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Attentional Processing and Recall of Emotional Words

Procesamiento atencional y recuerdo de palabras emocionales

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Abstract

Three experiments were carried out in order to evaluate the attention paid to words of different emotional value. A dual-task experimental paradigm was employed, registering response times to acoustic tones which were presented during the reading of words. The recall was also evaluated by means of an intentional immediate recall test. The results reveal that neither the emotional valence nor the arousal of words on their own affected the attention paid by participants. Only in the third experiment, in which words belonging to two specific semantic categories (sexual and threatening) were used, did females show significantly higher RTS for threatening words. Nonetheless, significant differences were observed in the immediate subsequent recall for the different types of words in all three experiments. Future studies should take into account: a) the differential status of words and pictures to capture attention, b) the differential influence of valence, as well as arousal, on recall of emotional words, and c) the differential effects of the semantic category on the attention paid to these words by males and females.

Key Words: Emotional words, attention, recall, sex differences.

Resumen

Se llevaron a cabo tres experimentos para evaluar la atención a palabras de diferente valor emocional. Se trabajó con un paradigma experimental de doble tarea, registrando los tiempos de respuesta ante tonos, los cuales fueron presentados durante la lectura de palabras. El recuerdo también fue evaluado a través de una prueba de memoria intencional inmediata. Los resultados revelan que ni el valor, ni la excitación de las palabras, afectan la atención de los participantes. Solamente, en el tercer experimento, en el que las palabras pertenecieron a dos categorías semánticas específicas (sexual y riesgo de muerte) las mujeres mostraron significativamente mayor RTS ante palabras amenazadoras. No obstante, se observaron diferencias significativas en el recuerdo inmediato posterior, para los diferentes tipos de palabras en los tres experimentos. Los estudios futuros deben tener en cuenta: (a) la situación diferencial de las palabras e imágenes para captar la atención, (b) la influencia diferencial de valencia, así como la excitación, en el recuerdo de palabras emocionales y (c) los efectos diferenciales de la categoría semántica de la atención prestada a estas palabras de hombres y mujeres.

Palabras Clave: Palabras emocionales, atención recuerdo, las diferencias de sexo.

Introduction

There is abundant empirical evidence highlighting the fact that stimuli with affective meaning attract and maintain attention to a greater degree than neutral stimuli (e.g., Lang, Bradley, & Cuthbert, 1997; Öhman, Flykt, & Esteves, 2001; Pratto & John, 1991). Nonetheless, it is still unclear how emotion affects the cognitive processing of affective stimuli, nor to what extent this processing differs on the basis of its valence (Kousta, Vinson, & Vigliocco, 2009) or of its arousal (Most, Smith, Cooter, Levy, & Zald, 2007).

A number of authors propose that the valence of stimuli is responsible for the attentional bias and that only stimuli evaluated as negative will attract attention. Along these lines, Pratto and John (1991) suggest that humans possess a mechanism which allows the rapid allocation of attention and resources to stimuli of negative valence. Thus lower latencies would be observed when faced with aversive stimuli than with positive or neutral ones. They also suppose that this mechanism provides no information on the degree of unpleasantness throughout the valence dimension. Consequently, moderately negative stimuli would have the same effect on attention as intense ones.

In keeping with Vogt, De Houwer, Koster, Van Damme and Cromberz (2008), the preference for assigning attention to negative stimuli could be explained by their importance as potential hazards for the organism. Hence, retreating when faced with negative stimuli is more critical for survival than approximation to positive or neutral stimuli, thus, the fight or flee system would be more relevant (Cacioppo & Gardner, 1999; Kousta et al., 2009). In support of this idea, Pratto and John (1991) found greater interference for negative stimuli than for positive ones in an emotional Stroop task; other authors found that highly negative pictures attracted more attention than moderately negative ones (Mogg et al., 2000).

Öhman et al. (2001) formulated the proposal based on the same evolutionary argument put forward by Pratto and John (1991). Thus, those stimuli which evolutionarily supposed a threat for survival (such as snakes, spiders or angry faces) would obtain greater processing priority than other types of stimuli (such as mushrooms or flowers). The influence of emotion on attention would be limited to those types of stimuli relevant to fear, which could even be processed automatically (see Öhman & Mineka, 2001). Supporting this proposal, in studies which employed a visual search task, participants located a snake more rapidly among a set of mushrooms than a mushroom among a set of snakes. Moreover, they located an angry face among a set of faces with an expression of happiness more quickly than vice versa (Hansen & Hansen, 1988; Öhman et al., 2001). Nonetheless, Constantine, McNally, and Hornig (2001) employing an emotional Stroop's task, found that pictures of both snakes and bunnies elicited greater response latencies than pictures of cows, and that there were no differences between snakes and bunnies. Nor have other studies found any differences in the attentional resources devoted to processing stimuli such as snakes and spiders, as opposed to neutral stimuli, even when the participants demonstrated a phobia towards these types of stimuli (e.g. Kindt & Brosschot, 1999; Merckelbach, Kenemans, Dijkstra & Schouten, 1993).

Although both the proposal of Pratto and John (1991) and that of Öhman et al. (2001) focused on the effect of stimuli with negative valence on attention, it has been established that positive valence-arousing stimuli may produce similar effects (Most et al., 2007). Thus, in a study in which the participants controlled the disappearance of each image, Lang, Greenwald, Bradley and Hamm (1993) verified that they chose to contemplate arousing pictures for longer periods than neutral pictures, regardless of whether their valence was negative or positive. Subsequent studies confirmed that, independently of their valence (positive or negative), arousing stimuli attracted attention more than neutral stimuli (Anderson, 2005; Arnell, Killman, & Fijavz, 2007; Schimmack, 2005; Vogt et al., 2008). For example, Schimmack (2005) conducted a study in which the participants had to ignore emotional pictures which varied in valence and arousal, while they carried out a primary, unemotional task (e.g., solving a mathematical problem). The greatest interference was obtained with arousing pictures (unpleasant pictures and models of the opposite sex), regardless of their valence. Thus, arousal may play a more relevant role than valence in the affective modulation of attention (Anderson, 2005; Schimmack, 2005). Keeping with this notion, the motivated attention model (e.g., Lang et al., 1997) proposes that the tendency towards selectively attending a given stimulus is the product of motivation, maintaining that none of the motivational systems (appetitive and aversive) would be dominant. Thus, motivationally significant stimuli (habitually arousing), regardless of their polarity, would attract and keep attention to a greater degree than neutral stimuli.

In the same way, as in the case of attention, there is currently a great deal of empirical evidence available on the influence of emotion in long-term memory performance. Thus, free recall of different types of stimuli (including words, utterances, photographs) is usually better if they contain positive or negative emotional content than if they are emotionally neutral (for reviews, see Bradley, 1994; Christianson, 1992; Reisberg & Heuer, 2004). Similarly, studies on autobiographical memory show that recall of personal events with emotional relevance is more probable than without it (e.g., Conway, 1995; Schulkind & Woldorf, 2005; Thompson, Skowronski, Larsen & Betz, 1996). There is also evidence of a greater probability of recognition for positive or negative stimuli compared with emotionally neutral ones, although the experimental results are less consistent than for free recall (see, for example, Redondo & Fernández-Rey, 2010).

In the specific case of the recall of emotional stimuli or events, even though the advantage of these over neutral ones is generally comparable for positive and negative ones, in some studies it has been found that negative items have a greater probability of being recalled than positive ones. Nonetheless, in other studies, above all on autobiographical memory, the opposite pattern has been found, with autobiographical memories frequently being biased towards the positive. These contradictory findings could be explained from an evolutive perspective, since the memory mechanisms have evolved by facilitating the codification and retrieval of information of an emotional content, more relevant on the basis of the goals of each individual (Lazarus, 1991; Le Doux, 1996). Thus, the recall of unpleasant and hazardous stimuli may frequently be relevant for survival, and in these cases more attention will be paid to these stimuli, provoking reactions which will make them difficult to forget. In other cases, however, positive stimuli may be as relevant as negative ones for one's goals, capturing attention in a similar way (e.g. Riemann & McNally, 1995). It is also well known that elderly individuals habitually show greater memory performance for the positive than for the negative when their goals are positive (for a review, see Mather & Carstensen, 2005).

The majority of studies aimed at evaluating the influence of emotion on memory compare performance for neutral events with that obtained for arousing and highly positive/negative events, without taking into account that emotional and neutral stimuli probably differ between themselves in more than one dimension (Kensinger, 2004). In this regard, one widely accepted approach considers that emotional stimuli may be better described on the basis of their coordinates in a bi-dimensional "valence-arousal" space (Lang et al., 1993; Russell, 1980). With this approach it is possible to investigate how the valence and arousal dimensions can contribute in a differential manner to both attentional processing and memory performance (Bradley, 1994; Kensinger, 2004). As has already been mentioned, in this context there is evidence that arousal-eliciting stimuli have a greater probability of being detected and dealt with (for a review, see Dolan & Vuilleumier, 2003; MacLeod & Mathews, 2004). Similarly, arousing information has a greater probability of being codified, consolidated and retrieved than non-arousing information, in spite of the evidence on how emotion influences retrieval processes not being totally consistent (for a review, see Buchanan, 2007; Kensinger, 2009). Certain influences of arousal on recall, above all when photographs were used as emotional stimuli (e.g., Bradley, Greenwald, Petry, & Lang, 1992; Ochsner, 2000), seem to occur in a relatively automatic manner, since those stimuli which elicit a high level of arousal would seem to be more linked to situations of survival for the individual, due to which they entail greater priority in mnemic processing (Bradley et al., 1992; Kensinger, 2004). Nonetheless, there may also be greater recall for low-arousal emotional stimuli than for neutral ones, which would be due to a controlled, collaborative processing thereof (Kensinger, 2004; Kensinger & Corkin, 2004).

As regards, the recall of emotional words, it has been argued that, at least in part, some of the effects of memory attributed to emotion are the result of the distinctiveness of the emotional items (Dewhurst & Parry, 2000; McCloskey, Wible, & Cohen, 1988). It is well known that the recall of an item is enhanced when the codification gives rise to a memory trace with unique or distinctive qualities in relation to all the other items in the learning list (Eysenck, 1979; Jacoby & Craik, 1979; Moscovitch & Craik, 1976). In this sense, it could be interpreted that emotional problems show less variability of context and, thus, would be more distinctive than neutral ones (Marsh, Meeks, Hicks, Cook, & Clark-Foos, 2006). Other authors argue that good memory performance for emotional words is an artefact arising from the differences in the facility to organise emotional words and neutral ones. When words are used as stimuli, recall may be influenced by the semantic relations existing between the stimuli, such that the recall of emotional

words may be increased, not due to emotionality, rather to the semantic interrelation between them (Talmi & Moscovitch, 2004).

One special semantic category comprises emotional words of a sexual content. Thus, although it is true that the majority of positive stimuli tend to be evaluated as less arousing than negative ones (e.g., Lang, Bradley, & Cuthbert, 1999; Most et al., 2007); those of a sexual content are an exception. These types of stimuli are evaluated with high arousal and valence scores, for both sexes (Bradley, Codispoti, Sabatinelli, Cuthbert, & Lang, 2001; Lang et al., 1999). Moreover, sexual stimuli may come to attract attention in the same degree (Most et al., 2007), or even more so (Anderson, 2005), than certain negative stimuli, and are also better remembered (e.g., Aquino & Arnell, 2007).

In any case, following the bi-dimensional approach and focusing on the processing of words with an emotional content, there is still no consistent evidence that emotionally loaded words receive preferential attentional processing in normal individuals, even though it may be possible to observe differential effects in the recall of these stimuli. The majority of the studies cited used pictures as stimuli; nonetheless, as we have seen, when words are used, highly similar results are obtained (e.g., Anderson, 2005). Notwithstanding the above, it is still not clear how valence and arousal of words affect attentional processing (Kousta et al., 2009). And, in spite of the abundant research into the processing of emotional words, this presents two serious problems. Firstly, inconsistency in the stimuli used precludes the generalisation of results (Scott, O`Donnell, Leuthold & Sereno, 2009). Hence, the majority of studies have compared neutral and negative words, and studies comparing positive and negative words are relatively scarce. Additionally, the majority of research has employed words which do not come from normative lists. Secondly, many of these studies lack the control of certain psycholinguistic variables which are known to affect the attentional processing of words (Kousta et al., 2009). Depending on whether this control is carried out or not, the results of a study may differ or may even be reversed (Balota et al., 2007).

The first of the problems has been resolved with the development of normative word lists, such as the Affective Norms for English Words (ANEW; Bradley & Lang, 1999). The framework for this instrument is the dimensional perspective of emotions (e.g., Bradley, 1994; Lang, 1995; Lang, Dhillon & Dong, 1995), already defended by Wundt (1896), and based on the work of Osgood, Suci and Tanenbaum (1957). From this perspective, three basic dimensions are proposed, through which the entire range of human emotions can be organised: valence (which ranges from pleasant to unpleasant), arousal (which ranges from calm to excited) and dominance or control (ranging from in control to out of control). The ANEW list provides normative values in these dimensions for 1,034 words.

The second of the problems can be solved by using lists which include the corresponding psycholinguistic indices for each word, such as the recent Spanish version of the ANEW (Redondo, Fraga, Padrón & Comesaña, 2007). This list includes a series of improvements to the American version. Thus, while Bradley and Lang (1999) include only one psycholinguistic index in their work (word frequency), in the Spanish adaptation, in addition to frequency, an additional four objective indices (number of letters, number of syllables, grammatical class, and orthographic neighbours) and three subjective indices (familiarity, concreteness and image ability) are incorporated. Controlling these indices is important to the extent in which they may obscure or distort the specific effects of emotional variables on attention and recall.

With the aim of systematically studying these effects, in this work three experiments are presented in which valence, arousal and the semantic category of words are manipulated successively. More specifically, the aim was to evaluate the attention paid to words of different emotional content employing a dual-task experimental paradigm similar to that of other works (Bradley, Cuthbert & Lang, 1996; Buodo, Sarlo & Palomba, 2002), registering response times to acoustic tones which were presented during the reading of words. The recall thereof was also evaluated by means of an intentional immediate recall test. In the first experiment pleasant and unpleasant (both high arousing) words were used, as well as a control condition with words neutral in terms of both pleasantness and arousal. In the second, low arousal, neutral arousal and high arousal words were used (all pleasant), as well as neutral words in both dimensions. Lastly, the semantic category was manipulated, presenting the participants with, in addition to neutral words, two groups of highly arousing words whose meaning had sexual and threatening connotations, respectively. The final objective was attempt to establish to what extent the three variables (valence, arousal and

semantic category) were determinant in the attention to and recall of emotional words.

Experiment 1: Effects of Emotional Valence

As has already been mentioned, even though it would seem to be patent that emotional valence influences the processing of words, the differences between positive and negative words are not clear (Kousta et al., 2009). According to the model from Lang, Bradley, and Cuthbert (1990, 1997), both attract more attention than neutral words, regardless of their motivational value. With the aim of shedding some light on this hypothesis, an initial experiment was conducted, whose two main objectives were: a) to study whether there are any differences in attentional resources devoted to pleasant and unpleasant words, and in the subsequent recall thereof, regardless of their semantic category and when arousal is maintained constant (high), and b) to ascertain to what extent the possible effects of affective valence coincide with those found for pictures. With the particular aim of providing a comparison of the results, a procedure already employed in a previous work was used (Buodo et al., 2002).

Method

Participants

A total of 101 students from the University of Santiago de Compostela, whose dominant language was Spanish, took part voluntarily in this experiment. Of these participants, 38 were male and 63 female, with ages ranging from 18 to 28 (M = 22.30, SD = 2.16; M = 22.90, SD = 2.39, respectively).

Materials and apparatus

As stimuli 90 words from the preliminary version of the Spanish adaptation of the ANEW[1] (Redondo, Fraga & Padrón, 2005) were selected. They were distributed into three groups with the following characteristics: the pleasant valence set (P), with 30 highly pleasant words, with values for valence and arousal between 6.5 and 9.0 (M = 7.85 and 7.13, respectively); the unpleasant valence set (U), with 30 highly unpleasant words, with values between 1 and 3.5 for valence (M = 2.02) and between 6.5 and 9 for arousal (M = 7.00), and the valence and arousal set (NN), with 30 words neutral in both arousal (M = 4.81) and valence (M = 5.00), with values between 4.5 and 5.5 in both cases. In order to confirm the presence/absence of the significant differences between the groups of words where it was aimed for, twin three-factor analyses of variance (ANOVAs) were conducted, the results of which show significant effects for both valence ($F(2, 87) = 1155.00$; $p < .001$) and arousal ($F(2, 87) = 367.67$; $p < .001$). The *post hoc* tests showed, in the case of valence, significant differences between all the groups (in the three comparisons, $p_s < .001$) and, in the case of arousal, between the groups P and U in relation to the group N (in both comparisons $p < .001$).

On the other hand, word frequency was controlled, with a mean frequency in groups P, U and N of 70.93, 47.98 and 51.96, respectively. The ANOVA conducted confirmed the absence of significant differences among all groups for this variable.

The experiment was carried out in soundproof cabin in which there was a PC and a 15" monitor with a resolution of 800 x 600 pixels, located some 45 cm away from the participant. Superlab software (version 2.0) was used to present the instructions and the stimuli. Words were presented in Times New Roman 30 bold font for 2000 ms in the centre of the screen, over a matt white background. The sound had duration of 50 ms, a frequency of 1000 Hz and an intensity of 70 db.

Design and variables

To analyse the influence of emotional valence on attention and recall a 3x3x2 factor design was employed. The within-subject factors were the emotional Valence of experimental words (P, U and NN) and the time Interval elapsed from the appearance of the word until the presentation of the sound (300, 975 and 1650 ms); the within-subject factor was Gender. Thus, there were 9 experimental conditions and 270 trials, the presentation of which was randomised for each subject. The dependent variables were the time elapsing from the presentation of the sound until the subject's response by pressing the space bar (response time) and the percentage of words recalled.

[1] The word numbers were as follows: pleasant - 67, 69, 138, 174, 200, 220, 248, 251, 263, 291, 305, 306, 317, 384, 417, 451, 469, 475, 494, 506, 630, 635, 682, 746, 759, 760, 872, 920, 1034, 1038; unpleasant - 2, 27, 89, 98, 100, 121, 128, 213, 222, 244, 257, 275, 295, 357, 419, 430, 445, 447, 454, 478, 482, 601, 653, 704, 713, 718, 771, 939, 944, 971; neutral -97, 148, 412, 434, 496, 534, 541, 545, 550, 642, 646, 655, 662, 688, 698, 701, 738, 745, 753, 763, 855, 866, 869, 874, 875, 916, 936, 952, 1008, 1016.

Procedure

The experimental sessions were conducted in suitably lighted cabins. Each subject performed the task individually and the instructions, which were the same for all participants, were given at the start of the session on the computer screen. Therein, the participants were informed that they would have to perform two tasks: to pay attention to the word which appeared each time on the screen (main task), and press the space bar as quickly as possible on hearing the sound (secondary task). The participants saw the words on three occasions, one in which the sound was presented at 300 ms from the word, another in which the sound was presented at 975 ms there, from and another which was presented at 1650 ms, with the aim of obtaining an immediate recall measurement, and at the same time assuring that the subjects paid attention to the words, they were also informed that a recall task would be performed at the end. Before starting the experiment itself, subjects carried out three practice trials. The mean duration of each session was 25 minutes.

Results

Of the 101 original participants, 20 were excluded, for two reasons: absence of response in 5% of the tests (13 out of a total of 270), and presenting response times (RTs) lower than 100 ms and/or RTs two standard deviations above the individual's mean response time. Thus, and adhering to Perea (1999), those subjects with 10% *outlier* trials (27) or with extreme results were eliminated. In line with these two criteria, the definitive sample comprised 81 participants: 32 male and 49 female.

Response times

In order to analyse the RTs to words of different emotional valence (P, U and N; see Table 1) a 3x3x2 ANOVA was performed. This analysis showed that the main factor, Valence, was not significant ($F(2, 158) = 1.085$; $p > .05$), whereas the effect of the Interval was significant, ($F(2, 158) = 111.61$; $p < .001$). Thus, the RTs to the sound diminished significantly as the temporal interval increased ($M = 264.12$ ms in the interval of 300, $M = 233.63$ ms in the interval of 975, and $M = 218.41$ ms in that of 1650; $p_s < .001$ in all comparisons). On the other hand, the interaction between the Valence x Temporal Interval factors was not significant ($F(4, 316) = .732$; $p > .05$). This result reveals that the RTs to the different intervals were statistically similar, independently of the emotional valence of the words.

Finally, the main effect of gender was significant ($F(1, 79) = 32.35$, $p < .001$), due to the fact that males obtained significantly lower RTs than females, regardless of the emotional valence of words and the interval for presenting the sound (189 ms and 288 ms, respectively). None of the second or third order interactions was significant.

Table 1
Mean reaction times (in ms) and standard deviations (in parentheses) in Experiment 1.

Sound interval	Type of word (valence)		
	Pleasant	Unpleasant	Neutral
Males 300 ms	209 (64)	206 (61)	209 (64)
Males 975 ms	184 (47)	189 (49)	186 (52)
Males 1650 ms	172 (41)	172 (44)	175 (48)
Females 300 ms	320 (99)	320 (105)	320 (97)
Females 975 ms	281 (87)	280 (83)	282 (82)
Females 1650 ms	261 (88)	265 (86)	266 (88)

Recall

To analyse recall, a 3x2 repeated-measures ANOVA was conducted (Valence x Gender). The effect of the Valence factor was significant (F (2, 158) = 5.50; $p <$ .01). Although the main effect of the Gender factor did not reach significance (F (1, 79) = 2.82; p = .097), the interaction between both factors was significant (F (2, 158) = 13.09; $p < .001$). For this reason, twin ANOVAs were conducted separately for males and females; here the Valence factor was significant (F (2, 62) = 3.76; $p <$ .05; F (2, 96) = 20.69; $p < .001$, respectively). In *post hoc* contrasts, it was observed that females recalled significantly fewer unpleasant words (29%) than pleasant and neutral ones (37% and 41%, respectively; in both comparisons, $p < .001$). On the other hand, males recalled significantly more pleasant words (36%) than neutral ones (27%; $p <$ .05), without there being a significant difference between the recall percentages for these two groups of words and that for unpleasant words (32%) (See Figure 1).

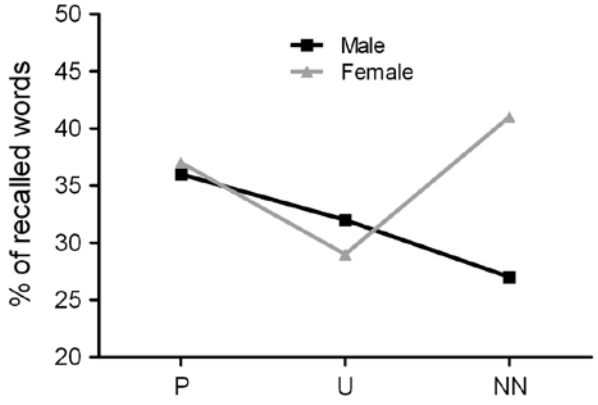

Figure 1. Percentages of recalled words in Experiment 1 (P = Pleasant words, U = Unpleasant words and NN = Neutral arousal and valence words).

In order to study the interaction in greater depth, the percentages of words recalled by males and females in each of the experimental conditions were compared (by means of t-tests for independent samples). The only comparison which was significant came about in the case of neutral words ($t = 3.76$; $p < .001$), with females recalling more words of this type than males.

Discussion

This experiment was conducted with the aim of verifying whether the affective valence of words has an effect on the allocation of the attentional resources they receive, as well as in the subsequent recall thereof. As mentioned above, a procedure similar to that employed by Buodo et al. (2002) was used; i.e., a dual-task paradigm in which it is considered that the RTs in the secondary task (pressing a key when hearing a sound) reflect the amount of attention devoted to the main task (reading the word). Nonetheless, unlike in the aforementioned study, in this experiment, no significantly different response times were obtained for pleasant, unpleasant and neutral words; i.e., the participants did not pay more attention to some words than to others. On the other hand, the results showed that, despite both sexes devoting similar attention to the different types of words, independently of their valence, they did not recall them the same. More specifically, males showed higher levels of recall for pleasant words, while females showed lower levels of recall for unpleasant words. Thus, regarding capacity for capturing attention, there does not seem to be any difference between positive and negative words. It is possible, however, that this lack of significant differences is due to the high level of arousal of both types of words (although this is obviously not applicable to neutral words). Hence, we proceeded to conduct a second experiment in which the arousal of words was specifically manipulated, on this occasion maintaining the valence constant.

Experiment 2: Effects of Emotional Arousal

As it has already been mentioned, affective valence is not the only relevant variable for the processing of emotional stimuli. Thus, since the end of 20th century, the need to consider activation or *arousal* as another of the determining factors of attention and the recall of emotional stimuli has gradually been confirmed. It is still unclear, however, to what extent both variables interact or, if under certain circumstances (e.g., depending on the type of task), one of them may be more decisive than the other in capturing attentional resources. From the perspective of Lang et al. (1997), for example, it is the motivational value of stimuli which is the basis of the attention given to them and, due to the nature thereof, motivationally relevant stimuli tend to be arousing (regardless of their positive or negative valence). As mentioned above, it is difficult to ignore pictures which are highly arousing, be they pleasant or unpleasant (Schimmack, 2005). Nonetheless, it may well be that this does not hold for words, to the extent that they constitute a "second signal system" (they represent meaning arbitrarily, through association with the objects/events which they denote) and that, accordingly, a high arousal word may not capture attention as intensively as would a high arousal image.

In order to verify whether high arousal words attract more attention than low arousal or neutral words, a second experiment was conducted in which the arousal of words was manipulated, maintaining their valence constant. In this case, given the difficulty of gathering a significant number of low arousal unpleasant words, we opted to select words with a high affective valence (positive).

Method

Participants

A total of 63 students from the University of Santiago de Compostela, whose dominant language was Spanish, took

part voluntarily in this experiment. Of these participants, 32 were male and 31 female, with ages ranging from 18 to 28 (M = 21.87, SD = 2.11; M = 21.5, SD = 2.44, respectively).

Materials

As stimuli we used 60 words selected from the Spanish adaptation of the ANEW[2] distributed into four groups. In three of them, the low arousal set (LA), the neutral arousal set (NA) and the high arousal set (HA) the valence was maintained constant, with values ranging from 6.5 to 9. In the LA set, mean valence was 7.43, in the NA set it was 7.33 and in the HA set it was 7.69; thus, in all cases these were pleasant words. Nonetheless, arousal was manipulated, so that the LA set comprised 15 low arousal words, with values ranging between 1 and 4.5 for arousal (M = 3.68); the NA set comprised 15 neutral words, with values ranging from 4.5 to 5.5 for arousal (M = 5.26); and the HA set comprised 15 high arousal words, with values between 6.5 and 9 for arousal (M = 7.22). Finally, a control condition was included, the neutral arousal and valence set (NN), with 15 words neutral in both arousal (M = 5.34) and valence (M = 5.21), with values between 4.5 and 5.5 in both cases. In order to confirm that the selection of materials responded to the criteria established, twin single-factor ANOVAs were conducted for valence and arousal. The aim was to ascertain whether: a) there were effectively any significant differences in arousal but not in valence between the LA, NA and HA groups of words; b) the LA and HA groups were different from the NN group in both valence and arousal; and c) if, in turn, the NA group was different from the NN group in valence but not in arousal. The results showed significant effects for both arousal (F(3, 56) = 96.23; p < .001) and valence (F(3, 56) = 140.86; p < .001). In the case of arousal, the *post hoc* tests showed significant differences between all groups (in all comparisons, p_s < .001) with the exception of the NA and NN groups (p = 1.000), and, in the case of valence, between the LA, NA and HA groups in relation to the NN group (in all comparisons p_s < .001).

On the other hand, the length (with the mean length in the LA, NA, HA and NN groups and being 6.67, 6.60, 6.20 and 6.13, respectively), frequency (means of 53.30, 32.21, 53.44 and 61.36), familiarity (6.22, 5.54, 6.00 and 6.12) and imageability (5.28, 5.24, 4.67 and 5.56) of the words were controlled. The ANOVAs conducted confirmed the absence of significant differences among all groups for these variables (in all comparisons, p_s > .05).

Design and variables

A 4x3x2 factor design was used, with two within-subject factors and one between-subject factor, the first two being the degree of Arousal of words, with four levels (LA, NA, HA and NN) and the Time interval which elapsed from the appearance of the word until the sound, with three levels (300 ms, 975 ms and 1650 ms). The between-subject factor was Gender. Thus, there were a total of 12 experimental conditions and 264 trials, the presentation of which was randomised for each subject. As in the previous experiment, the dependent variables were the time elapsing from the presentation of the sound until the subject responded by pressing the space bar (RT) and the percentage of words recalled.

Procedure

The procedure used was the same as in the previous study, in so that the subjects had to pay attention to the different words and press space bar as quickly as possible on hearing the sound.

Results

In this study, the same data-filtering criterion was applied as in the previous experiment, eliminating three females and one male. Thus, the final sample comprised 59 participants: 31 males and 28 females.

Response times

With the aim of comparing whether there were differences in the response times between the 4 groups of words (see Table 2) a 4x3x2 ANOVA (Arousal x Interval x Gender) was conducted. This analysis showed one single significant effect for the Interval (F (2, 114) = 27.87; p < .01). Thus, as the temporal interval increased the response latencies fell. Accordingly, the mean RT in the 300 ms interval was significantly higher (M = 265.31 ms) than in the 975 ms interval (M = 241.83 ms), and the RT in the latter was

[2] The word numbers were as follows: LA - 308, 350, 355, 399, 404, 420, 464, 468, 549, 632, 652, 696, 715, 896, 986; NA- 67, 68, 209, 302, 318, 320, 457, 479, 487, 497, 575, 691, 761, 840, 934; HA- 69, 138, 220, 306, 384, 417, 451, 475, 506, 630, 635, 682, 746, 920, 1034; NN- 95, 97, 104, 129, 327, 412, 496, 534, 545, 550, 646, 662, 745, 866, 961.

also greater than in the 1650 ms interval (M = 223.41 ms) (in all comparisons, $p_s < .001$). On the contrary, the effect of Arousal was not significant (F (3, 171) = 1.06; $p > .05$), since the mean RTs were highly similar in all four groups of words (M = 244.26; M = 245.33; M = 240.40; M = 244.09, for the LA, NA, HA, and NN word groups, respectively). The interaction between Arousal and Interval was not significant, since the different levels of arousal for the words did not give rise to significantly different RTs in the different intervals for presenting the sound. Finally, neither Gender factor nor the other interactions between factors were significant.

Table 2
Mean reaction times (in ms) and standard deviations (in parentheses) in Experiment 2

Sound interval	Type of word (arousal)			
	High	Low	NA	NN
Males 300 ms	266 (148)	271 (148)	268 (139)	271 (148)
Males 975 ms	250 (116)	249 (122)	251 (125)	255 (130)
Males 1650 ms	223 (104)	229 (115)	228 (102)	230 (110)
Females 300 ms	259 (119)	265 (119)	269 (134)	253 (112)
Females 975 ms	231 (87)	235 (106)	231 (106)	234 (101)
Females 1650 ms	214 (92)	217 (94)	224 (101)	221 (110)

Recall

To analyse recall, a 4x2 ANOVA was conducted (Arousal x Gender). The Arousal factor was significant (F(3, 171) = 6.71; $p < .001$), while neither the Gender nor the interaction thereof with arousal were significant (both $p > .05$). In the subsequent contrasts, it was observed that participants recalled significantly more low arousal words (LA) and high arousal (HA) words than neutral arousal words (NA) ($p < .05$ and $p < .001$, respectively), with the mean percentages of words remembered as follows: 33% in the LA group, 27% in the NA group, 38% in the HA group and 31% in the NN group.

Nonetheless, and in spite of the absence of a significant interaction between arousal and gender, as can be seen in Figure 2, only high arousal words were remembered significantly more by both males and females, while in actual fact only females remembered more low-arousal words: 38%, as opposed to 29% in males.

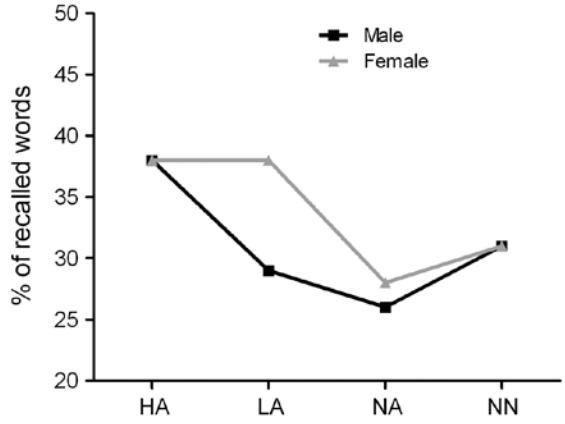

Figure 2. Percentages of recalled words in Experiment 2 (HA = High arousal words, LA= Low arousal words, NA = Neutral arousal words, NN = Neutral arousal and valence words).

Discussion

This second experiment revealed the role of arousal in attentional processing and the recall of emotional words, which varied in their level of arousal (low arousal, neutral arousal or high arousal), although their level of pleasantness was kept constant (except for the group of words which were neutral in arousal and valence). The results obtained concur with those from the previous experiment, in the sense that neither males nor females devoted different attentional resources to the different groups of words.

Thus, it would seem that this procedure is not very sensitive for detecting differences in RTs when the emotional stimuli are words, although it does allow certain differences to emerge in memory-related aspects. The results show that, in the absence of unpleasant words, those with the highest recall rates among pleasant words are high arousal words and, also, in the case of females, low arousal ones.

Given that no significant differences were obtained in attention between positive and negative words, between either of the two groups and the neutral words (Experiment1), or between low arousal, neutral arousal and high arousal words (Experiment2), a third experiment was conducted in which the same procedure was followed with another set of stimuli. Thus, participants were once again presented with pleasant and unpleasant words, but on this occasion, said words belonged to two semantic categories (sexual and threatening) previously employed

with pictures by Buodo et al. (2002). Therefore, this is an experiment in which affective valence is manipulated, while the level of arousal is maintained high (as in Experiment1), but introducing a third variable, the semantic connotation of words, which, as seen in the introduction, could affect attentional processing and the recall of stimuli.

Experiment 3: Effects of Semantic Category

It has already been mentioned that sexual and threatening stimuli seem to be special cases (Bradley et al., 2001; Lang et al., 1999). These are stimuli which strongly attract attention (Anderson, 2005; Most et al., 2007) and which are generally recalled better (Aquino & Arnell, 2007). Buodo et al. (2002), for example, found that, among aversive pictures, participants paid greater attention to pictures related to blood than to other negative pictures, as well as to pictures of sexual content compared with other pleasant pictures.

For this reason, we conducted an experiment whose main objectives were to study whether: a) in the case of words, participants devoted more (or fewer) attentional resources to those with a sexual connotation (pleasant) and/or threatening (unpleasant) connotation than to words neutral in pleasantness and activation; b) there are differences in the attention captured by pleasant and unpleasant words; and c) the stimuli of any of these categories is remembered better (or worse) than the rest.

Method

Participants

A total of 88 students from the University of Santiago de Compostela, whose dominant language was Spanish, and each of whom received three euros for their participation. Of these participants, 33 were male and 55 female, with ages ranging from 18 to 30 (M = 20.79, SD = 3.08; M = 18.71, SD = 1.07, respectively).

Materials

In order to select the materials for this experiment a preliminary study was required, due to the fact that we did not have sufficient words evaluated in valence and arousal in one of the experiment conditions. More specifically, in the ANEW there are not enough words with sexual content which comply with all the necessary requirements for the control of emotional and psycholinguistic variables which we aimed to establish. For this reason, and with a procedure similar to that used in the Spanish adaptation of the ANEW, a list of 32 words was prepared (16 neutral and 16 of a sexual content) and presented in three different previously randomised orders. Thirty males and thirty females (different from those who would go on to participate in the experiment itself) with a mean age of 20.62 participated in the study Each one of the three experimental lists was assigned at random to 10 males and 10 females, so that these subjects evaluated each word for valence and activation in twins scales from 1 to 9 by means of the Self-Assessment Manikin (SAM). Given that we were searching for highly pleasant and arousing words, of the 16 words with sexual content, 5 were eliminated as they presented very low average scores for both valence and arousal and one was eliminated due to a high absence of responses. With the 10 remaining words two repeated measures ANOVAS were conducted for the valence and arousal variables. The results did not show significant effects either for the Experimental list factor or for the Gender factor, or for the interaction between both.

On the basis of this study and on the Spanish adaptation of the ANEW three sets of words were prepared[3]: the sexual content set (S), comprising 24 words with values between 6.5 and 9 for arousal (M = 7.43) and for valence (M = 7.62); the threatening content set (T), comprising 24 words with values between 6.5 and 9 for arousal (M = 7.31) and between 1 and 3.5 in valence (M = 1.60); and the neutral arousal and valence set (NN) comprising 24 words with values between 4.5 and 5.5 for arousal and valence (M = 4.74 and M = 4.98, respectively).

In order to confirm the presence/absence of the significant differences between the groups of words aimed for, twin single-factor ANOVAs were conducted for Valence and Arousal, the results of which show significant effects for both valence ($F(2, 71) = 1279.01$; $p < .001$) and arousal ($F(2, 71) = 433.46$; $p < .001$). As could have

[3] The word numbers were as follows: sexual - 57, 64, 125, 295, 343, 364, 512, 530, 722, 744, 748, 791,819, 899 (the 10 words selected on the basis of the prior study were: afrodisíaco, amorío, atractivo, clímax, copular, coqueteo, fornicar, ligue, sexappeal, striptease; threatening - 1, 2, 27, 46, 244, 275, 292, 295, 344, 396, 397, 445, 474, 482, 586,591, 601, 614,704, 713, 798,867, 939, 964; neutral - 97, 130, 148, 412, 496, 541, 545, 560, 566, 580, 646, 655, 666, 675, 680,688, 698, 701,738, 828, 855, 942, 1008, 1016.

been expected, the *post hoc* tests conducted subsequently showed, in the case of arousal, significant differences only between the group N and the groups S and T (in both comparisons, $p_s < .001$) and, in the case of valence, significant differences between the three groups of words (in all comparisons, $p_s < .001$).

On the other hand, and as in the previous experiment, the length (with the mean lengths of groups S, T and N being 6.71, 7.46, and 6.42 respectively), frequency (means of 32.81, 26.68 and 46.60) and neighbourhood (1.33, 0.54, and 1.63) and, to the extent possible, familiarity (6.07, 5.44 and 6.11) and imageability (5.45, 5.28 and 5.80) of words were controlled[4]. The ANOVAs conducted confirmed the absence of significant differences among all groups for these variables.

Design and variables

A factorial design with two within-subject factors and one between-subject factor was used. The first two were the Semantic category of the words, with three levels (S, T, and N) and the Time interval which elapsed from the appearance of the word until the sound was presented. The between-subject factor was Gender. Thus, there were a total of 9 experimental conditions and 216 trials, the presentation of which was randomised for each subject. As in the previous experiments, the dependent variables were the time elapsing from the presentation of the sound until the subject responded by pressing the space bar (RT) and the percentage of words recorded.

Procedure

The procedure used was same as in the previous experiments, so that the subjects had to pay attention to the different words and press space bar as quickly as possible on hearing the sound.

[4] The longitude, frequency and neighbourhood values for those words not appearing in the ANEW were obtained through the B-Pal (Davis & Perea, 2005). Currently there are no data available on the familiarity and imageability of some of the selected words, due to which the analyses of these subjective indices were conduced with 10 randomly selected words from each group.

Results

For the analysis of the RTs in this study, four females were eliminated, three of them as result of applying the same data filtering criteria as in the previous experiment. Another woman whose percentage of recalled words was verified as an outlier, employing the Dixon Extreme Store Test (Dixon, 1950), was also eliminated. Thus, the sample over which both analyses were carried out (RTs and percentage of words remembered) finally comprised 84 participants: 51 females and 33 males.

Response times

With the aim of comparing whether there were any differences in the RTs among the 3 groups of words, a 3x3x2 repeated-measurement ANOVA was conducted in which the factors Semantic category, Interval and Gender were included. This analysis showed a significant effect for Interval ($F(2, 164) = 107.06$; $p < .001$), so that, in the same way as in the previous experiments, as the temporal interval increased, RTs decreased. Thus, the mean RT in the 300 ms interval was significantly higher ($M = 331.59$ ms) than in the 975 ms interval ($M = 285.20$ ms), and the RT in the latter was also greater than in the 1650 ms interval ($M = 266.11$ ms) (in all three comparisons, $p_s < .001$). On the contrary, the main effects of the Semantic category and of Gender were not significant, although the interaction between both factors was significant ($F(2, 164) = 4.48$; $p < .05$). For this reason, two separate ANOVAs were conducted for males and females. The results show that the effect of semantic category of words was only significant in the case of females ($F(2, 100) = 3,98$; $p < .05$). In the subsequent contrasts, it was found that this effect was due to females having significantly greater RTs to threatening words ($M = 294.24$ ms) than to neutral ones ($M = 287.60$; $p < .05$). Moreover, although no significant difference was found between males and females in the *post hoc* analysis, males showed slightly higher RTs than females for both sexual words (299.81 ms as opposed to 290.21 ms) and neutral words (299.12 ms as opposed to 287.60 ms), while the RTs for threatening words were highly similar (294.82 ms and 294.24 ms, respectively). Figure 3 shows the mean RTs for males and females for each group of words, independently of the temporal interval, as this factor did not interact significantly with either of the other two.

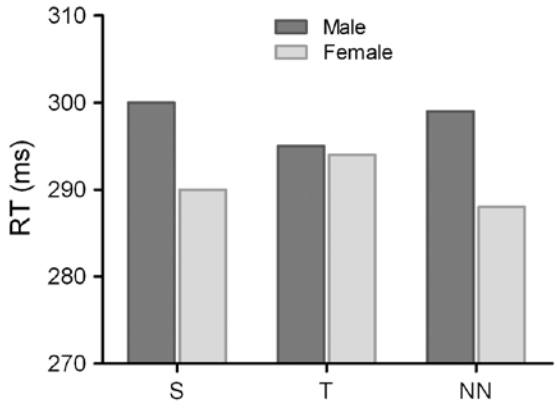

Figure 3. Mean RTs in Experiment 3 (S = Sexual words, T = Threatening words, NN = Neutral arousal and valence words).

Recall

To analyse recall, a 3x2 ANOVA (Semantic Category x Gender) was conducted, with the main effects of both factors being significant ($F(2, 164) = 38.62$; $p < .001$, for the Semantic category and $F(1, 82) = 4.83$; $p < .05$, for Gender), but not the interaction between them ($F(2, 164) = 0.41$; $p > .05$). Given that the Gender factor was significant (males recalled 34% of the words, females 39%) twin repeated-measure ANOVAs were carried out separately for males and females, with the effect of Semantic Category being significant in both cases ($F(2, 64 = 17.18$; $p < .001$ and $F(2, 100) = 22.19$; $p < .001$, respectively). In the *post hoc* contrasts, it was verified that, in the case of males, they remembered significantly more sexual words (43%) than threatening and neutral words (26 and 33%, respectively; $p < .001$ and $p < .05$ respectively), with the difference between recall of threatening words and neutral words approaching significance ($p = .06$). With regard to females, they also remembered significantly more sexual words (48%) than threatening and neutral ones (33 and 38%, respectively; $p < .001$ and $p = .001$, respectively). Despite the absence of a significant interaction between the Semantic category of the words and Gender, given that the latter factor was significant, *post hoc* tests were conducted revealing that males recalled significantly fewer threatening words than females ($t = 2{,}47$; $p < .05$). In the other two word categories, the differences were not significant (see Figure 4).

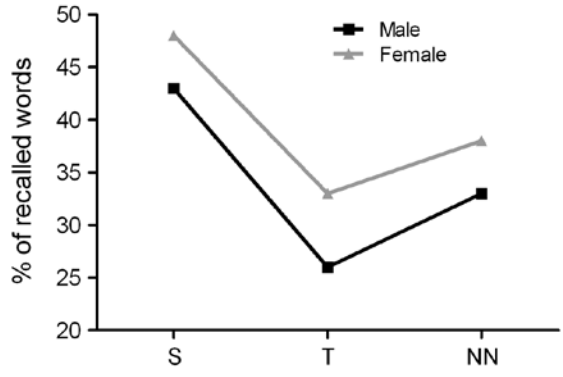

Figure 4. Percentages of recalled words in Experiment 3 (S = Sexual words, T = Threatening words and NN = Neutral arousal and valence words).

Discussion

In this third experiment, in which the semantic category of the words used was manipulated, for the first time we find significant differences in the amount of attentional resources devoted to the words. These differences were only observed in the case of females, who, in comparison with the sexual and neutral words, showed significantly higher RTs for threatening ones.

Once again, the data obtained with the recall failed to reflect directly previous attentional processing. On one hand, males recalled more sexual and neutral words ($p = .06$) than threatening ones, despite the RTs, being statistically similar in both sexes. On the other hand, females also showed greater recall for sexual words, despite having paid similar attention to sexual and threatening words, and more attention to threatening words than to neutral words. In addition, females generally devoted slightly fewer attentional resources to words than males; nonetheless, they recalled significantly more.

Thus, with this procedure, differences in the attentional processing of words have been attained. This would seem to be linked with the fact of having chosen pleasant and unpleasant words which, in addition to being highly arousing, belong to two specific semantic categories: sexual and threatening.

General Discussion

The results obtained in the experiments described herein reveal that neither the emotional valence nor the arousal

of words on their own affected the attention paid by participants, given that similar response times were obtained with pleasant and unpleasant words, as well as with high arousal and low arousal words. Only in the third experiment, in which words belonging to two specific semantic categories (sexual and threatening) were used, did females show significantly higher RTs for threatening words. Nonetheless, significant differences were observed in the immediate subsequent recall for the different types of words in all three experiments. Thus, in comparison with neutral words, females showed poorer recall for unpleasant words, while males had better recall for pleasant words (Experiment 1). Moreover, both sexes showed better recall for high arousal words (Experiment 2) and sexual words and lower recall for threatening ones (Experiment 3).

With regard to the first experiment, in which pleasant, unpleasant and neutral words were used, only the main effects of gender and of the time interval between the appearance of the word and the presentation of the sound were significant. Moreover, males responded more rapidly than females in all conditions, a factor that has already been documented (Adam et al., 1999; Dane & Erzurumluoglu, 2003; Kosinski, 2009; Noble, Backer, & Jones, 1964; Welford, 1980). In any case, the most relevant aspect for the purposes of the current experiment is that the affective valence of words had no influence on response times, nor did it interact significantly with the rest of the factors; accordingly, no significant differences were found with the different types of words on the basis of gender or temporal interval. One possible explanation for the absence of effects for emotional valence may be that this procedure, which was operative in the case of pictures (Buodo et al., 2002), is not be sufficiently sensitive to detect the expected effects of words of a different emotional polarity.

Another possible explanation for the difference between these results and those of Buodo et al. (2002) could lie in the fact that our manipulation of the stimuli was also different. For the present experiment, pleasant, unpleasant and neutral words were selected from any semantic category, while Buodo et al. (2002) selected words with specific content. More specifically, in Experiment 1, they used sport/adventure pictures, threat scenes, and household objects. In addition, in Experiment 2 they found significantly different RTs, within pleasant pictures, between sport/adventure pictures and sex pictures; and, within unpleasant pictures, between threat pictures and blood/injury ones. It is well known that certain semantic categories or conceptual contents capture the attention of subjects significantly more, as has been demonstrated in a number of studies (e.g., Schimmack, 2005).

Even so, taking the dimensional perspective into account, pleasant and unpleasant words were equivalent in terms of their arousal level (which was significantly higher than for neutral words), and it may well be that this variable is responsible for subjects devoting different levels of attentional resources to emotional words; although if this were the case, we should have found significant differences between RTs to pleasant and unpleasant words as opposed to neutral ones.

Nonetheless, when analysing the recall data, a significant effect was found for the affective valence of words and a significant interaction thereof with gender. Thus, although response times to the different types of words were similar, recall percentages were significantly different. More specifically, males recalled significantly more pleasant words than neutral ones, while females recalled significantly fewer pleasant and neutral words. Hence, despite males and females paying the same attention to the different types of words, their recall percentages differed significantly. Accordingly, we do not seem to be able to establish a direct relation between the amount of attention paid to the stimuli and the extent of the recall thereof. Thus words of different emotional valence, which have apparently been processed for a similar time, are recalled in a different manner, at least immediately after the experiment. One possible explanation for these disparate findings may lie in the fact that, as has been maintained from the motivated attention model (Lang et al., 1990, 1997), the emotional stimuli would have evolutionarily acquired an advantage for processing and recall with respect to neutral stimuli and, as has been pointed out by Kousta et al. (2009), this advantage would be evident at a pre-attentional level (e.g., Gaillard et al., 2006).

With regard to the differences between males and females, relative to neutral words, the former show better recall for pleasant words, while the latter recalled fewer unpleasant words. These results do not tally with certain interpretations derived from the evidence of sex differences in brain activity associated to the encoding and retrieval of emotional stimuli (see Hamann & Canli, 2004). These

authors suggest that females may have a greater capacity for integrating emotional experience, due to which they would demonstrate greater recall of the stimuli than males. Nonetheless, this is not the first time that behavioural recall measurements have failed to support this notion. For example, Herbert, Junghofer, and Kissler (2008), and Kissler, Herbert, Winkler, and Junghofer (2009), using an incidental recall task subsequent to the breeding of emotional adjectives, confirmed a general trend towards greater recall for pleasant words than for unpleasant and neutral ones, regardless of the sex of participants.

It should be noted that a subsequent analysis of the materials enabled us to verify that unpleasant words were longer and less familiar than pleasant and neutral ones, and less imaginable than the latter ones. These differences could explain the fact that females recall fewer unpleasant words, but they would not explain why males recall similar percentages of pleasant and unpleasant words; or why women recall significantly more neutral words than men. Although attempting to control these possible sources of error is advisable, it should be pointed out that both pleasant and unpleasant words were high arousal words. And in these two conditions, there were no significant differences in recall between males and females.

For this reason, and due to the absence of differences in attentional processing for different groups of words, a second experiment was conducted. The results concur with those from the previous experiment, in the sense that both males and females paid the same attention to the different groups of words. Taking these results into account, we can assert that the degree of arousal of words had no influence on response times, nor did it interact significantly with the rest of the factors; hence, no significant differences were found with the different types of words on the basis of gender or temporal interval. Once again, these results differ from those found by Buodo et al. (2002). As mentioned above, these differences could be explained by the different attention capturing capacities of words and pictures, or by the fact that the aforementioned authors chose pictures with specific content; i.e. from specific semantic categories.

Nevertheless, and in the same manner as for the previous experiment, significant differences were found in recall with regard to the degree of arousal of words. Thus, males and females recalled significantly more high arousal and low arousal words than neutral arousal ones. And although the interaction between them was not significant, females also recalled lower arousal words than males. Thus, we can assert that, in spite of the response times for males and females being similar, their recall differed significantly on the basis of their degree of arousal.

Taking the results of these experiments into account, we can state that (under this experimental procedure) the location in the affective space on the different groups of words used did not differentially affect the attentional processing of words, but it did affect immediate recall.

We then went on to conduct a further experiment selecting words which, in addition to being pleasant or unpleasant, belonged to two specific semantic categories (sexual and threatening), employed previously by Boudo et al. (2002). Unlike the previous two experiments, the results did show significant differences in attentional resources devoted to the words. More specifically, women obtained significantly higher response times for words with a threatening content than for neutral words. With regard to gender differences, males paid more attention to sexual and neutral words than females (although the differences were not significant), with both sexes paying the same attention to words of a threatening content. Taking these results into account, we can affirm that differences were obtained in the attentional processing of words using this procedure, although these results are possibly due to the manipulation in the semantic content of the stimuli employed. Thus, using these same categories, Buodo et al. (2002) found that, among aversive pictures, participants paid greater attention to pictures related to blood than to other negative ones, and to pictures of sexual content compared with other positive ones.

In regard to recall, the results once again showed the absence of a relation between the percentage of recalled words and the attentional resources used previously for the processing thereof. Thus, although males devoted similar attentional resources to the three categories of words, they recalled significantly more sexual words than threatening and neutral ones. In the same manner, although females paid more attention to threatening words, the subsequent recall thereof was similar to that found in males, recalling more words of a sexual content than threatening and neutral ones. Conversely, in spite of the fact that females dedicated slightly less attention to words than males, they recalled significantly more.

The overall results of the present research can be summarised as follows: (a) there were no significant differences in the attentional resources devoted to emotional words with different affective valence (Experiment 1) or with a different degree of arousal (Experiment 2); (b) females paid more attention to threatening words than to sexual and neutral ones (Experiment 3); and (c) a general trend was found towards a greater recall of pleasant words when arousal was maintained constant (Experiment 1), high arousal words when valence was maintained constant (Experiment 2), and words of the sexual content (Experiment 3). From our point of view, the main contribution of this work lies in showing, on one hand, the differential influence of valence, as well as arousal, on the attention to and recall of emotional words and, on the other hand, the differential effects of the semantic category on the attention paid to these words on the basis of gender; all under the rigorous experimental control of the stimuli employed, with the majority of words having been taken from the Spanish adaptation of the ANEW (Redondo et al., 2007). Based on the location in the affective space of the different words supplied by this instrument, we can guarantee that the differences obtained are the consequence of manipulating factors of valence, arousal and semantic category, and that they are not due to any other possible effects derived from any lack of control in those variables which have a bearing on the processing of words (length, familiarity, image ability, etc.).

Therefore, the results obtained highlight the fact that, in order to obtain significant effects on attention, this procedure requires, on one hand, the joint consideration of the dimensions of valence and arousal and, on the other, a selection of words from especially relevant semantic categories. These categories include both sexual and threatening words, two aspects which are closely related to the well-being/unease of individuals, so that we humans would seem to have developed a specific capacity for a preferential codification of these stimuli (e.g., Öhman & Mineka, 2001). This would result in greater subsequent recall for words of sexual content, and a tendency towards forgetting threatening words, in line with the natural motivation (in the absence of other factors) towards remembering the pleasant and forgetting the unpleasant.

Future research will concentrate on the differences and similarities between males and females in the processing and recall of emotional words, employing designs to overcome certain problems derived from the configuration of experimental lists, which have already been alluded to by some authors (e.g., Aquino & Arnell, 2007). In this regard, it should be started from a baseline which would be determined by the attention to and recall of emotionally neutral stimuli, using, in this case, sets of neutral words belonging to one single semantic category. On the basis of a direct comparison with this control condition, it would be possible to establish the attention/recall for pleasant/high-arousal/sexual words vs. negative/low-arousal/threatening words, presenting them in separate lists in order to avoid any possible neutralisation of the effects. Thus, the control of non-emotional factors, such as the semantic relation between items, as well as their location in the affective space, would enable us to gain a more complete overview of the effects of emotion on attention and memory.

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