings did not come about as a by-product of priming being greater for task-shift trials than for nonshift trials.
Nevertheless, several other problems can be identified that complicate an interpretation of Experiments 1 and 2 as conclusive evidence for our thesis that semantic priming (affective or nonaffective) is dependent upon the extent to which participants assign attention to the stimulus dimension of interest. First of all, one might question whether our manipulation of feature-specific attention allocation was truly ‘specific’. A few years ago, De Houwer and Randell (2004) demonstrated that reliable affective priming of pronunciation responses can be obtained if pronunciation is made conditional upon the detection of (nonaffective) semantic target information. More specifically, they asked participants to pronounce target words, except when the target word referred to an occupation (i.e., ‘LAWYER’, Experiment 2). When pronunciation was made conditional upon the detection of a perceptual feature of the target stimuli (e.g., font color), no affective priming of pronunciation responses emerged. This pattern of results convincingly demonstrates: (a) that affective stimulus information is stored within the semantic system (see also Bower, 1991; De Houwer & Hermans, 1994) and (b) that affective priming of pronunciation is dependent upon the extent to which pronunciation is semantically mediated.

In the light of these findings, one might argue that the priming effects obtained in Experiments 1 and 2 were simply due to the fact that participants were more efficiently forced to adopt a semantic processing mode in the 75% (evaluative) categorization conditions than in the 25% (evaluative) categorization conditions. Put differently, instead of attributing the impact of intermixing pronunciation trials with different proportions of categorization trials to variations in the extent to which specific semantic stimulus dimensions were selectively attended to, one might argue that a general, unspecific increase in semantic stimulus processing was responsible for the observed effects.

A second issue that complicates the interpretation of Experiments 1 and 2 relates to the fact that we used the same stimulus sets for both categorization and pronunciation trials. It could thus be argued that priming effects in the 75% categorization groups were dependent upon targets having been previously categorized on priming-relevant dimensions. Moreover, given that we manipulated the proportion of pronunciation/categorization trials, the likelihood that a specific target was presented on a categorization trial before it was presented on a pronunciation trial was much higher in the 75% categorization groups as compared to the 25% categorization groups. Accordingly, the idea that priming was dependent upon targets having been previously categorized on priming-relevant dimensions can also account for the observation that reliable priming emerged in the 75% categorization groups only.

Finally, it is somewhat problematic that the main effect of categorization condition reached significance both in Experiments 1 and 2. Participants were overall faster to pronounce targets in the 25% categorization condition (affective or nonaffective) than in the 75% categorization condition. At first sight, this finding may seem very plausible, almost trivial. Indeed, as pronunciation trials were relatively rare in the 75% categorization conditions and participants were not informed about the nature of the required response (pronunciation vs. categorization) until the targets were presented, most response latencies in these conditions comprised a task-shift component. In contrast, relatively few response latencies comprised such a task-shift component in the 25% categorization conditions. Given that switching between tasks is time-consuming (e.g., Dreisbach, Haider, & Kluwe, 2002), it seems normal to observe longer overall response latencies in the 75% categorization conditions than in the 25% categorization conditions. In addition, one might argue that the main effect of condition reflects a more pronounced practice effect in the 25% categorization conditions as compared to the 75% categorization conditions because more pronunciation trials were presented in the former condition than in the latter. However, it is also known that priming effects tend to increase as the overall response latency increases (e.g., Williams, 1996). Given that we observed priming effects when the overall response latencies were long but not when they were short, one might thus argue that our findings resulted from a scaling problem rather than the effects of feature–specific attention allocation.

**Experiment 3**

Experiment 3 deals with each of these issues raised above. Just as in Experiments 1 and 2 we randomly intermixed pronunciation trials and categorization trials. This time, however, the proportion of pronunciation trials was always 25%. On the remaining trials, participants were either asked to respond on the basis of the affective connotation of the targets (75% affective categorization condition) or to categorize the targets as object vs. person (75% nonaffective semantic categorization condition). Participants were thus encouraged to engage in semantic stimulus processing to the same extent in both conditions. Crucially, we manipulated affective congruence and nonaffective semantic congruence simultaneously and independently from each other on the pronunciation trials. If the priming effects observed in the 75% categorization conditions of Experiments 1 and 2 were due to an overall, unspecific increase in semantic stimulus processing, significant affective priming as well as significant nonaffective semantic priming should emerge in both conditions of Experiment 3. In contrast, if the priming effects observed in the 75% categorization conditions of Experiments 1 and 2 resulted from feature-specific attention allocation, significant priming should emerge for the salient stimulus dimension only.

Second, to rule out the possibility that our findings are dependent on targets having been categorized on priming-relevant dimensions, different stimulus sets were used for pronunciation trials and categorization trials. None of the stimuli in the 75% affective categorization condition referred to persons or objects (e.g., ‘summer’) and stimuli in the 75% nonaffective categorization condition were all affectively neutral (e.g., ‘box’).

Finally, Experiment 3 deals with the problem that priming effects in Experiments 1 and 2 emerged when the overall speed of responding was long but not when it was short. Whatever mechanism caused this data pattern (a high pro-
portion of task-switching trials or less-pronounced practice effects, see above), it could no longer affect the overall speed of responding in Experiment 3 as the number of pronunciation trials was kept constant (i.e., 25%). Moreover, as we manipulated affective and nonaffective relatedness on a within-subjects basis in Experiment 3, the overall speed of responding in different priming conditions was simply identical within each selective attention condition.

Method

Participants

A total of 56 undergraduates at Ghent University (13 men, 43 women) participated for course credit or were paid €8 for their help in this experiment and an unrelated other experiment.

Materials

Because it was impossible to construct a sufficiently large stimulus set on the basis of the word norms of Hermans and De Houwer (1994), we decided to select Dutch words at face value. The stimuli for the critical pronunciation trials were 32 positive and 32 negative words referring to either objects or humans (16 words in each category, see "Appendix"). For each participant, the computer program semi-randomly split this set of words into a prime set and a target set. Both sets comprised eight words of each stimulus category.

Different stimulus sets were used for the categorization trials. In the 75% affective categorization condition, the stimuli used were 48 positive and 48 negative words, none of which referred to either humans or objects (see "Appendix"). For each participant, the computer program semi-randomly split this set of words into a prime set and a target set, each consisting of 24 positive and 24 negative words. In the 75% nonaffective semantic categorization condition, the stimuli that were presented on the categorization trials were 48 words that referred to objects and 48 words that referred to humans. All these words were affectively neutral (see "Appendix"). The computer program semi-randomly split this set of words into a prime set and a target set. Both sets comprised 24 words that referred to objects and 24 words that referred to humans. The apparatuses used this experiment were identical to those used in Experiment 1.

Procedure

Participants were randomly assigned to either the 75% affective categorization condition (n = 28) or the 75% nonaffective semantic categorization condition (n = 28). In both conditions, participants were asked to prononuce targets words as fast as possible unless a green rectangle appeared around it. Whenever the cue appeared on the computer screen, participants were required to categorize targets. In the 75% nonaffective categorization condition, participants were asked to categorize the targets by saying the Dutch word for ‘human’ or ‘object’. In the 75% affective categorization condition, participants were asked to categorize the targets by saying the Dutch word for ‘positive’ or ‘negative’. On pronunciation trials, no cue was presented.

The experimental phase consisted of three blocks of 128 trials. Each block consisted of 96 filler trials (nonaffective semantic categorization or affective categorization, depending on the experimental condition) and 32 pronunciation trials. On pronunciation trials, each of the 16 trial types (4 possible prime – target combinations in terms of valence and 4 possible prime – target combinations in terms of semantic category) occurred equally often (i.e., 6). Thus, both the affective consistency proportion and the nonaffective semantic consistency proportion was .50. Each stimulus of the critical prime set and critical target set (i.e., stimuli that were presented on the pronunciation trials) was presented exactly once in each block. Within the boundaries of these restrictions, primes and targets were randomly combined for each participant separately.

Both groups completed a practice phase consisting of 24 randomly presented target-only trials. A pronunciation response was required on six of these practice trials; a categorization response was required on the remaining trials (nonaffective semantic categorization or affective categorization, depending on the experimental condition). Only words of the filler lists were presented during the practice phase. There were no warm-up trials. In all other aspects, the procedure of Experiment 3 was identical to that of Experiment 1.

Results

ANOVA

Two participants (one in the 75% nonaffective semantic categorization condition and one in the 75% affective categorization condition) made an abnormally high amount of errors on the categorization trials (i.e., more than 2.5 standard deviations above the group mean). These two participants were excluded from the analyses. Only the data of the critical pronunciation trials were analyzed. Data of trials on which the voice key was not appropriately activated (3.61%) or an incorrect response was given (1.83%) were discarded. For each participant and each of the four priming conditions separately (nonaffective semantic congruence × affective congruence), all response latencies that deviated more than 2.5 standard deviations from the mean were treated as outliers (2.53%). Four latency means were calculated: two for affective congruence (congruent trials vs. incongruent trials) and two for nonaffective semantic congruence (congruent trials vs. incongruent trials). Mean response latencies were then subjected to a 2 (categorization condition: 75% evaluative categorization vs. 75% nonaffective semantic categorization) × 2 (stimulus dimension: valence vs. human/object) × 2 (congruence: congruent vs. incongruent) ANOVA.

The crucial three-way interaction between condition, stimulus dimension, and congruence reached significance, F(1, 52) = 7.64, p < .01, MSE = 144.65. As can be seen in Table 1, the data pattern completely matched our expectations in both conditions. The effect of congruence

2 Inclusion or exclusion of these participants does not impact on the pattern of significant and nonsignificant effects.
reached significance for the valence dimension in the 75% affective categorization condition, \( F(1, 26) = 18.38, p < .0005, \text{MSE} = 144.75 \), but not in the 75% nonaffective categorization condition, \( F(1, 26) = 1.30, p > .25 \). Conversely, the effect of congruence reached significance for the human/object dimension in the 75% nonaffective categorization condition, \( F(1, 26) = 8.92, p < .01, \text{MSE} = 145.49 \), but not in the 75% affective categorization condition, \( F < 1 \). Although the main effect of condition was nonsignificant, it approached significance, \( F(1, 52) = 2.81, p = .10, \text{MSE} = 145.49 \). All other effects were nonsignificant, \( F < 1 \).

**Bin analyses**

Similar to the previous experiments, we performed additional analyses to examine whether the data pattern was dependent upon the speed of responding. After we split individual reaction time distributions for each priming condition into three 1/3-bins (see De Jong et al., 1994), mean response latencies were subjected to a 2 (categorization condition: 75% evaluative categorization vs. 75% nonaffective semantic categorization) \( \times 2 \) (stimulus dimension: valence vs. animal/object) \( \times 3 \) (bin: 1 vs. 2 vs. 3) \( \times 2 \) (congruence: congruent vs. incongruent) ANOVA.

The results were clear-cut. The crucial three-way interaction between condition, stimulus dimension, and congruence again reached significance, \( F(1, 52) = 4.39, p < .05, \text{MSE} = 936.07 \), and none of the effects involving congruence were moderated by the bin variable, all \( F < 1 \). There was no evidence that the nonsignificant effects of affective congruence and nonaffective semantic congruence in the 75% affective categorization condition, \( F < 1 \), as well as for affective congruence and categorization condition, \( F < 1 \), whereas the effect was completely absent in the 75% affective categorization condition, \( F < 1 \). Similarly, the effect of affective congruence reached significance in the 75% affective categorization condition, \( F(1, 2320.01) = 16.35, p < .001 \), but not in the 75% nonaffective categorization condition, \( F < 1 \).

**Discussion**

In the present experiment, we examined affective and nonaffective semantic priming in a pronunciation task. Crucially, pronunciation trials were embedded in a context of either evaluative or nonaffective semantic categorization trials. Results showed that when an evaluative judgment of the target stimuli was required on the categorization trials, response latencies on pronunciation trials were clearly affected by affective relatedness but not by nonaffective semantic relatedness. Conversely, when participants were asked to categorize target stimuli on the basis of nonaffective semantic category membership, significant nonaffective semantic priming emerged but no affective priming emerged. This pattern of results coincides with the findings of Experiments 1 and 2, and substantiates our claim that automatic semantic priming is modulated by feature-specific attention allocation.

The present experiment also confirms that the findings of Experiments 1 and 2 were not a by-product of priming being greater for task-shift trials than for nonshift trials. First of all, it is unclear how such a mechanism could have contributed to the observed pattern of results in the present experiment: The average number of task-shift trials relative to the number of nonshift trials was identical in both conditions and differential priming effects were found subjects was 35.45%. The proportion of total variance in response time due to

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3 Given that each prime stimulus and each target stimulus appeared exactly once in each block, we were able to examine potential effects of stimulus repetition by including Block as a factor in the overall ANOVA. Although mean response latencies decreased over blocks, \( F(2, 104) = 64.89, p < .001, \text{MSE} = 3008.06 \) not by nonaffective semantic relatedness. Conversely,

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4 Experiment 3 is a replication of an earlier study (N = 36) in which the crucial three-way interaction between condition, stimulus dimension, and congruence also reached significance, \( F(1, 34) = 6.03, p < .05, \text{MSE} = 305.20 \). Nevertheless, the data were not entirely consistent with our predictions as the affective priming effect failed to reach significance in the 75% affective categorization condition. We suspect that this finding resulted from the fact that the affective connotation of the experimental stimuli (e.g., cat, bed) was relatively weak relative to the context stimuli (e.g., love, torture). Word norms collected by Hermans and De Houwer (1994) indeed confirmed that the experimental stimuli were less extreme than the context stimuli used in the 75% affective categorization condition, \( t(22) = 5.19, p < .0005 \) and \( t(22) = 8.28, p < .0005 \), for negative and positive words, respectively.
for different stimulus dimensions within each categorization condition. Nevertheless, for the sake of certainty, we performed additional analyses in which the nature of the response that was required on trial 1 was included as a within-subjects factor. In all conditions, priming effects were unaffected by this factor, all Fs < 1.5 In the 75% nonaffective semantic categorization condition, mean affective priming effects were 12 ms (SD = 37.53 ms) and 14 ms (SD = 19.83 ms) for nonswitch trials and switch trials, respectively, whereas nonaffective priming effects were 4 ms (SD = 36.47 ms) and 1 ms (SD = 24.23 ms) for non-switch trials and switch trials, respectively. In the 75% non-affective semantic categorization condition, mean nonaffective priming effects were 10 ms (SD = 32.32 ms) and 9 ms (SD = 24.23 ms) for nonswitch trials and switch trials, respectively, whereas affective priming effects were 4 ms (SD = 24.02 ms) and 4 ms (SD = 19.32 ms) for non-switch trials and switch trials, respectively.

Experiment 3 is also important for a number of other reasons. First of all, given that: (a) the proportion of (semantic) categorization trials was identical in both categorization conditions and (b) priming effects emerged for stimulus dimensions that were selectively attended to only, the results of Experiment 3 raise doubts about the possibility that the effects in the 75% categorization conditions were due to a general, unspecified increase in semantic stimulus processing (see De Houwer, Hermans, & Spruyt, 2001). In contrast, an explanation in terms of feature-specific attention allocation accounts for the findings of all three experiments in a straightforward and parsimonious manner.

Second, we replicated the effects of feature-specific attention allocation on automatic semantic priming despite the use of different stimulus sets for the (experimental) pronunciation trials and the categorization trials. We can thus conclude that the impact of feature-specific attention allocation on semantic priming is not dependent upon targets having been previously categorized on priming-relevant dimensions (for related findings, see also Pecher, Zanolie, & Zeelenberg, 2007).

Finally, the overall speed of responding in Experiment 3 was not statistically different in the two selective attention groups. Moreover, mean response latencies for affective and nonaffective semantic priming conditions were identical within each selective attention condition. Therefore, Experiment 3 also deals with the scaling problem that occurred in Experiments 1 and 2.

**General discussion**

On the basis of the GCM of classification (Nosofsky, 1986, 1987), we have argued that the semantic analysis of task-irrelevant stimuli is modulated by feature-specific attention allocation. In line with this framework, we found semantic priming effects to depend upon the extent to which participants focused their attention upon specific semantic stimulus dimensions (for related findings, see Barsalou, 1982; McKoon & Ratcliff, 1995; for related findings in the domain of attentional capture in visual search, see Folk & Remington, 1998).

It is important to note, however, that our framework does not necessarily imply that the semantic analysis of task-irrelevant stimuli is completely absent for stimulus dimensions that are not selectively attended to. What we propose is that feature-specific attention allocation determines the extent to which specific semantic stimulus dimensions are processed, not whether they are processed at all or not. That is, assigning attention to a particular stimulus dimension reduces: (a) the probability that and (b) the extent to which other stimulus dimensions of task-irrelevant stimuli will be analyzed. Therefore, unless feature-specific attention allocation reaches some asymptotic level, our framework does not rule out the possibility that task-irrelevant dimensions of task-irrelevant stimuli can be processed to a mild degree after all. As a consequence, we are also reluctant to equate the absence of semantic priming in the conditions without focused attention with complete absence of semantic activation (see also Heil et al., 2004; Neely & Kahan, 2001; Tse & Neely, 2007). Perhaps, the behavioral measure used in our studies was simply not sensitive enough to capture the small amount of semantic activation produced by stimulus dimensions that were not selectively attended to.

Nevertheless, there are also indications that the observed null-findings in the conditions without focused attention were not caused by Type-II errors. First of all, aggregating the data across experiments using Winer’s Z did not reveal any different results (see Winer, 1971). For the affective stimulus dimension, Winer’s Z (across Experiments 1 and 3) equaled .71, p > .20. For the nonaffective semantic stimulus dimensions, Winer’s Z (across Experiments 1 and 3) equaled -.29, p > .60. These findings are consistent with the idea that semantic activation was truly nonexistent in the groups without focused attention. Second, we examined the statistical power for affective and nonaffective semantic priming effects across experiments (one-tailed, α = .05). The effect size of the affective priming effect that emerged across the focused-attention groups of Experiments 1 and 3, dz, was .60. The power for detecting such an effect (using the total N of Experiments 1 and 3), as calculated by the computer program G’Power of Faul, Erdfelder, Lang, and Buchner (2007), is greater than .99. This means that the likelihood of falsely accepting the null hypothesis, β, is below .01. The effect size of the nonaffective semantic priming effect that emerged across the focused-attention groups of Experiments 2 and 3 was .57. The power for detecting such an effect (using the total N of Experiments 2 and 3) is greater than .97. This means that the likelihood of falsely accepting the null hypothesis, β, is below .03. However, if one assumes that the true effect size of semantic priming in the groups without focused attention was much smaller than the effect size of semantic priming in the focused-attention groups, statistical power of the present experiments may have been insufficient.

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5 Because nonshift trials were rare and some trials were lost due to errors and inaccurate triggering of the voice key, the number of nonswitch trials was sometimes very low. For three participants, the number of (valid) nonswitch trials was even restricted to a single data point in one of the four priming conditions. For that reason, the data of these participants (one in the 75% affective categorization condition and two in the 75% nonaffective semantic categorization condition) were excluded from this analysis.
after all. For the affective priming effect, for example, statistical power would drop to .89, .69, or .41 if the true effect size were only two-thirds, half, or one-third of the priming effect observed in the focused-attention groups, respectively. Likewise, statistical power for detecting a nonaffective semantic priming effect would drop to .79, .58, or .34 if the true effect size were only two-thirds, half, or one-third of the priming effect observed in the focused-attention groups, respectively. For that reason, the strongest conclusion that can be drawn at this point is that semantic activation is modulated by feature-specific attention allocation.

This conclusion has important implications for the discussion concerning the automaticity of semantic priming. Whereas most researchers have defended the idea that the activation of word meaning proceeds in an automatic, unconditional fashion (e.g., Neely, 1977; Posner & Snyder, 1975), others have called this hypothesis a myth (Besner, Stolz, & Boutilier, 1997; Stolz & Besner, 1999). The results most often cited as evidence against the unconditional automaticity of semantic priming comes from the letter search paradigm (for reviews, see Maxfield, 1997; McNamara, 2005). In a typical letter search study, participants decide whether a prime word (e.g., ‘CAT’) contains a letter that is duplicated (e.g., ‘AAA’) above each of its letters before they respond on the basis of the target. Results typically show that semantic priming in this paradigm is statistically null and almost always greatly reduced relative to a condition in which participants read the primes silently (Tse & Neely, 2007). Several researcher have argued that, if semantic activation were truly automatic, performing a letter search on the prime should not affect the presence of priming for stimulus dimensions that were not selectively attended to cannot be attributed to visual feature integration impairment. The best evidence for this argument comes from Experiment 3, where semantic priming effects were found in both selective attention conditions. This finding clearly demonstrates that the primes always produced semantic activation. In line with our framework, however, reliable priming occurred only for stimulus dimensions that were selectively attended to. We can thus conclude that our findings provide strong evidence against the hypothesis that the extraction of meaning is unconditionally automatic. Researchers working in the field of semantic priming are thus advised to take precautionary measures to control for the impact of feature-specific attention allocation on semantic activation, especially if one accepts the idea that feature-specific attention allocation may be triggered by subtle procedural details such as a salient manipulation along a particular stimulus dimension.

The observation that semantic analysis depends on feature-specific attention allocation is also relevant for researchers working in the field of affective priming, automatic stimulus evaluation, and social psychology. More specifically, our findings have important implications for the discussion concerning: (a) the (un)conditionality of affective stimulus processing and attitude activation, (b) the reliability of the affective priming effect in the pronunciation task, and (c) the affect primacy hypothesis. We will discuss these implications one by one.

Unconditional automatic affective stimulus processing?

Over the last decades, the affective priming effect has been frequently pictured as a reliable marker of automatic affective stimulus processing. To support this viewpoint, it is typically argued: (a) that the affective priming effect can come about only if the valence of the primes has been processed and (b) that the affective priming effect appears to be a fairly unconditional phenomenon (e.g., De Houwer et al., 2001; Spruyt, Hermans, De Houwer, & Eelen, 2002). Assuming that the affective priming effect is indeed a reliable marker of automatic affective stimulus processing, the present findings demonstrate that affective stimulus processing is modulated by the extent to which affective stimulus information is attended to. One thus has to reject the classic thesis that affective stimulus processing is “completely unconditional in terms of a prepared or receptively tuned cognitive state” (Bargh, 1997). Interestingly, studies employing completely different paradigms seem to corroborate this viewpoint. Consider, for instance, the findings of Duscherer, Holender, and Molenaar (2008). These authors failed to replicate the affective Simon effect (i.e., faster responding on the basis of a nonaffective stimulus feature of an affectively polarized stimulus when response and  

6 Following Moors and De Houwer (2006), we adhere to a feature-based, decompositional approach to the definition and diagnosis of automaticity. According to this viewpoint, different automaticity features (e.g., unintentional, uncontrollable, unconscious, efficient, and fast) can be conceptually and logically separated and should therefore be studied independently from each other. It thus makes little sense to classify a process as nonautomatic simply because it is found to depend on a particular (set) of precondition(s). However, if it is hypothesized that a particular process is unconditionally automatic, the observation that this process is dependent upon a single precondition is sufficient to reject that hypothesis.
stimulus have the same affective connotation as compared to a different affective connotation) when presenting affectively polarized target words in a context of affectively neutral target words (25% affectively polarized words vs. 75% neutral words). In contrast, they did observe an affective Simon effect when using stimuli that were all emotionally charged.

Recent studies conducted in our lab (Spruyt, De Houwer, Hermans, & Moors, 2009) suggest that feature-specific attention allocation may also have been a critical factor in the affective matching studies published by Klauer and Musch (2002, Experiments 5–8). Klauer and Musch (2002) presented participants with affectively polarized primes and targets and asked them to judge either the affective match between the primes and the targets (affective matching condition) or the match on a nonevaluative stimulus dimension such as color (nonaffective matching condition). In line with the affective matching account of affective priming (see, Klauer & Musch, 2002; Klauer & Stern, 1992; Musch & Klauer, 2003; Wentura, 2000), they observed that ‘yes’ responses in the nonaffective matching condition were facilitated by an evaluative match relative to an evaluative mismatch whereas the reverse was true for ‘no’ responses. A similar effect of task-irrelevant stimulus information did not occur when stimulus valence was task-relevant and a nonevaluative stimulus feature, such as color, was task-irrelevant. Clearly, this pattern of results corroborates the hypothesis that affective stimulus information can be processed independently of the explicit goal to evaluative incoming stimulus information. Moreover, because affective stimulus information was found to exert an influence upon the speed of responding in nonaffective similarity judgment tasks, the studies of Klauer and Musch (2002) seem to suggest that affective stimulus processing does not require selective attention for affective stimulus information.

However, it could be hypothesized that the evaluative nature of the response labels in these studies (‘yes’ vs. ‘no’) increased the salience of the affective stimulus dimension and, consequently, the extent to which participants assigned attention to the affective stimulus dimension (for related arguments, see Eder & Klauer, 2007; Eder & Rothermund, 2008). Crucially, the same response labels (‘yes’ vs. ‘no’) were used when participants were asked to respond on the basis of the evaluative match between the primes and the targets. Thus, the saliency of the affective and nonaffective stimulus features was not held constant across matching conditions.

In our studies (Spruyt et al., 2009), we manipulated the affective saliency of the responses labels in the nonaffective matching procedure. For example, participants were asked to respond either with affectively laden verbal responses (e.g., ‘flower’ vs. ‘cancer’) or affectively neutral verbal responses labels (e.g., ‘square’ vs. ‘circle’). Results showed a significant impact of the (task-irrelevant) evaluative match between the primes and the targets only if affectively polarized response labels were used. Conversely, we also asked participants to respond with color words to the evaluative congruence of colored words. For example, in one experiment, participants were asked to pronounce the word “yellow” when the prime and the target were affectively congruent and to pronounce the word “blue” when the prime and the target were affectively incongruent. Under these conditions, the error data and the response latency data revealed a clear impact of the perceptual congruence (i.e., color match vs. color mismatch) on the affective similarity judgments. These findings are important for several reasons. First, they convincingly demonstrate that feature-specific attention allocation is a subtle, yet critical factor in the affective matching paradigm too. Second, and more generally, they show that affective and nonaffective stimulus features obey the same rules of stimulus encoding.

Affective priming in the pronunciation task

Over the past decade, the question of whether reliable affective priming of pronunciation responses can be obtained has received a great deal of attention. The reason for this interest is twofold. First of all, it has been argued that finding affective priming effects in the pronunciation task allows one to conclude that affective stimulus processing does not depend on participants having an explicit evaluative processing goal (Bargh, 1997; Bargh, Chaiken, Raymond, & Hymes, 1996; Zajonc, 1980; Zajonc, 1984). Second, whether or not affective priming of pronunciation responses can be found is highly relevant for the discussion concerning the mechanisms that underlie the affective priming effect itself. In a prototypical affective priming study, participants are asked to categorize the target words as positive or negative as fast as possible. There is general consensus that affective priming effects in this task are primarily driven by Stroop-like response interference (e.g., De Houwer et al., 2002; Gawronski, Deutsch, & Seidel, 2005; Klauer, Roijnagel, & Musch, 1997; Klinger et al., 2000; Spruyt, Hermans, et al., 2007; Storbeck & Robinson, 2004; Wentura, 1999; Wentura, 2000). According to this response level account of affective priming, the primes and the targets activate compatible response tendencies on affectively congruent trials whereas incompatible response tendencies become activated on affectively incongruent trials. Responding is assumed to be delayed on affectively incongruent trials relative to affectively congruent trials because some time is required to resolve a conflict between concurrently activated response tendencies. Such a mechanism, however, cannot explain affective priming in the pronunciation task as affectively congruent and affectively incongruent primes cannot influence response selection differentially when participants respond on the basis of the identity of the targets. If reliable affective priming of pronunciation responses can be found, one must thus conclude that another mechanism can underlie the affective priming effect as well. As a likely candidate, several authors have suggested that affective priming effects may also result from processes operating at the encoding level (e.g., Bargh et al., 1996; Chen & Bargh, 1999; De Houwer & Randell, 2004; De Houwer et al., 2001; Duckworth, Bargh, Garcia, & Chaiken, 2002; Ferguson, Bargh, & Nayak, 2005; Spruyt et al., 2002; see also Bargh, 1997). According to this encoding account of affective priming, affectively polarized prime stimuli pre-activate the memory representations of affectively related targets, thus making it easier...
to encode targets with the same valence as compared to targets with a different valence.

Both in Experiments 1 and 3, however, affective priming failed to emerge unless participants were encouraged to assign attention to the affective stimulus dimension. This observation coincides with the results of several other pronunciation studies that produced null-findings. Indeed, although initial reports attested to the reliability of the affective priming effect in the pronunciation task (Bargh et al., 1996; Hermans, De Houwer, & Eelen, 1994), several researchers were unable to replicate this effect. Klauser and Musch (2001), for example, failed to obtain significant affective priming of pronunciation responses in a series of four, statistically powerful experiments (total N > 700). Despite the use of procedures that were almost identical to those used by Bargh et al. (1996) and Spruyt et al. (2004) also failed to obtain the effect. Finally, nonsignificant results were reported by De Houwer et al. (1998) and Spruyt et al. (2002, Experiment 3).

At first sight, these failures are clearly inconsistent with the encoding account of affective priming as well as the hypothesis that affective stimulus processing does not depend on participants having an explicit evaluative processing goal. However, affective priming in the pronunciation task does appear to be replicable if pictures are used as primes (Giner-Sorolla, Garcia, & Bargh, 1999; Spruyt & Hermans, 2008; see also Spruyt et al., 2002). Moreover, if both the prime set and the target set consist of pictures and participants are asked to name the target pictures (i.e., the picture–picture naming task), affective priming effects are readily obtained (Spruyt et al., 2002; Spruyt et al., 2004; Wentura & Frings, 2008; Spruyt, Hermans, et al., 2007).

Elsewhere (see, for example, Spruyt et al., 2002), we have explained these effects of stimulus modality on the basis of the memory model of Glaser and Glaser (1989); see also Glaser, 1992). According to this model, pictures have privileged access to a semantic system that contains all semantic knowledge whereas words first need to access a nonsemantic lexical system before they can activate semantic stimulus information. Given that affective information is stored within the semantic system (e.g., Bower, 1991; De Houwer & Hermans, 1994; De Houwer & Randell, 2004; Fiske & Pavelchak, 1986), one can thus expect affective priming effects in the word pronunciation task or picture naming task to be more reliable when pictures, instead of words, are used as primes and targets (see also Spruyt et al., 2002). The present findings suggest another explanation, however. Pictures that are used in affective priming research are typically either extremely positive (e.g., a picture of a young, attractive woman cuddling a baby) or extremely negative (e.g., a picture of a corpse). That is, the emotional content of the pictures is typically manipulated in a very salient manner. It seems highly implausible that this salient manipulation would go unnoticed by the participants. As already explained in the introduction, such a situation may be sufficient to induce selective attention for the affective stimulus dimension. According to our framework, then, affective priming should emerge, as was repeatedly observed. Clearly, this alternative explanation is incompatible with the hypothesis that affective stimulus processing is unconditional in terms of a prepared or receptively tuned cognitive state (Bargh, 1997). It does not imply, however, that the encoding account of affective priming is no longer tenable. According to our framework, feature-specific attention allocation modulates the extent to which specific prime information is extracted, not the nature of the mechanism that reveals this activation in a particular experimental task.

The priority of nonaffective semantic analysis vs. the priority of affective analysis

Advocates of the automatic stimulus evaluation hypothesis have argued that affective stimulus processing precedes nonaffective (semantic) analysis (e.g., Murphy & Zajonc, 1993; Zajonc, 1980). In contrast, Storbeck and Robinson (2004, p. 90) recently argued that nonaffective semantic stimulus processing may be more obligatory at encoding than affective stimulus processing. Our studies clearly demonstrate that one needs to control for effects of feature-specific attention allocation if one wants to compare affective and nonaffective semantic stimulus processing in a valid manner. In Experiment 3, we varied affective and nonaffective semantic priming under conditions that either promoted selective attention for affective stimulus information or selective attention for nonaffective semantic stimulus information. As predicted, significant priming effects emerged only for stimulus information that was selectively attended. Crucially, the generic question of whether affective analysis or nonaffective semantic analysis takes priority at encoding is rendered pointless by this finding. Instead, it appears to be a more fruitful approach to scrutinize the conditions under which either affective analysis or nonaffective semantic analysis takes priority.

It must be clear, however, that it was never our intention to either reject or to confirm the general idea that affective stimulus processing can proceed in an automatic fashion. Based on the present findings, we merely contest the alleged unconditionality and primacy of automatic stimulus processing; not the idea that affective stimulus information can be processed in an automatic fashion under certain conditions per se. Moreover, it is important to emphasize that processes of attention allocation themselves do not need to rely on conscious strategies (Moors & De Houwer, 2006). Thus, the mere observation that affective stimulus processing can be modulated by processes of feature-specific attention allocation does not logically imply that conscious strategies are at play. Finally, it must be emphasized that it still remains to be seen how and to what extent feature-specific attention allocation exerts an influence on affective stimulus processing in everyday life. It seems reasonable to assume, for example, (a) that humans are predisposed to assign attention to the affective stimulus dimension because it has a survival value to do so (for a related discussion, see Nairne & Pandeirada, 2008), but (b) that such an ‘affective processing bias’ can be easily attenuated if current goals and task demands require that nonaffective stimulus dimensions are selectively attended. Such a viewpoint would reconcile our thesis that affective stimulus processing is modulated by feature-specific attention allocation with the classic hypothesis that stimulus valence has a unique status.
among semantic features (e.g., Bargh, 1996; Bargh, 1997; Osgood, Suci, & Tannenbaum, 1957; Zajonc, 1980).

**Summary and conclusions**

To our knowledge, the present research is the first to demonstrate that the semantic analysis of task-irrelevant stimuli is modulated by feature-specific attention allocation. In Experiments 1 and 3, affective priming failed to emerge in a pronunciation task unless participants were encouraged to assign attention to the affective stimulus dimension. This finding is in line with earlier failures to replicate the affective priming effect in the standard word–word pronunciation task as well as the nonaffective semantic categorization task and sheds new light on the fact that the affective priming effect tends to replicate relatively easily in the picture–picture naming task. More specifically, our findings suggest that affective priming comes about only if experimental procedures are used that somehow induce selective attention for the affective stimulus dimension. As such, our findings question the viability of the hypothesis that affective stimulus processing is completely unconditional in terms of a prepared or receptively tuned cognitive state. It should be noted, though, that our findings do not exclude the possibility that humans are predisposed to assign attention to the affective stimulus dimension by default in everyday life. They merely demonstrate that such an affective processing bias can be easily attenuated if current goals and task demands require that nonaffective stimulus features are selectively attended.

Importantly, the effects of feature-specific attention allocation are by no means restricted to the affective stimulus dimension. In Experiments 2 and 3, we failed to obtain nonaffective semantic priming of pronunciation responses unless participants were encouraged to assign attention to (relevant) nonaffective semantic stimulus information. Researchers working on (nonaffective) semantic priming as well as those working on affective priming and automatic stimulus evaluation are thus advised to take precautionary measures to control for the impact of feature-specific attention allocation.

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**Appendix**

**Stimuli used in Experiment 1**

**Positive primes:** GELUKKIG (happy), BLIJ (glad), EERLIJK (honest), OPTIMISTISCH (optimistic), GEZOND (healthy), BETROUWBaar (reliable), WARMHARTIG (warmhearted), VRIENDELIJK (friendly), RECHTVAARDIG (just), OPGEWEKT (cheerful), DANKbaar (grateful), OPRECHT (sincere), SYMPATHIEK (sympathetic), PRETTIG (pleasant), WARM (warm), GRAPPIG (funny), ZACHT (tender), ONTSPANNEN (relaxed), ORIGINEEL (original), BEHULPZAAM (helpful), GOEDAARDIG (kindhearted), HOOPvol (hopeful), BEGRIJPEND (understanding), ACTIEF (active), LEVENDIG (lively), INTELLIGENT (intelligent), ROMANTISCH (romantic), VEELZIJDIG (versatile), ZUIVER (pure), SLIM (smart).

**Negative primes:** VALS (false), HAATDRAgEND (resentful), ONEERLIJK (dishonest), GEMEEN (mean), BOOSAARDIG (malicious), BRUTAAL (brutal), OndANKbaar (ungrateful), VULGAR (vulgar), LAF (cowardly), PESSIMISTISCH (pessimistic), ASOCIAAL (asocial), IRRITEREND (irritating), TACtLOOS (tactless), VERWAAND (conceited), VERVELENd (annoying), ONETHISCH (unethical), KLAGEND (lamenting), DOM (silly), ONINTERESSANT (uninteresting), BOT (blunt), BAZIG (overbearing), LUI (lazy), POCHERIG (boastful), DROEVIG (sad), INCOMPETENT (incompetent), DWAAS (foolish), NALATIG (negligent), EENZAAm (lonely), ZWAk (weak), AFSTOTEIJK (repulsive).

**Positive targets:** POESJE (kitten), PUPPY (puppy), BABY (baby), VRIEND (friend), BRUID (bride), MEISJE (girl), BLOEM (flower), VLINDER (butterfly), MOEDER (mother), KLEUTER (toddler), HELD (hero), GENIE (genius), CLOWN (clown), WINNAAR (winner), VERLOOFPDe (fiancé(e)), CADEAU (present), TAART (pie), ZON (sun), MUZIEK (music), CHOCOLADE (chocolate), PARFUM (perfume), GOUD (gold), BALLON (balloon), ROOMIJS (ice cream), PIZZA (pizza), ZIJDE (silk), DIAMANT (diamond), RADIO (radio), FILM (movie), GESCHENK (gift).

**Negative targets:** SPIN (spider), BACTERIE (bacteria), PEDOFiEL (pedophile), SADIST (sadist), GANGSTER (gangster), KAKKERLAK (cockroach), MUG (mosquito), MOORDENaar (mugger), DICTATOR (dictator), KWAL (jerk), DIEF (thief), SCHIMMEL (fungus), PARASIEt (parasite), SLANG (snake), ONKRUID (weed), WAPEN (weapon), BRAAKSEL (vomit), KOGEL (bullet), DOODSKiST (coffin), GRAF (grave), SLIJM (slime), VUILNIS (litter), URINE (urine), GASMASKER (gasmask), SKELET (skeleton), ZIEKENHUIS (hospital), WERGIF (poison), STANK (stench), BOM (bomb), WONDE (wound).

**Stimuli used in Experiment 2**

**Animal:** ANTILOPE (antelope), EEND (duck), HAGEDIS (lizard), HERT (deer), HONDJE (puppy), HORZEL (hornet), KAKKERLAK (cockroach), KAT (cat), KEVER (beetle), MUG (mosquito), OLIFANT (elephant), PAARD (horse), POESJE (kitten), RATeLSLAnGE (rattlesnake), RATTEn (rats), SLAK (snail), SPIN (spider), VLINDER (butterfly), Vogel (bird), WORMEN (worms).

**Object:** BALPEN (ball pen), BED (bed), BRIEF (letter), CONDoom (condom), GASMASKER (gasmask), HOED (hat), KRANT (newspaper), MANd (basket), MICROSCOOP (microscope), NAALD (needle), PIANO (piano), REVOLVER (revolver), ROLSTOEL (wheelchair), SCHAAR (scissors), STOEL (chair), STRIJKPLANK (ironing board).
TAFEL (table), TAPIJT (carpet), TAS (cup), TROMPET (trumpet).

Stimuli used in Experiment 3

Experimental stimuli

Positive/ Human: VRIEND (friend), BABY (baby), WINNAAR (winner), BROER (brother), GENIE (genius), MOEDER (mother), OPTIMIST (optimist), MEISJE (girl), HELD (hero), EXPERT (expert), BRUID (bride), VRIENDIN (girlfriend), ZUS (sister), REDDER (rescuer), PARTNER (partner), KIND (child).

Positive/Object: DIAMANT (diamond), CADEAU (present), WIEG (cradle), TEDDYBEER (teddy), CONFETTI (confetti), GESCHENK (gift), PAREL (pearl), BALLON (balloon), PARASOL (parasol), STRANDBAL (beach ball), JURKJE (charming little dress), SNOEPZAK (candy bag), JUWEEL (jewel), SIERAAD (ornament), SCHAT (treasure), SPEELTJE (toy).

Negative/ Human: TIRAN (tyrant), GANGSTER (gangster), BRUJT (brute), VANDAAL (vandal), SNOB (snob), EGOIST (self-seeker), BEUL (headman), DIEF (thief), SADIST (sadist), HOER (whore), VRIJAND (enemy), PEDOFIEL (pedophile), MOORDENAAR (murderer), VERLIEZER (loser), CRIMINEEL (criminal), PSYCHOPAT (psychopath).

Negative/Object: BOMMEN (bombs), KOGEL (bullet), REVOLVER (revolver), GASMASKER (gasmask), ROLSTOEL (wheelchair), GRANAT (grenade), PIJNBAK (rack), BOM (bomb), INJECTIENAAL (syringe), RIOOLPIJP (sewer), URNE (urn), SLAUCHTBAK (slaughtering block), INFIUSUS (drip), DWANGBAUS (straitjacket), DOODSKIST (coffin), LIJKWAGEN (hearse).

Filler stimuli

Positive: LIEFDE (love), LACH (laugh), KUS (kiss), SCHOONHEID (beauty), VAKANTIE (vacation), VREDE (peace), GELUK (lucky), TROUW (fidelity), VERLIEFDHEID (being in love), ZOMER (summer), KNUFFEL (hug), ZON (sun), ROMANTIEK (romance), FEEST (party), WENS (wish), MELODIE (melody), APPLAUS (applause), LIED (song), KRACHT (power), OMHELPING (embrace), SEKS (sex), JEUGD (youth), SUCCES (success), STEUN (support).

Negative: HEL (hell), HAAT (hate), KANKER (cancer), DOOD (death), EXECUTIE (execution), TUMOR (tumor), MARTELING (torture), AIDS (aids), OORLOG (war), INCEST (incest), VERKRACHTING (rape), MOORD (murder), SLIJM (slime), VREES (fear), VET (fat), WONDE (wound), AVFAL (litter), WOEDE (rage), AGRESSIE (aggression), BEDROG (deceit), OVERTREDING (violation), FOUT (error), ZIEKTE (sickness), RAMP (disaster).

Human: ARCHIVARIS (archivist), BEWONER (resident), CONCIERGE (warden), VOETGANGER (pedestrian), BEGEIDER (attendant), ARBEIDER (worker), BEDIENDE (office worker), WERKNEMER (employee), REIZIGER (traveler), CHAUFFEUR (driver), BURGER (citizen), INWONER (inhabitant), BEZOEKER (visitor), STEDELING (townsman), SPREKER (speaker), BEAMBTE (functionary), GEDUREEDE (addressee), AANWEZIGE (person present), TOESCHOUWER (spectator), GETUIGE (witness), BIBLIOTHECARIS (librarian), WAARNEMER (observer), VOLWASSENE (adult), HANDELAAR (trader).

Object: MAP (file), KAUT (cover), TAS (bag), BORD (plate), DOOS (box), TAFEL (table), LEPEL (spoon), MAND (basket), BALPEN (ball pen), STOEL (chair), TAPIJT (carpet), KAST (closet), STRAAT (street), DEUR (door), KRAAN (tap), POTLOOD (pencil), KNOOP (button), VORK (fork), SLEUTEL (key), EMMER (bucket), LAMP (lamp), TELEFOON (telephone), SPONS (spoon), BORSTEL (broom).

References


