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Affective priming with associatively acquired valence

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Three experiments explored the effect of affectively congruent or incongruent primes on evaluation responses to positive or negative valenced targets (the "affective priming" effect). Experiment 1 replicated the basic affective priming effect with Spanish nouns: reaction time for evaluative responses (pleasant/unpleasant) were slower on incongruent trials, where the prime and the target were of opposed valence, than on congruent trials, where prime and target had the same valence. In Experiment 2, this congruency effect was obtained with primes that were pseudo-words that had been previously associated with symbolic positive or negative outcomes (medicinal plants or poisons). However, the effect was only obtained on trials with positive targets. In Experiment 3, the primes were positive, negative and neutral pseudo-words that had acquired valence through association with positive, negative or neutral outcomes, respectively. In this case, the congruency effect was obtained with both positive and negative targets. Evaluative responses to the targets were significantly slower on incongruent than on congruent trials. However, reaction times on trials with neutral primes did not differ significantly from reaction times on trials with either positive or negative primes. These results suggest that associative learning procedures where a neutral cue is paired with a symbolic valenced outcome confer this cue an affective valence or condition an evaluative response to it. This associatively acquired valence then affects evaluative processing of a target when the learned signal is used as a prime. However, our results do not allow a conclusion as to wether this effect is due to the facilitatory effects of congruence, the inhibitory effects of incongruency or both.

In standard associative/predictive learning procedures with human subjects, a cue such as a word or a visual stimulus is paired with a symbolic outcome, generally a word or a picture denoting a relevant event such as the presence of a disease or an allergic reaction (Shanks, 1995). The task of the subject is learning to predict the outcomes based on those cues. Usually, learning in these procedures is estimated through measures that tap explicit knowledge about the cue-outcome relationship. For example, the subject may be asked what is the outcome that will follow a cue on a specific trial or be required to give an overall estimate of the probability with which a cue predicts a given outcome. These measures supposedly reflect knowledge gained

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through incremental associative processes, though the extent to what explicit and deliberate reasoning and problem-solving processes affect performance at the time of testing in these procedures is not well known.

Most of the experiments on associative learning with predictive tasks have used outcomes that have a positive or negative affective valence. Words like "poison" or "illness", for example, have a negative valence and this property can be conceived as one of the semantic features of those words (Osgood & Suci, 1955). Although only the explicit knowledge about cue-outcome association is usually measured, one can reasonably hypothesize that a cue paired with a valenced outcome, even if it is presented under the symbolic form of a word, should acquire a valence similar to that of the outcome. There are several lines of evidence pointing to a distinction between two basic learning processes developing during the course of associative learning with valenced outcomes. One is expectancy or predictive learning, the acquisition of knowledge about the cue-outcome association. The other is evaluative learning, a shift of cue valence towards the valence of the associated outcome. A direct demonstration of this second process is the well-known phenomenon of evaluative conditioning, whereby evaluation of a target cue is changed by its association with a valenced outcome (e.g., Levey & Martin, 1975; DeHouwer, Thomas & Baeyens, 2001). Moreover, it has been shown that in human classical conditioning with an aversive US, expectancy and evaluative learning co-occur and a distinction has been suggested in this context between two qualitatively different forms of learning, expectancy learning and referential learning (Hermans et al., 2002). While expectancy learning involves the activation of an expectation of a real ocurrence of the unconditioned stimulus (US), referential learning is thought to change the valence of the conditioned stimulus (CS) without generating an expectancy of the inminent occurrence of the US. The distinction between two learning processes has also been made in the context of simple associative learning in animals. Pairing a flavoured substance with a toxin that causes gastrointestinal distress has two effects, taste avoidance, measured by consumption tests and taste aversion, measured through the taste reactivity test (Grill & Norgren, 1978). While taste avoidance seems to be mediated by the signal value of the flavour, taste aversion is thought to reflect an evaluative, hedonic or incentive learning process (e.g., Parker, 2003).

Stimulus valence is thought by many authors to be automatically activated when the stimulus is presented (e.g., Fazio, 2001; Bargh et al., 1992). According to the automaticity hypothesis, incoming stimuli are quickly and spontaneously evaluated as "good" or "bad", without the need of controlled processes like deliberation or intention to evaluate. One of the empirical phenomena supporting this conception is the so-called "affective priming" effect. In affective priming experiments, primes and targets are valenced stimuli and trials vary as to the congruence or incongruence between the affective valence of the prime and the target. For example, when words are used as stimuli, a congruent trial might be "loyalty"-"springtime" (pos/pos) and and incongruent trial "party"-"hunger" (pos/neg). Affective priming is defined as a faster reaction time (RT) to the target on congruent than on incongruent trials (e.g., Fazio et al., 1986; for reviews see Fazio, 2001 and Klauer, 1998). Although several tasks have been employed, affective priming has been more reliably found with an "affective decision" or evaluative task, where the subject has to indicate if the target word is "good" or "bad", “pleasant” or “unpleasant”. Affective priming is usually interpreted in terms of spreading activation from the prime to similarly valenced targets that facilitates encoding of congruent targets. Following this logic, slower responses on incongruent trials would be due to inhibition of the activation of the opposite valence. However, a second interpretation has been proposed based on response competition or facilitation, that links affective priming to the well-known Stroop effect. According to this interpretation, presentation of the prime activates its associated evaluative response, so that evaluation of the target is facilitated on congruent trials and interfered on incongruent trials when an opposite response is required (e.g., Wentura, 1999). Though they differ as to the level at which facilitation or interference is supposed to occur (at encoding or at response decision time), both theories are coincident in hypothesizing automatic activation of affective evaluation of the prime.

The aim of the experiments reported in this paper is testing if an affective priming effect can be obtained when the targets are valenced words and the primes are signals previously associated with valenced outcomes during a standard predictive learning procedure. The interest of this strategy is twofold: First, affective priming based on recently established associates would confirm that, besides turning antecedent cues into predictive signals for the associated outcome, predictive learning procedures also change the affective evaluation of the cues. Second, if affective priming with the new associate is obtained with temporal parameters (short SOA or stimulus-onset asynchrony) usually thought to preclude the intervention of controlled processes, this would support the idea that the acquired evaluation is activated automatically. In this respect, the affective priming paradigm has a clear advantage over evaluative conditioning, where the subject is explicitly asked to evaluate the stimuli.

There are already some demonstrations that affective priming can be produced with stimuli with newly acquired valence (DeHouwer, Hermans & Eelen, 1998; Hermans et al., 2002). However, as will be more thoroughly discussed in the presentation of Experiment 2, the procedures employed in these studies to condition a new affective valence have been different from those routinely used in human predictive learning experiments and we felt that it would be useful to test if affective priming would as well be obtained with signals whose affective valence has been acquired through such procedures. Experiment 1 is an attempt to replicate the basic affective priming effect with Spanish valenced words as primes and targets. Experiment 2 and 3 employ the same procedure, but using as primes pseudo-words that the subjects had previously learned to associate with a positive or a negative outcome. While in Experiment 2 only positive and negative primes were included, Experiment 3 also included neutral primes that during the previous learning phase had not been paired with positive or negative outcomes.

EXPERIMENT 1

Experiment 1 was aimed at replicating the basic priming effect with our stimulus materials, Spanish words with positive or negative valence. This procedure would later be used in our predictive learning studies, with the only exception that the primes would be recently established associates (pseudo-words) instead of real Spanish words.

METHOD

Participants. Participants were 19 first- and second-year psychology students from the Universidad Complutense (1 male, 18 females), with ages 18-21, who received partial course credit for participating.

Materials. Presentation of stimuli and register of responses was controlled through the software E-Prime 1.1. Stimuli were Spanish nouns written in black on a white background and presented at the center of the screen. Words were presented in Courier New font 18 point. The program was run on a Pentium III computer with a 64Mb RAM memory and the stimuli were presented on a VGA 17" monitor (refresh rate 60 Hz). Subjects were seated at a distance of 40-50cm from the screen. Responses were registered through a keyboard placed at a distance of 35 cm from the subject. The keys used for responding were <B> and <space bar>. The responses assigned to each key were counterbalanced. Sessions were carried individually.

Stimuli were 64 spanish nouns with positive or negative valence (32 positive, 32 negative, see Appendix 1), selected according to the pleasantness dimension of the normative study of Algarabel (1996), where 1 is the maximun negative evaluation and 7 the maximum positive evaluation.. Mean pleasantness ratings for the selected positive and negative words was 5.82 and 1.788, respectively, $t(1, 62)= 79.410$, p=.000. A second selection criterion was word frequency use, according to the Spanish norms of Alameda and Cuetos (1995). In previous pilot studies with simple affective and lexical decision tasks, we had found that reaction times (RT) to these words did not differ significantly when the words were grouped in two frequency categories (<33 and 38-66). Positive and negative words were equated as to their frequency of use. Mean frequency of positive and negative words was 37.40 and 36.56, respectively, $t(1, 62) = 0{,}190$, $p= >.05$. Positive and negative words were also equated as to their number of syllabes, t (1, 62)=1.644, word length, $t(1, 62)=1{,}617$ and imaginability, $t(1,62) = 1{,}332$ (all $p >.05$).

Procedure. A within-subjects design with prime-target affective congruency (positive-negative) and target valence (positive-negative) as factors was used. The instructions stressed that attention should be paid to the first word (the prime), but that the task was to respond to the second word (the target). After reading the instructions, that were presented self-paced on the computer screen, 25 training trials were given in order to familiarize the subjects with the experimental procedure. These training trials were identical to those of the experimental phase, with the only difference that different stimulus words were used. Results from this training phase were not analyzed. Once finished the training phase, subjects had to press the key <enter> to begin the experiment proper.

The experimental phase comprised 64 trials, divided in two 32 trial blocks separated by a rest period that the subject could terminate voluntarily after pressing the <enter> key. Each trial comprised two words, prime and target, presented sequentially. Primes were presented in upper-case and targets in small letters. Each trial began with a warning signal, consistent on three black points presented sequentially at the center of the screen, with a total duration of 450 msec. After a blank of 150 msec, an asterisk was presented during 500 msec at the center of the screen, acting as a fixation point. Immediately after this, the prime word was presented with a duration of 200 msec. The prime and target words were separated by a SOA (stimulus-onset-asynchrony) of 250 msec. The target was present until the subject had responded or until a maximum interval of 2000 msec had elapsed. The task of the subject was to respond if the target word was "pleasant" or "unpleasant", pressing the <B> or <space bar> keys on the keyboard. The response assigned to each key was counterbalanced.

Four trial conditions were used, varying in prime-target affective congruency and in target valence: two congruent conditions (positive-positive and negative-negative) and two incongruent conditions (positive-negative and negative-positive). An example of a congruent trial is "*hermosura / romance*" (*beauty / romance*) and of an incongruent trial "*abrazo / martirio*" (*embrace / martyrdom*). Eight trials of each of the four categories were included in each block. Prime-target pairings were randomly determined for each subject, so that any systematic influence of prime-target relations different from affective valence was compensated for. The same words were used on blocks 1 and 2, with the difference that the prime and target roles were inverted, so that for example words acting as primes on block 1 acted as targets on block 2. With this disposition, each word appeared twice over the entire test phase and once on each block.

RESULTS AND DISCUSSION

In this and the following experiments mean reaction times were considered only from trials with a correct response. Moreover, reaction times (RT) outside a range of 200-2000 msec were excluded in order to eliminate the potentially confounding effect of outliers. In the present experiment, average error rate across subjects was 7% and no RTs from correct trials had to be excluded because there was no one falling outside the specified range.

Mean error rates for congruent and incongruent trials were 4% and 10% respectively [t (18) = 1.388, n.s.]. Mean RTs for congruent and incongruent trials were 879 (SD134) and 929 (SD167) msec, respectively, thus revealing a congruency effect of 50 msec. As Table 1 shows, this congruency effect appeared both with positive and negative target words. Mean RTs varied also depending on the target valence. Mean RT for positive targets was 919 (SD161) and for negative targets 883 (SD138), a difference that is at odds with previous results in affective priming studies that have reported slower RTs for negative targets (e.g., DeHouwer, Hermans & Eelen, 1998) and with the results of pilot studies that we carried out with affective and lexical decision tasks.

A repeated measures ANOVA performed on RT data with congruency, valence and blocks as factors gave a significant effect of both congruency, $F(1,18) = 9.61$ ($p = .006$), and valence, $F(1,18) = 7.09$ ($p = .016$). The estimation of effect size (partial eta squared) was .348 for congruency and .283 for valence, which means a large effect of both variables (Cohen, 1988). Congruency x Valence interaction was not significant ($p>.05$). It is interesting to note that the congruency effect was maintained over the two blocks of trials. Although there was a significant effect of blocks on mean RT values, $F(1,18) = 5.35$, $p= .033$, revealing an effect of practice, the block x congruency interaction was not significant ($p>.05$). Though there was a general decrease of mean RT from the first to the second blocks of trials, in both blocks RT was slower for incongruent than for congruent trials.

Table 1. Experiment 1. Mean reaction times on congruent and incongruent trials.

	Pos. target	Neg. target
CONGRUENT	886 (153)	875 (139)
INCONGRUENT	951 (197)	895 (156)
Inc - Cong difference	65	20

The present experiment was successful in replicating the basic affective priming effect using as stimuli a set of Spanish nouns with several psycholinguistically relevant variables (frequency, number of syllables, word length and imaginability) carefully controlled. The affective decision response was slower on incongruent trials, with primes and targets of opposed affective valence, than on congruent trials, where prime and target shared the same affective valence. Though the affective valence of the target had an overall significant effect on decision time, the congruency effect was obtained both with positive and negative target words. As we have already pointed out, the result of slower RT for positive than for negative targets is at odds with previous evidence, both from us and from other laboratories. In our pilot studies, we used the same set of words employed in the present experiment in simple affective (pleasant/unpleasant) and lexical decision (word/pseudo-words) tasks, where the words were presented alone, not preceded by any stimulus. In both tasks, we found that positive words were responded to faster than negative words. The reason why in the present experiment the opposite result was obtained is unclear.

EXPERIMENT 2

Some previous studies have already shown affective priming effects with newly learned associates. However, in these studies the procedures employed to give a new affective meaning to the stimuli that would be later used as primes were dissimilar from those routinely used in human predictive learning experiments. One procedure used to generate new affective meaning has been differential Pavlovian conditioning, with an aversive electrocutaneous stimulus as the unconditioned stimulus (US) and pictures of human faces as CSs. Hermans et al. (2002) showed that after conditioning, the aversive CS+ presented as a prime slowed reaction times on incongruent trials where affectively positive target words were presented, compared to congruent trials where the target was a negative word. The use of a US that induces physical discomfort stands in clear contrast to the symbolic outcomes employed in standard predictive learning experiments and one can reasonably argue that these procedures might be differentially effective to alter the valence of the signal. In that same experiment, however, the authors found a similar congruency effect with primes that were pictures of faces that had been paired with positive or negative descriptive adjectives. This notwithstanding, it can be argued that the conditions under which these pictures acquired an affective valence were rather special, given that the picture-adjective pairings were interspersed with the aversive conditioning trials and that a very short inter-trial interval (1-4 sec) was used. It is by no means clear to what extent this procedure has effects comparable to those that would be obtained with more standard predictive learning procedures. Another possibly confounding factor of Hermans et al. experiment is that a relatively small target set size was used during the priming phase. Targets were 12 dutch nouns (six positive, six negative) each of which appeared 12 times over the priming phase. Repetition of the targets along the experimental phase is not without consequence, as it increases the accessibility of their associated semantic features, among them their affective valence and this might affect the degree of the priming effect. In fact, target set has been shown to affect response times in priming tasks, an effect that has also been observed in affective priming experiments (Klauer & Musch, 2001, Experiment 1). In Klauer & Musch report, for example, RT was found to be directly related to target size and there are some suggestions that the reduced latencies associated with small target set sizes might decrease priming effects (Hines, 1992).

An affective priming effect has also been obtained with primes that have been associated with valenced symbolic stimuli. In the first demonstration of affective priming with new associates, DeHouwer, Hermans & Eelen (1998, Experiment 4) first asked their subjects to learn the translation of 10 “pseudo-words” (in fact, Turkish words) to Dutch (five with positive and five with negative valence). Later, during the priming phase, with the pseudo-words as primes and new Dutch words as targets, a congruency effect was obtained, with slower RT on incongruent than on congruent trials. This effect was obtained in spite of the short number of pairings (four) of the pseudo-words with their Dutch translation during the learning phase. As was the case with the Hermans et al. (2002) experiment, during the priming phase each target appeared on 12 occasions. Moreover, targets were selected only on the basis of their affective valence and relevant psycholinguistic properties such as word frequency were not controlled for.

In this and the following experiment, we used during the learning phase a procedure similar to those routinely employed in predictive learning experiments, with a large number of trials in each of which the subject has to anticipate the associated valenced outcome. Specifically, the subject had to learn if the signal stimulus was a medicinal plant (positive outcome) or a poison (negative outcome). During the later, priming phase, the signals acted as primes that preceded Spanish nouns with positive or negative valence. The targets were the same words employed in Experiment 1 that, as we have already described, were selected so that positive and negative words were equated as to several psycholinguistically relevant variables. During the priming phase, each target appeared only once.

METHOD

Participants. Participants were 24 first- and second-year psychology students from the Universidad Complutense (6 males, 18 females), with ages 18-21, who received partial course credit for participating.

Materials. Except where otherwise stated, apparatus, testing conditions and procedural details were similar to those of Experiment 1. The stimuli used as signals on the associative learning phase were pseudo-words. To ensure that these pseudo-words did not have any intrinsic affective or pleasantness value, a normative study was carried out with 98 psychology students that would not participate in the experiments. The students were presented with a list of 17 pseudo-words printed on a paper sheet and were asked to rate each on a scale from 1 (very unpleasant) to 7 (very pleasant), with 3 being the neutral point (nor pleasant or unpleasant). The 8 pseudo-words closer to this neutral point (see Appendix 2) were selected as signals to be used in the experiments (range, 3.30-3.98; M= 3.67, SD= 1.49). This pseudo-words acted as primes during the priming phase. The same words employed in Experiment 1 were used as targets during that phase.

Procedure

Associative learning phase. The Experiment comprised two different tasks given in succession. First, there was a learning phase, where the subject had to learn to identify four medicinal plants (positively valenced signals) and four deadly poisons (negatively valenced signals), each corresponding to a pseudo-word. The instructions presented the experiment as a learning simulation task, where the subject had to adopt the role of a doctor who has to learn to identify medicinal plants and poisons in a primitive village where plants are the only available medicines. After reading the instructions, presented on the computer screen, the subjects received four demonstration trials with pseudo-words that would not be later used during the training phase. The task of the subject was to anticipate if a given pseudo-words was a medicinal plant or a deadly poison. The subjects were instructed to press the keys <1> or <0> to indicate what was the outcome associated with each pseudo-words. The response assigned to each key was counterbalanced.

The learning phase comprised 20 blocks of 8 trials. In each block the eight pseudo-words were presented, four associated with a positive outcome (medicinal plant) and four with a negative outcome (deadly poison). For half the subjects, pseudo-words 1-4 were medicinal plants and for the other half they were poisons. All blocks were identical, except for the order of presentations of trials, that was randomised. Each trial began with a blank screen lasting 500 msec, followed by a pseudo-word presented for 1000 msec. In the following screen, the subject was asked to press <1> or <0> to indicate if the pseudo-word corresponded to a medicinal plant or a deadly poison. This screen lasted until the subject responded or until a maximum of 5000 mesc had elapsed. Both the response given and the RT were registered. After the response, feedback was given and the pseudo-word and its associated outcome appeared again on the screen (e.g., "correct" SIBOLE is a medicinal plant). Separating blocks, a study table was presented where a list of the four medicinal plants and the four poisons was presented. To avoid any effect of list position, the order of the list of pseudo-words was changed for each presentation of the table. The study table was preceded by the message "REMEMBER", presented after completion of each block. After completion of block 10, the subject was allowed to take a rest and resume the experiment when she decided to.

Priming phase. The priming phase was similar to that of Experiment 1, with the difference that the primes were the eight pseudo-words used as signals on the learning phase. As in Experiment 1, there were four trial conditions in this phase, two congruent (pos/pos, neg/neg) and two incongruent (pos/neg, neg/pos). The difference was that the positive primes were the pseudo-words identified as medicinal plants during the previous learning phase and the negative primes the pseudo-words identified as poisons. Each of the pseudo-words appeared as primes eight times, four followed by positive and four followed by negative targets. Each target was presented only once on the priming phase. Temporal and other variables were identical to those of Experiment 1.

RESULTS AND DISCUSSION

On the acquisition phase, subjects showed a progressive decrease of errors over the 20 blocks of trials. Reaction times of the responses were also recorded. During the acquisition phase, the decrease of errors was accompanied by a decrease of reaction times. Mean values of percentage correct responses and of reaction times on the last, 20th block of trials, were 98% and 421 msec. A repeated measures ANOVA gave a significant effect of blocks on percentage correct responses, $F(19) = 6.97$, p=.00, and on reaction times $F(19) = 10.9$, p= .00.

On the priming phase, mean error rates for congruent and incongruent trials were 6% and 8%, respectively, t (23) = 1.61 (n.s.). Mean reaction times were 884 msec for congruent trials and 902 for incongruent trials (dif = 18). Table 2 presents mean RTs for congruent and incongruent conditions with positive and negative targets.

A repeated measures ANOVA with blocks, valence and congruence as factors gave a marginally significant effect of blocks, $F(1,23) = 3.97$, p=.058, and a significant effect of valence, $F(1,23) = 5.42$, p=.029 (eta squared = .191) and of the congruence x valence interaction, $F(1,23) = 6.22$, p= .020 (eta squared = .213). However, the effects of congruence and of the rest of the two- and three-way interactions were not significant. The significant congruence x valence interaction was explored through paired comparisons with the Bonferroni adjustment, that showed a significant difference between the reaction times of positive-congruent and positive-incongruent trials (p= .018).

These results show that an affective priming effect can be obtained with primes of associatively acquired valence. However, this effect was manifested only when congruent and incongruent trials with positive targets were compared. Thus, evaluation of a positively valenced target word was retarded when the word was preceded by a prime that had acquired negative valence through an associative learning procedure. However, reaction time to negative targets was not significantly affected by the valence of the prime.

Although there have been previous demonstrations of affective priming with primes of recently acquired valence, these have been based on learning procedures than involve the use of physically aversive USs (e.g., Hermans et al., 2002; Hermans, Spruyt & Eelen, 2003) or that are more similar to evaluative conditioning than to standard predictive learning paradigms (DeHouwer, Hermans & Eelen, 1998). Our results suggest that learning which involves pairing of neutral stimuli with symbolic valenced outcomes in a predictive task has two different effects. First, the acquisition of explicit knowledge about the signal-outcome association, as revealed through the increase in correct responses during the learning phase. Moreover, the results of the priming phase suggest that learning also seems to involve conditioning of affective valence to the signals, that corresponds to the valence of the paired outcome. To what extent this last effect reflects the operation of explicit or implicit learning processes cannot be determined based only on the present results. However, the signals were effective to affect the speed of evaluative decisions the targets, with temporal parameters that are usually considered to preclude the intervention of controlled and deliberate strategies. This suggests that after learning, the presentation of the signals gives rise to the automatic activation of their acquired affective valence, that would then facilitate or interfere processing of the valence of the target. Finally, the asymmetry of the priming effect, that was observed only with positive targets, might reflect a more general asymmetry in the effects of positive and negative affective information. In fact, there are both theoretical proposals and empirical data that suggest a primacy of negative information (e.g., Ohman, Flykt & Esteves, 2001; Pratto & John, 1991). The results of the present experiment seem to indicate that the ability of negative information to interfere processing of positive information is stronger than the ability of positive information to interfere processing of negative information. Of course, in the present conditions this should be dependent on the relative associative strength of positive and negative primes. It might be that acquisition of negative valence is a faster process than acquisiton of positive valence and that with a sufficient level of training both positive and negative primes would exert similar effects on the processing of valenced targets.

Table 2. Experiment 2. Mean reaction times on congruent and incongruent trials.

	Pos. target	Neg. target
CONGRUENT	878 (108)	874 (111)
INCONGRUENT	927 (128)	894 (129)
Inc - Cong difference	49	20

EXPERIMENT 3

In Experiment 2 it was shown that affective priming can be obtained with primes that had acquired affective valence through a predictive learning task. However, the priming phase only included congruent and incongruent trials, where the valence of prime and target was similar or different, respectively. As there were no trials with neutral primes, there was no baseline against to which compare the effect of congruent or incongruent trials. In the present experiment, the priming phase included the same proportion of congruent, incongruent and neutral or control trials. On these control trials, the primes were pseudo-words that during the learning phase had been presented as plants that were without effects (they were not medicinal plants nor poisons).

METHOD

Participants. Participants were 25 first- and second-year psychology students from the Universidad Complutense (8 males, 17 females), with ages 18-45 (all subjects were 18-21, except for one who was 45) who received partial course credit for participating.

Materials. In the present experiment there were three categories of pseudo-words and eight Spanish words were added to the set previously used for the priming phase. A new pseudo-words was added to those employed in Experiment 2, so that there were three categories, each comprising three words, that were paired with positive, negative or no outcomes during the associative learning phase. A total of 72 Spanish nouns (36 positive, 36 negative) were used as targets during the priming phase. Valence, according to Algarabel (1996) norms, was 5.83 for positive and 1.77 for negative words, t(1, 70)= 79.264, p=.000. Mean syllable number was 3.19 and 2.97 and mean word length was 7.7. for positive and 7.11 for negative words. Positive and negative words were also equated as to their frequency of use (37.47 for positive and 36.5 for negative words) and imaginability (5.08 for positive and 4.72 for negative words). Statistics for these variables were the following: Syllable number, $t(1, 70)=1.52$; word length, $t(1, 70) =1.55$; frequency, $t(1, 70)= 0.235$, p=.81; imaginability, $t(1,70)= 1.81$, all $p_s > .05$.

Procedure. The procedure was similar to that of Experiment 2, with the only differences being derived from including trials with neutral pseudo-words (plants without effect) both on the associative learning and the priming phases.

The associative learning phase comprised 30 blocks of nine trials each. On each block, there were three trial conditions: positive, negative and neutral. On the neutral trials the three corresponding pseudo-words were identified as "*without effects*". All parameters and procedural details of this phase were similar to those of Experiment 2.

The priming phase had similar characteristics to those of Experiment 2. However, in the present experiment there were 72 experimental trials, divided in two blocks of 36 trials, separated by a resting interval. On each block there were six trials conditions, depending on the relationship between the valences of the prime and the target. There were, as in the previous experiments, congruent (pos/pos, neg/neg) and incongruent (pos/neg, neg/pos) trials. Moreover, there were two trial conditions (neu/pos, neu/neg) where the target was preceded by a pseudo-word that had been identified as without effect during the learning phase. These neutral or control trials served as a baseline against to which the effects of valence congruency or incongruency could be compared.

RESULTS AND DISCUSSION

Acquisition over the 30 trial blocks of the associative learning phase was showed as a progressive and steady decrease of errors and reaction times. Final mean values for these measures on block 30 were 95% correct responses and 1088 msec, respectively (note that, compared to Experiment 2, the increase from two to three response alternatives more than doubled mean RT). The effect of blocks was highly significant for both measures: percentage correct, $F(29) = 24.82$; reaction times, $F(29) = 23.57$ (both p=.00).

A repeated measures ANOVA with blocks, valence and trial condition (congruent, incongruent and neutral) as factors gave a significant effect of blocks, $F(1,24) = 14.79$, p=.001 (eta squared = .381)and of the block x trial condition interaction, $F(2,28) = 6.13$, p=.004 (eta squared = .374). No other main effect or interaction reached statistical significance. To explore the block x trial condition interaction, paired comparisons with the Bonferroni adjustment were carried out. These comparisons revealed a significant difference between the congruent and incongruent conditions only on Block 1 (p= .007).

Table 3. Experiment 3. Mean reaction times on the different trial conditions of Experiment 3.

	BLOCK 1	*BLOCK 2*
CONGRUENT	895 (150)	848 (134)
INCONGRUENT	952 (142)	830 (109)
NEUTRAL	909 (150)	859 (157)
Inc - Cong difference	57	-18

The results of the present experiment partially replicate those of Experiment 2. The main result was that the affective priming effect with stimuli of associatively acquired valence was replicated. However, in the present experiment the effect only appeared on the first block of the priming phase. Moreover, in contrast to what was observed in experiment 2, there was no interaction of congruence and valence. Finally, though RTs on trials with neutral pseudo-words tended to fall between those corresponding to congruent and incongruent trials, this trend was no significant. Thus, the present results cannot resolve if the affective priming effect is mainly due to the inhibitory effects of valence incongruence, the facilitatory effects of valence congruence or both. In previous experiments when positive, negative and control (or neutral) trials have been compared, there have been demonstrations of both facilitation and inhibition and there are some suggestions that the extent to which each is responsible of the priming effect might depend on SOA duration time (Hermans, DeHouwer & Eelen, 2001, Experiment 1).

In contrast to what we observed in the first two experiments, where the affective priming effect was maintained over the entire experimental session, in the present experiment the effect only appeared on the first block of 36 trials. One interpretation of this result is that the repeated presentation of the positive and negative signals (pseudo-words) not followed by the outcome with which they were associated during the learning phase, led to extinction of their acquired valence. The problem is to explain why then this extinction did not take place in Experiment 2, where in fact the number of learning trials where each signal appeared (20) was inferior to that in Experiment 3 (30). However, one important difference is that only in Experiment 3 neutral or control trials were included. One possibility is that during the priming phase the mix of positive, negative and neutral trials not paired with their corresponding outcomes generated some interference effect that led to faster extinction of the previously acquired valence.

GENERAL DISCUSSION

The present series of experiments was aimed at exploring the affective priming effect. Experiment 1 replicated the basic effect with Spanish nouns of positive or negative valence. In that experiment, the affective decision or evaluative response (pleasant/unpleasant) to the target words was slower on incongruent trials, where the prime and the target had opposite affective valence. In Experiments 2 and 3 we tried to test if a similar effect could be obtained when the primes were pseudo-words that previously had acquired positive or negative valence in the course of a standard predictive learning task, where they signalled positive (medicinal plant) or negative (deadly poison) outcomes. In Experiment 2 the affective priming effect with new associates was observed, but only when congruent and incongruent trials with positive target words were compared. In Experiment 3, control trials were included, where the primes were neutral signals that on the associative learning phase had been identified as without consequences. Again, the affective priming effect was observed, though in this case it only appeared on the first half of the experimental session.

Some reported affective priming effects with stimuli of recently acquired valence contrast with Fazio´s (Fazio et. al., 1986) contention that automatic activation of affective evaluations require that the object or stimulus have a high associative strength. For example, DeHouwer, Hermans and Eelen (1998) obtained the congruency effect using as primes previously neutral verbal stimuli that had been presented only four times along with different positive or negative meanings. In fact, the authors took their results as suggesting that automatic activation of valence can be observed even with stimuli of weak associative strength. In the present series of experiments we obtained the affective priming effect with primes that had been repeatedly paired with valenced outcomes. In fact, in a previous non-published study using a similar procedure, we did not obtain a significant congruency effect when the learning phase comprised only ten blocks of trials (remember that in Experiments 2 and 3, 20 and 30 blocks were given, respectively). Our results, then, are more in line with Fazio´s proposal that a strong stimulus-evaluation association is necessary for automatic activation of valence to occur. In fact, there are results from episodic priming experiments clearly showing that extended practice with word-word associations is needed for a priming effect to appear (Dagenbach, Carr & Horst, 1990). It might be, however, that stimulus-evaluation associations are fastly acquired, so that valence is automatically activated after a few learning trials. In any case, the differences between our learning procedure and that employed by DeHouwer and co-workers difficults a comparison of the results. A parametric study would be needed, varying systematically the number of learning trials, to evaluate the relationship between associative strength and affective priming.

A question of theoretical interest relates to the supposedly automatic character of valence activation. According to the standard opinion, a priming effect with the SOA value of 250 msec that we have used in our experiments is indicative of automatic processes (e.g., Neely, 1977). There are several explicit comparisons of the effect of different SOA values on the affective priming effect. These studies have shown that affective priming is obtained with relatively short SOAs but that the effect wanes with long SOA values, though the precise temporal course of the phenomenon seems to depend on procedural details, such as the nature of the decision task and the disposition of the prime and the target on the computer screen (e.g., Fazio et al., 1986, exp. 2; Hermans, DeHouwer & Eelen, 2001). For example, in Fazio et al. experiment, the affective priming effect was obtained with 300 msec, but not with 1000 msec SOA. This same dependence on time parameters has been observed in studies that have used primes of recently acquired valence. Specifically, affective priming with aversively conditioned stimuli is observed with 300 msec, but not with 1000 msec SOA (Hermans, Spruyt & Eelen, 2003). Of course, in the absence of information about the effects of different SOA values, we cannot conclude if the priming effect obtained with our experimental procedure shows this same temporal dependence, and a conclusion as to the automatic character of valence activation in our experiments must await further experiments comparing the effect of different SOA values.

RESUMEN

Priming afectivo con estímulos de valencia adquirida asociativamente. Se estudió en tres experimentos el efecto que sobre la evaluación de "targets" con valencia positiva o negativa tenía la presentación de "primes" congruentes o incongruentes afectivamente (el llamado efecto de "priming afectivo"). En el Experimento 1 se replicó el efecto básico empleando como estímulos nombres del idioma español: el tiempo de reacción de las respuestas evaluativas (agradable/desagradable) fue más lento en los ensayos incongruentes, en los que "prime " y "target" eran de valencia contraria, que en los congruentes, en los que ambos estímulos eran de igual valencia. En el Experimento 2, este efecto de la congruencia se obtuvo con "primes" que fueron seudo-palabras que habían sido previamente asociadas con consecuencias simbólicas positivas o negativas (plantas medicinales o venenos). Sin embargo, el efecto sólo se obtuvo en los ensayos con "targets" positivos. En el Experimento 3, los "primes" fueron seudo-palabras positivas, negativas o neutras, que habían adquirido una valencia mediante su asociación con consecuencias, positivas, negativas o neutras, respectivamente. En este caso, el efecto de congruencia se obtuvo con "targets" tanto positivos como negativos. Las respuestas evaluativas a los "targets" fueron significativamente más lentas en los ensayos incongruentes que en los congruentes. No obstante, los tiempos de reacción en los ensayos con "primes" neutrales no difirieron significativamente de los tiempos de reacción en los ensayos con "primes" positivos o negativos. Estos resultados sugieren que los procedimientos de aprendizaje asociativo en los que una clave neutra es asociada con una consecuencia simbólica dotada de valencia afectiva confieren a esa clave una valencia similar o condicionan ante ella una respuesta evaluativa. Esta valencia adquirida asociativamente afecta luego al procesamiento evaluativo del "target" cuando la señal es presentada como "prime". Sin embargo, nuestros resultados no permiten concluir si este efecto es debido a los efectos facilitadores de la congruencia, los efectos inhibitorios de la incongruencia o a ambos.

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APPENDIX 1

List of Spanish words used in Experiments 1 and 2.

worrd	*Valence(*)*
abuso	N
aurora	P
calavera	N
cordialidad	P
deleite	P
delicia	P
delito	N
depresión	N
disgusto	N
diversión	P
dulzura	P
entierro	N
escasez	N
esclavitud	N
excursión	P
expresión	P
hermosura	P
injusticia	N
invasión	N
lealtad	P
manantial	P
maravilla	P
martirio	N
ofensa	N
optimismo	P
pobreza	N
pradera	P
prisión	N
robo	N
romance	P
tirano	N
vacación	P
abrazo	P
afición	P
aroma	P
atracción	P
bomba	N
caos	N

(*) P= positive valence; N= negative valence

cárcel	N
cariño	P
celda	N
combate	N
compañero	P
daño	N
derrota	N
desastre	N
descanso	P
desprecio	N
diálogo	P
examen	N
gozo	P
hierba	P
ignorancia	N
lástima	N
luto	N
navaja	N
paraiso	P
piano	P
pintor	P
pistola	N
resplandor	P
sufrimiento	N
tranquilidad	P
vegetación	P

APPENDIX 2

Pseudo-words used in Experiments 2 and 3

VIRMOTU

LASENTI

DIMALE

SIBOLE

DACONLO

TUCAMAL

ZELENGUE

CONARU

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