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Affective priming in a lexical decision task: Is there an effect of words' concreteness?

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Affective priming occurs when responses to a target are facilitated when it is preceded by a prime congruent in valence. We conducted two experiments in order to test whether this is a genuine emotional effect or rather it can be accounted for by semantic relatedness between primes and targets. With this aim, semantic relatedness and emotional congruence between primes and targets were orthogonally manipulated. Participants performed a lexical decision task. In Experiment 1 we tested concrete words and in Experiment 2 we tested abstract words. We obtained both an affective priming effect and a semantic priming effect that were not modulated by words' concreteness. Furthermore, there was affective priming regardless of whether primes and targets were semantically related or unrelated. These results suggest that affective priming is a genuine emotional effect.

In recent years there has been an increasing interest in the study of the processing of emotional words. Some studies conducted in the field have relied on the affective priming paradigm. In this paradigm, participants are presented with primes and targets that can be either congruent or incongruent with respect to their affective valence. Participants are asked to perform different tasks with the target. The most commonly used task is evaluation (i.e. to categorize the word as being either positive or negative). The affective priming effect consists on a reaction time advantage for affectively congruent pairs (e.g. thief-murderer) as compared to incongruent pairs (e.g.champion-murderer).

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During the last decade, there has been a debate on the mechanism underlying affective priming. One of the earliest accounts of this effect relies on the notion of spreading activation across a network of interconnected concept nodes. According to this account, the affective meaning of a prime is automatically processed and this activation will spread to the representation of other concepts with the same valence. Therefore, when a target is preceded by a prime with the same valence, its processing is facilitated, because the concept of the target has been already preactivated by the prime (e.g. Fazio, Sanbonmatsu, Powell, & Kardes, 1986). There is an alternative account proposing that the affective priming effect is rather produced by response competition. In particular, a prime would automatically induce a tendency to give a response associated with its valence. As in evaluative decision tasks participants have to classify the target as positive or negative, that tendency would facilitate the response to a target with the same valence of the prime and would produce an interference when the valence of the target is the opposite (e.g., Klauer & Musch, 2001). To disentangle the issue of whether affective priming effects are due to spreading activation or to a response competition mechanism it is necessary to use non-evaluative tasks. According to a response competition account, affective priming should not be observed in them. The results of the studies that have tested other tasks, such as pronunciation, semantic categorization or lexical decision (see Klauer & Munsch, 2003, for a review), are not consistent: In some cases an affective priming effect was reported (e.g., Pecchinenda, Ganteaume, & Banse, 2006), whereas in other studies the effect was not obtained in non-evaluative tasks (e.g., Storbeck & Robinson, 2004).

In the present study we will use a lexical decision task to further investigate whether affective priming effects can be explained by a spreading activation account. Furthermore, our main aim is to test the possible contribution of semantic relatedness to affective priming. Most studies in affective priming literature have neglected a relevant point, that is, affectively congruent words tend to be more semantically related than affectively incongruent words (e.g. thief-murderer vs champion-murderer). If affectively congruent stimuli are also semantically related, affective priming might be reflecting a semantic effect rather than an emotional effect. As is well known, words are responded more quickly when they are preceded by a word related in meaning than by an unrelated word, this is the so-called semantic priming phenomenon (see McNamara, 2005, for a review).

In order to study the contribution of semantic relatedness to affective priming researchers can use different strategies. They can control for semantic relatedness between primes and targets. Alternatively, they can concurrently manipulate both affective and semantic relatedness between primes and targets. This last approach is the one we use in the present study. Our aim is to test whether it is possible to obtain affective priming regardless of whether primes and targets are semantically related or unrelated. This is a very relevant question in order to know whether there is a genuine effect of the emotional content of words on priming.

There are few studies in the literature that have used a similar approach, and they differ in the criterion used to consider words as semantically related. For example, Padovan, Versace, Thomas-Antérion and Laurent (2002) compared responses in an evaluation task to prime-target pairs that might be either affectively related, affectively and semantically related, or completely unrelated. In this study, the authors intuitively created the semantically related and unrelated pairs but there was not an objective measure of semantic relatedness. They obtained semantic priming but failed to observe affective priming. In a later study in which semantic relatedness was more clearly specified, Castner et al. (2007) used as experimental stimuli pairs of words affectively congruent or incongruent that were associatively related or not. Participants had to perform a lexical decision task. The authors obtained both semantic and affective priming. However, it has to be taken into account that Castner et al. (2007) defined semantic relationship as association, but words which are not associatively related may still have any kind of semantic relationship (e.g. horse-donkey). Therefore, it remains unclear whether semantic relatedness was totally excluded in their affectively related pairs.

In other studies the degree of semantic relatedness between primes and targets was estimated through rating tasks performed by judges. This is the case of the Moritz and Graf (2006)' study, who reported both affective and semantic priming in a pronunciation task. And there are also two studies in which semantic relatedness was defined as belonging to the same semantic category. Both Storbeck and Robinson (2004) and Storbeck and Clore (2008) used pairs of words that could belong or not to the same semantic category (e.g. animals) and that could be either affectively congruent or incongruent. In a series of experiments, the authors obtained semantic priming across tasks and experimental conditions, wereas affective priming was only observed in the evaluation task.

The above reviewed studies suggest that although semantic priming seems to be a reliable phenomenon, affective priming is only obtained in several conditions and seems to be clearly dependent on the task used. The task that most consistently produces affective priming is evaluation. But it is not surprising to obtain affective priming when participants are explicitly asked to focus on the emotional properties of words. Furthermore, there are some limitations in the previous studies that preclude definitive conclusions about the nature of affective priming and its dependence on semantics. First of all, as we have exposed, semantic relatedness was not operationalized in the same way in the different studies. In addition, in most studies (Moritz & Graf, 2006; Padovan et al., 2002; Storbeck & Clore, 2008; Storbeck & Robinson, 2004), the experimental words were not obtained from normative databases. As a consequence, affective variables that are known to affect word processing, such as arousal (e.g. Carretié et al., 2007), were not taken into account. Furthermore, most of these studies were not conducted with the usual procedures of semantic priming experiments, in which responses to different primes (which are matched in lexical variables such as frequency and length) are compared always in reference to the same target and repetition of primes and targets within the experiment is avoided. It would be highly desirable to conduct affective priming studies with words obtained from normative databases and with the same strict control that is used in semantic priming experiments. This is the approach we adopt in the present study. We believe that this is the best way to control for variables that can affect word processing and to obtain reliable conclusions about the effects of the emotional content of words on priming.

Concerning variables that should be taken into account in affective priming and semantic priming experiments, there is word concreteness. It has been repeatedly demonstrated that concrete words have a cognitive advantage over abstract words. This superiority for concrete words has been reported in memory tasks (e.g. Romani, MacAlpine, & Martin, 2007), as well as with more initial tasks such as the lexical decision task (e.g., Binder, Westbury, McKiernan, Possing, & Medler, 2005, but see Kousta, Vigliocco, Vinson, Andrews, & Del Campo, 2011 for the opposite pattern of results). Several theoretical proposals have been made to account for differences in processing between concrete and abstract words. Some of them state that there is a qualitative difference between the conceptual representation of these two types of words, in particular concepts corresponding to concrete words would be predominantly organized in terms of semantic similarity whereas abstract concepts would be predominantly organized by associative links (Crutch & Warrington, 2005). Other proposals asume that the difference between concrete and abstract concepts is more quantitative. According to them, concrete word representations are assumed to be richer than abstract word representations (Paivio, 1971; Schwanenflugel, 1991). A last proposal has recently appeared suggesting that concrete and abstract words differ in the proportion of sensory, motor, affective and linguistic information they bind. In particular, there would be a preponderance of sensorimotor information in concrete concepts and a preponderance of affective/linguistic information in abstract concepts (Kousta et al., 2011; Viggliocco, Meteyard, Andrews, & Kousta, 2009). According to this proposal, emotional knowledge should be more salient to the processing of abstract words than concrete words. In a recent study, Newcombe, Campbell, Siakaluk, & Pexman (2012) found evidence consistent with this proposal in a categorization task. Concerning affective priming, to our knowledge, there are no studies that have taken into account the level of concreteness of their experimental stimuli. However, if emotional information is more preponderant in abstract than in concrete concepts, as suggested by Vigliocco et al. (2009) and by Kousta et al. (2011), it might well be that affective priming is more probably observed with abstract words than with concrete words. This is a question that we address in the present study.

There is a last variable that has not always been considered in affective priming studies, that is valence (positive/negative). The experimental materials in these studies include congruent pairs that can be either positive-positive or negative-negative. In a similar way, the incongruent trials can be either positive-negative or negative-positive. In many cases, the most usual strategy to analyze the results has been to compare congruent and incongruent trials, by averaging the data obtained from positive and negative words (e.g., De Houwer, Hermans, Rothermund, & Wentura, 2002; Storbeck & Clore, 2008; Storbeck & Robinson, 2004; Wentura, 2000). However, there is a huge amount of research that has showed a differential processing for positive and negative stimuli at the behavioral and brain levels. For instance, negative words are detected faster (e.g., Dijksterhuis & Arts, 2003) and influence earlier stages of affective processing (e.g., Comesaña et al., 2013) than positive words. In addition, the neural circuits activated by the two types of words are not the same (e.g., Kim & Hamann, 2007). These results suggest that the affective representations of positive and negative words rely on distinct cognitive, temporal and spatial neural sustrates. So it might be that the pattern of affective priming effects is not the same for positive and negative words. In fact, some studies in the field have addressed this point and have demonstrated that positive targets are usually responded faster than negative targets (Blair et al., 2006; Padovan et al., 2002). Concerning the magnitude of the priming effects, the results are not consistent, since some studies have found that it does not depend on the valence of the target (Moritz & Graf, 2006) whereas other authors have failed to obtain affective priming with negative targets (Padovan et al., 2002). Clearly, further research is needed to establish the role of target valence on affective priming.

The aim of the present work was to test whether affective priming is a genuine emotional phenomenon. We investigated the contribution of semantic relatedness to affective priming and we tested, for the first time, whether affective and semantic priming effects can be modulated by words' concreteness. We also explored the role of target valence on affective priming.We used a task not focused on emotionality, a lexical decision task, and we orthogonally manipulated affective congruence and semantic relatedness between primes and targets that could be either concrete (Experiment 1) or abstract (Experiment 2). We selected the experimental words from normative databases and we also adopted the strict control procedures which are usual in semantic priming experiments.

EXPERIMENT 1

METHOD

Participants. Fifty-seven undergraduate Psychology students (44 women, 13 men), from the Rovira i Virgili University (Tarragona, Spain), with ages ranging from 18 to 37 (M=19.9, SD=2.9) took part in this experiment. They received a course credit for their participation.

Materials and design. We selected three sets of 48 words from the Spanish adaptation of the ANEW (Redondo, Fraga, Padrón, & Comesaña, 2007). The words belonging to two of the sets (Set 1 and Set 2) were used as primes. Words included in the third set were used as targets. Furthermore, each set was composed by 24 positive words and 24 negative words. Words in the three sets were matched for valence, arousal, frequency, length and concreteness (see Table 1 for values). We obtained values for valence and arousal from the ANEW and values for frequency from B-Pal (Davis & Perea, 2005). Furthermore, as there were no normative data available for concreteness for all the experimental words, we asked a group of 39 students, different from those who participated in the experiment, to provide concreteness ratings for primes and targets on a 1 to 7 scale (1=very abstract word, 7=very concrete word). The analysis of variance (ANOVA) conducted for the relevant variables revealed that there was not any significant difference among the three sets of words (all $Fs<1.6$). Furthermore, positive words were also matched among the three sets (all $Fs<1.8$), as there were negative words (all $Fs <1.8$).

Table 1. Characteristics of the experimental words of Experiments 1 and 2 (mean and standard error of the mean in parentheses).

Experiment 1	Valence	Arousal	Frequency	Length	Concrete-ness
Set 1 (Congruent Primes)	4.5 (0.3)	5.7 (0.1)	27.4 (6.8)	6.4 (0.3)	6.2 (0.1)
Set 2 (Incongruent Primes)	4.6 (0.3)	5.6 (0.1)	28.5 (8.1)	6.7 (0.2)	6.1 (0.1)
Set 3 (Targets)	4.8 (0.3)	5.4 (0.1)	50.9 (14.9)	6.4 (0.2)	6.1 (0.1)
Set 3 (Positive Targets)	6.6 (0.2)	5.2 (0.2)	86.8 (27.9)	5.9 (0.2)	6.0 (0.1)
Set 3 (Negative Targets)	2.9 (0.2)	5.7 (0.2)	15.0 (3.5)	6.9 (0.3)	6.2 (0.2)

Experiment 2	Valence	Arousal	Frequency	Length	Concrete-ness
Set 1 (Congruent Primes Semantically Related)	4.7 (0.4)	5.6 (0.2)	21.2 (4.9)	7.2 (0.3)	3.4 (0.1)
Set 2 (Incongruent Primes Semantically Related)	4.8 (0.4)	5.7 (0.1)	17.0 (4.2)	7.2 (0.3)	3.4 (0.1)
Set 3 (Congruent Primes Semantically Unrelated)	4.7 (0.3)	5.7 (0.1)	28.8 (6.1)	7.0 (0.3)	3.8 (0.1)
Set 4 (Incongruent Primes Semantically Unrelated)	4.6 (0.4)	5.8 (0.1)	44.9 (18.1)	6.8 (0.3)	3.7 (0.1)
Set 5 (Targets)	4.8 (0.4)	5.6 (0.2)	18.1 (2.8)	7.1 (0.2)	3.6 (0.1)
Set 5 (Positive Targets)	7.3 (0.1)	5.5 (0.2)	23.9 (4.2)	7.5 (0.3)	3.6 (0.1)
Set 5 (Negative Targets)	2.2 (0.1)	5.6 (0.2)	12.3 (3.4)	6.8 (0.3)	3.6 (0.1)

We constructed our experimental pairs by orthogonally manipulating two variables: Affective congruence and semantic relatedness. Concerning affective congruence, primes and targets could be either congruent (i.e. both positive or negative) or incongruent (i.e. a positive prime followed by a negative target or vice versa). Words included in Set 1 were used in the congruent condition, whereas words included in Set 2 belonged to the incongruent condition. To confirm that congruent pairs were affectively more similar than incongruent pairs, we compared valence between primes and targets in the congruent and incongruent conditions for positive and negative targets separately. The analyses showed that there were not differences in valence between congruent primes and their targets, both in positive pairs and in negative pairs ($p=0.5$).

Conversely, in the incongruent condition, there was a clear difference in valence between primes and targets when primes were negative and targets positive, $t(46)=14.1$, $p<.001$, as well as in the opposite case, $t(46)=14.2$, $p<.001$.

The variable of semantic relatedness also had two levels (semantically related words and semantically unrelated words). To construct the semantically related pairs, we selected primes and targets from the three sets that belonged to the same semantic category. In order to obtain the semantically unrelated pairs, we used the same three sets of words. We rearranged primes and targets so that a given prime obtained from Set 1 that was included in the semantically related condition with a given target, also appeared in the non semantically related condition with another target, which never was of the same semantic category (and we did the same with primes belonging to Set 2). To confirm that our a priori classification of word pairs into semantically related and semantically unrelated was correct, we asked an additional group of 60 students to perform a similarity rating task.They were asked to rate the semantic similarity between primes and targets on a nine-point scale (1=non –related in meaning, 9=very related in meaning). For any given pair, we averaged the ratings given by the students to obtain a mean value of semantic similarity. The statistical analysis revealed that pairs in the semantically related condition were rated as more similar than pairs in the unrelated condition, $t(190)=6.5$, $p<.000$. Furthermore, primes and targets in both the related and the unrelated condition were not associated according the existing norms of association in Spanish (Fernández, Díez, Alonso, & Beato, 2004).

By crossing the two variables above described, we obtained forty-eight groups of four experimental pairs (see Table 2 for examples).That is, each target word was presented under any of four priming conditions: (1) semantically related congruent condition, in which the target word was preceded by a word both related in meaning and affectively congruent (2) semantically related incongruent condition, in which the prime was related in meaning to the target but affectively incongruent, (3) semantically unrelated congruent condition, in which primes and targets had not any semantic relationship but were affectively congruent, and (4) semantically unrelated incongruent condition, in which primes and targets were not related in meaning and they were affectively incongruent. We constructed four different versions of the experiment, so that the 48 target words appeared under the four priming conditions across participants, but any participant did not see any prime or target more than once.

Table 2. Examples of experimental pairs.

	Experiment 1	Experiment 2
Semantically Related – Affectively Congruent Pairs	*mariposa - paloma* (butterfly - pigeon)	*éxito - victoria* (success - victory)
Semantically Related – Affectively Incongruent Pairs	*mosquito - paloma* (mosquito - pigeon)	*fracaso - victoria* (failure - victory)
Semantically Unrelated- Affectively Congruent Pairs	*diamante - paloma* (diamond - pigeon)	*íntimo - victoria* (close - victory)
Semantically Unrelated- Affectively Incongruent Pairs	*ataúd - paloma* (coffin - pigeon)	*distante - victoria* (distant - victory)

Finally, as in this experiment participants had to perform a lexical decision task, we constructed forty-eight nonwords to be presented as targets. They were constructed by using legal and pronunceable sequences in Spanish, although they didn't have any meaning. We selected an additional set of 48 words from ANEW to be used as primes for the nonwords. Half of these primes were positive and the other half negative. The word-nonword pairs were the same across the four versions of the experiment.

A practice block of eight pairs was constructed. This block included examples of each type of prime-target pair in the same proportion as the experimental set.

Procedure and apparatus. Participants performed the experiment in separate sound-proof booths. They were randomly assigned to one of the four experimental lists. We gave participants written instructions about the task they had to perform. Each experimental trial was as follows: when participants pressed a foot-swich connected to the computer, a cross-sign fixation point appeared in the center of the screen for 500 ms. Immediately after it was substituted by the prime word, presented for 150 ms. The prime was immediately replaced by the target, which was displayed for 1000 ms. Participants were instructed to ignore the first word and to indicate whether the second letter string was a word or not, by pressing one of two response buttons, using their preferred hand for the "yes" responses. The order of presentation of the words was randomised for each participant.

The stimuli were displayed and the reaction times and error percentages recorded by the DMDX package developed by Forster and Forster (2003).

RESULTS

We analysed only the trials in which participants made correct responses. Reaction times (RTs) that were more than two standard deviations above and below the participant's mean in all conditions were trimmed to the appropriate cutoff values to moderate the influence of outliers. As a result, 3.9% of the data were excluded.

Separate 2 (semantic relatedness) x 2 (affective congruence) ANOVAS were carried out with RT and error data with participants and items as random variables. Participants' means of reaction times and the percentage of errors data are shown in Table 3. The analysis of RTs revealed a main effect of semantic relatedness that was significant both by participants, $F1(1,56)=8.12$, $p<.01$, $\eta^2_p=0.13$, and by items, $F2(1,47)=7.3$, $p<.01$, $\eta^2_p=0.13$. Concerning affective congruence, although participants' reaction times were slower in the affective incongruent condition than in the congruent condition, this effect was not significant, either in the participants analysis or in the items analysis (both $Fs<3.8$). The interaction between both factors also failed to reach statistical significance (both $Fs<1.7$).

The ANOVA for the percentage of error data failed to reveal any significant effect either in the participants or in the items analyses (all $Fs<3.0$).

The results of the present experiment show that participants responded faster when primes and targets were semantically related than when they were unrelated, that is, there was a semantic priming effect. However, we failed to obtain a reliable affective priming effect. The words used in this experiment were concrete. As it has been recently suggested that emotional information may be more relevant in the representation of abstract words than concrete words (Kousta et al., 2011, Vigliocco et al., 2009), in the next experiment we investigated whether affective priming can be observed with abstract words.

Table 3. Results of Experiment 1 (mean and standard error of the mean in parentheses).

	Reaction Times	Percentage of Errors
Semantically Related – Affectively Congruent Pairs	567.5 (10.0)	4.3 (0.6)
Semantically Related – Affectively Incongruent Pairs	592.3 (10.1)	5.7 (0.8)
Semantically Unrelated-Affectively Congruent Pairs	600.3 (10.5)	6.3 (0.9)
Semantically Unrelated-Affectively Incongruent Pairs	605.4 (10.5)	6.5 (0.9)

EXPERIMENT 2

Participants. Fifty-six undergraduate Psychology students (52 women, 4 men), from the Rovira i Virgili University (Tarragona, Spain), aged between 18 and 44 years (M=20.3, SD=4.1), participated in this experiment in exchange for partial course credit. They had not participated in Experiment 1.

Materials. In this experiment it was not possible to use the same words in the semantically related and unrelated conditions, as we did in Experiment 1. This was because the criterion we used to classify prime-target pairs as related or unrelated (i.e. that they belonged or not to the same semantic category) was very difficult to use with abstract words. Therefore we based our selection of semantically related and unrelated word pairs on similarity ratings obtained from a group of judges.

We selected five sets of 48 words from the Spanish adaptation of the ANEW (Redondo et al., 2007). Words belonging to Set 1, Set 2, Set 3 and Set 4 were used as primes. Words included in the fifth set were used as targets. Furthermore, half of the words in each set were positive and the remaining half were negative. As in the previous experiment, we collected data for concreteness. We asked an additional group of 65 students to rate concreteness on a 1 to 7 scale. We conducted an ANOVA with the factor "set" for valence, arousal, frequency, length and concreteness. This analysis showed that the five sets were well matched according to these variables (all Fs<2.4). We also obtained a successful matching among sets for both positive words (all Fs<1.4) and negative words (all Fs<2.4).

As in Experiment 1, we orthogonally manipulated affective congruence and semantic relatedness. Concerning affective congruence, words included in both Set 1 and Set 3 were used in the congruent condition, whereas words from both Set 2 and Set 4 belonged to the incongruent condition. We compared valence between pairs and targets to confirm that congruent pairs were affectively more similar than incongruent ones. Both positive and negative primes of the congruent condition had a similar valence to their corresponding targets (both ts<1.4). Conversely, there was a significant difference between the valence of primes and targets in the incongruent condition, both for positive primes, $t(70)=30.6$, $p<.001$, and for negative primes, $t(70)=32.4$, $p<.001$.

Concerning semantic relatedness, we collected ratings from an additional group of 80 students by using the same procedure as in Experiment 1. Words belonging to the semantically related condition were rated as more similar than words in the unrelated condition, $t(190)=6.9$, $p<.001$. Finally, we also checked that words of each pair (either in the related or the unrelated condition) were not associated according to Spanish norms of association.

We had the same experimental conditions as in Experiment 1. That is, prime-target pairs could be either related or unrelated in meaning, as well as affectively congruent or incongruent (see examples at Table 2). We also had four versions of the experiment, to which participants were randomly assigned. In addition, we constructed 48 non-words (different from those of Experiment 1) that derived from abstract words rather than concrete words. We selected 48 abstract words from the ANEW (24 positive and 24 negative) to be used as primes for the non-words. The word-nonword pairs were the same across the four versions of the experiment. The practice block of Experiment 1 was modified by substituting concrete words by abstract words.

Procedure. The procedure was exactly the same as in Experiment 1.

RESULTS

Incorrect responses were excluded from the analyses. Reaction times that were more than two standard deviations from the mean for a given participant in all conditions were trimmed to the appropriate cutoff values (this excluded 3.8% of the data). Furthermore, we realised that there were four items to which participants gave a wrong response more than 50% of the times. We eliminated data from these four items of the analysis.

We conducted separate ANOVAs with RT and errors data with the same factors as in Experiment 1. Participants' RT means and percentage of errors are shown in Table 4. The analysis of RT revealed an effect of affective congruence, that was significant in the analysis by participants, F1(1,55)=6.29, $p<.05$, $\eta^2_p=0.10$ and near to significance in the analysis by items, F2(1,43)=3.64, $p=.06$. Conversely, there was not any significant effect of semantic relatedness (both Fs<0.78). The interaction between both factors also failed to reach statistical significance (both Fs<0.53).

Table 4. Results of Experiment 2 (mean and standard error of the mean in parentheses).

	Reaction Times	Percentage of Errors
Semantically Related – Affectively Congruent Pairs	566.2 (10.1)	4.5 (0.8)
Semantically Related – Affectively Incongruent Pairs	579.4 (10.9)	5.3 (0.9)
Semantically Unrelated- Affectively Congruent Pairs	572.4 (10.8)	5.9 (0.9)
Semantically Unrelated- Affectively Incongruent Pairs	580.8 (11.3)	5.2 (1.0)

The ANOVA for the percentage of error data failed to reveal any significant effect either in the participants or in the items analyses (all Fs<1.4).

The results of the present experiment show that participants responded faster when primes and targets were affectively congruent than when they had opposite valences. That is, we obtained an affective priming effect. Therefore, it seems that it is more probable to obtain affective priming with abstract words than with concrete words, as we predicted from the proposal of Kousta et al. (2011). However, we failed to obtain the semantic priming effect. In order to know whether words' concreteness can modulate both affective and semantic priming, as it seems to be the case from the separate results of Experiment 1 and 2, we conducted a joint analysis of these two experiments.

COMPARISON OF EXPERIMENTS 1 AND 2

In experiment 1 we obtained a semantic priming effect but we failed to observe a reliable affective priming effect. In Experiment 2, there was an opposite pattern of results, since we obtained affective priming effect but not a semantic priming effect. As the difference between Experiment 1 and 2 is the degree of concreteness of the materials used, these results seem to suggest that this characteristic of words can modulate both types of priming. In order to know whether there is a modulation of semantic and affective priming by words' concreteness, we conducted an ANOVA of the data of both experiments, introducing "concreteness" as a between-subjects factor. We only analysed RTs as there was not any reliable effect on the percentage of errors in any of the two experiments. Furthermore, we added another factor to the analysis that was "target valence". This factor was a within-subjects factor in the analysis by participants and a between-subjects factor in the analysis by items. Although affective priming studies commonly do not distinguish between positive and negative words, as reviewed in the introduction, there is a large amount of evidence suggesting differences in the processing of these two types of words. With the inclusion of "target valence" as a factor in our analysis we attempted to explore the possible contribution of this variable to the affective priming effects obtained.

The ANOVA revealed an effect of "target valence" that was significant both by participants, $F1(1,111)=106.26$, $p<.001$, $\eta^2_p=0.49$ and by items, $F2(1,88)=10.54$, $p<.005$, $\eta^2_p=0.11$, showing that positige targets ($M=572.7$) were responded faster than negative targets ($M=601.5$). Furthermore, participants responded faster when primes and targets were semantically related ($M=583.9$) than when they were unrelated ($M=590.4$), as revealed by the main effect of "semantic relatedness", that was significant by participants, $F1(1,111)=5.53$, $p<.05$, $\eta^2_p=0.05$ and near to significance by items, $F2(1,88)=3.736$, $p=.07$, $\eta^2_p=0.04$. The factor "affective congruence" also reached statistical significance in both analyses, $F1(1,111)=5.22$, $p<.05$, $\eta^2_p=0.05$, $F2(1,88)= 4.25$, $p<.05$, $\eta^2_p=0.05$. This last effect shows that words were responded faster when they were preceded by an affectively congruent prime ($M=583.9$) than when they were preceded by a prime with an opposite affective valence ($M=590.2$). Concerning concreteness, although abstract words ($M=576.15$) were responded faster than concrete words ($M=598.1$), this effect only reached statistical significance in the analysis by items, $F1(1,111)=2.41$, $p=.12$, F2(1,88)=6.14, $p<.05$, η^2_p =0.06. Finally, the interaction between "target valence", "semantic relatedness" and "affective congruence" was significant by participants, F1(1,111)=5.97, $p<.05$, η^2_p =0.05 but not by items. Planned Bonferroni comparisons revealed that, when targets were positive, there was only semantic priming in affective incongruent pairs ($p<.05$) and affective priming in semantically unrelated pairs ($p<.05$). Conversely, when targets were negative, there was only a reliable semantic priming effect in affectively congruent pairs ($p<.05$) and an affective priming effect in semantically related pairs ($p<.05$).

The results of the joint analysis of Experiments 1 and 2 show that, when considering all the participants and items together, we can obtain both semantic and affective priming effects. Furthermore, the lack of a reliable interaction between these effects and words' concreteness suggest that, contrary to our conclusion in Experiment 2, neither semantic priming nor affective priming seems to be modulated by this variable. Furthermore, the lack of a reliable interaction with "target valence" suggests that, although in average positive words are responded faster than negative words, the magnitude of either the semantic or the affective priming effects does not depend on the valence of targets.

DISCUSSION

In the present study we have tested whether affective priming can be observed in a lexical decision task, by manipulating both affective congruence and semantic relatedness between primes and targets. We have tested concrete and abstract words in two different experiments. If we consider the results of both experiments together, we have found both an affective priming and a semantic priming effect that are not modulated by either concreteness or target valence.

The results of the present study show that there is a facilitation in targets' processing when they are preceded by a a semantically related prime. This is the so-called semantic priming effect, repeatedly demonstrated in a huge amount of studies (e.g. Bueno & Frenck-Mestre, 2008; McRae & Boisvert, 1998; Perea & Rosa, 2002; Sánchez-Casas, Ferré, García-Albea & Guasch, 2006; Sánchez-Casas, Ferré, Demestre, García-Chico, & García-Albea, 2012). Although there is a strict control of variables affecting word processing in research about semantic priming, the possible role of the emotional content of words has been usually neglected. The results of the present study show that semantic priming is not affected by this affective content, as it is obtained regardless of whether primes and targets are affectively congruent or incongruent.

Semantic priming is a robust phenomenon, which is usually obtained without difficulties. In contrast, affective priming is a more elusive phenomenon. In fact, studies that have tried to tease apart these two effects usually report semantic priming effects, whereas affective priming is more limited and restricted to particular experimental conditions and tasks (e.g. Padovan et al., 2002; Storbeck & Clore, 2008; Storbeck & Robinson, 2004). However, affective priming is a valuable tool that allows researchers to investigate whether emotionality has an effect on word processing. Therefore, it is very relevant to elucidate the conditions in which this effect can be obtained. On the one hand, in order to conclude that emotionality has a genuine effect on word processing, it is necessary to demonstrate that affective priming does not depend on the degree of semantic relatedness between primes and targets. On the other hand, we believe that in order to conclude that the effect of emotionality in priming is a general phenomenon, it has to be demonstrated in tasks which are not focused on the affective content of words. The use of these tasks, such as lexical decision, is also relevant to investigate whether affective priming can be explained as a result of spreading activation between similarly valenced concepts on memory. However, many studies in the field either have only relied on evaluative tasks or have not taken into account the degree of semantic relatedness between primes and targets (see Klauer & Munsch, 2003 for a review). There are only few studies that have attempted to disentangle the effects of semantic relatedness and affective congruence between primes and targets on affective priming, by concurrently manipulating these two variables (Castner et al., 2007; Moritz & Graf, 2006; Storbeck & Clore, 2008; Storbeck & Robinson, 2004). Among them, only two studies have reported an affective priming effect with non-evaluative tasks, such as pronunciation (Moritz & Graf, 2006) and lexical decision (Castner et al., 2007). But in at least one of these studies (Castner et al., 2007), it remains unclear whether semantic relatedness between primes and targets was totally excluded. As stated in the introduction, some of the inconsistencies in previous results might be explained by a poor control of variables affecting word processing.

In the present study we have adopted a strict control procedure and we have obtained an affective priming effect. However, it has to be taken into account that the magnitude of this effect, although reliable, was small. These results, together with the findings of previous studies failing to found affective priming, suggest that this seems to be a tenuous effect and that variations in the stimuli selection or in the variables controlled might determine whether the affective priming effect will be obtained or not. Nevertheless, which is clear from the present results is that affective priming can be observed in a non-emotional task, thus suggesting that it is a general phenomenon and that emotionality has an effect in its own on priming, which can be dissociated from semantic relatedness. Furthermore, the present results have theoretical implications concerning the mechanism responsible for affective priming. In lexical decision (differently from evaluative categorization) there is not any competition between the response tendency elicited by the prime and that produced by the target. Thus, the present findings suggest that affective priming can be accounted for by a mechanism of spreading activation across a network of interconnected nodes (Fazio et al., 1986). In addition, as the present affective priming effects are not modulated by semantic relatedness, it would mean that those nodes should be connected as a result not only of their semantic relatedness but also of their affective relatedness, as Moritz and Graf (2006) proposed. However, Pecchinenda et al. (2006) pointed out that a spreading activation account of affective priming is faced with the "fanning problem" (Anderson & Bower, 1973). This is to say, if the activation caused by a prime has to spread to many nodes (i.e., those corresponding to words with the same valence), the activation would be divided over so many concept nodes that it is unlikely that the activation received by each node is strong enough to have much effect on the processing of the target. According to Pecchinenda et al. (2006), this problem might be overcome with a distributed view of semantic memory, in which all concepts with the same valence would share a particular subset of processing units. Therefore, when a prime is followed by a target with the same valence, a subset of the distributed representation of the target would be preactivated and this would facilitate its processing.

Apart from investigating the contribution of semantic relatedness to affective priming we were also interested on testing the role of word concreteness. Kousta et al. (2011) and Vigliocco et al. (2009) suggested that affective information might be more relevant in the representation of abstract words than in the representation of concrete words. We predicted that if this statement is true, we should find a higher affective priming effect for abstract words than for concrete ones. Although the separated analyses of Experiments 1 and 2 initially suggested that affective priming was only reliable with abstract words, we can not maintain this conlusion after the joint analysis of the two experiments. This analysis did not reveal any modulation of priming effects by concreteness, thus failing to give support to the proposal of Kousta et al. (2011) and Vigliocco et al. (2009). It might be that affective priming is a paradigm not sensitive enough to capture differences in the role of emotional content in the processing of concrete and abstract words and that other types of tasks, requiring a deeper conceptual processing, can reveal such effects. For example, in the study of Newcombe et al. (2012), participants had to decide whether a set of words were concrete or abstract. The authors reported that the dimension "emotional experience" (i.e., the relative ease with which words elicit an emotional experience) facilitated the decision process (as revealed by reaction times and errors) much more with abstract words than with concrete words, thus suggesting that emotional knowledge is more salient to the processing of abstract words than concrete words.

A note of caution has to be taken concerning our conclusions about concreteness, as they are not grounded on an experimental manipulation, but rather on an analysis conducted a posteriori. Clearly, the most suitable way to address the issue of concreteness would be to manipulate it in a single experiment, and matching concrete and abstract words in the most relevant variables known to affect word processing. In fact, Kousta et al. (2011) demonstrated the relevance of these variables. In particular, they found that once imageability and context availability, along with other lexical and sublexical variables were controlled, there was an advantage for abstract word processing over concrete words. We obtained a similar pattern of results, as reaction times in the present study were higher for concrete than for abstract words. These findings, together with those reported by Kousta et al. (2011), are at odds with the huge amount of literature showing an advantage in processing for concrete words (see Marques & Nunes, 2012, for a review). Clearly, they suggest that in order to reach definite conclusions about the role of concreteness on processing it is necessary to conduct a rigorous control of the above mentioned variables.

A final issue investigated in the present study was the possible modulation of affective priming by target valence. Most affective priming studies have not taken into account this variable and have compared congruent and incongruent trials by pooling data of positive and negative words (e.g., De Houwer et al., 2002; Storbeck & Clore, 2008; Storbeck & Robinson, 2004; Wentura, 2000). Nevertheless, there are several studies that have introduced, as we have done, valence as a factor (e.g., Blair et al., 2006; Padovan et al., 2002). Our findings are in agreement with previous studies in the field that have failed to obtain differences between positive and negative targets concerning the magnitude of the affective priming effect (Moritz & Graf, 2006). Furthermore, we have observed, as in other affective priming studies (e.g., Blair et al., 2006; Padovan et al., 2002), that negative targets are responded slower than positive targets. This result is also in agreement with previous work reporting slower responses for negative stimuli in a variety of cognitive tasks (e.g., Algom, Chajut, & Lev, 2004; Estes & Verges, 2008). This pattern of results has been interpreted as being due to an innate defense mechanism that temporarily freezes all ongoing activity when threathening stimuli appear (Algom et al., 2004). As a consequence, participants would be slower to react to negative words. However, it has to be taken into account that other variables (e.g., frequency) than valence might explain the differences in reaction times between positive and negative words in the present study. Clearly, further research is needed in which positive and negative words are matched as better as possible in order to reach definite conclusions about the role of valence on word processing.

In sum, the main contribution of the present study is to have demonstrated that it is possible to obtain a genuine affective priming effect, not depending on semantics, in a non-evaluative task. These findings suggest that emotionality has an effect on its own on priming which is compatibe with a distributed view of semantic memory in which emotional information is included in the representation of words. In addition, neither words' concreteness nor target valence modulated the pattern of effects. Further research is needed including a strict control of variables and testing other experimental paradigms to elucidate the role of these variables in the processing of emotional words.

RESUMEN

***Priming* afectivo en la tarea de decisión léxica: ¿Tiene efectos la concreción de las palabras?.** El *priming* afectivo se produce cuando las respuestas a un *target* se ven facilitadas cuando éste es precedido por un *prime* con una valencia congruente. Realizamos dos experimentos con el objetivo de comprobar si se trata de un efecto genuinamente emocional, o si es el resultado de la relación semántica entre *primes* y *targets*. Con este objetivo, manipulamos de forma ortogonal la relación semántica y la congruencia emocional entre *primes* y *targets*. Los participantes realizaron una tarea de decisión léxica. En el Experimento 1 evaluamos palabras concretas y en el Experimento 2, palabras abstractas. Obtuvimos un efecto tanto de *priming* afectivo como de *priming* semántico. La concreción de las palabras no moduló dichos efectos. Además, se obtuvo *priming* afectivo tanto si los *primes* y *targets* estaban relacionados semánticamente como si no lo estaban. Estos resultados sugieren que el *priming* afectivo es un efecto genuinamente emocional.

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