Does it matter if we approach or withdraw when reading? A comparison of fear-related words and anger-related words

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ABSTRACT

The main aim of the present research was to explore the role of affective features beyond valence and arousal (i.e., the approach-withdrawal dimension) in visual word processing. For this purpose, fear-related words and anger-related words were compared in three tasks: a lexical decision task (LDT), a valence decision task (VDT) and an approach-distancing decision task (ADDT). Although these two types of words did not differ in the first two tasks, faster 'distancing' responses were given to anger-related words than to fear-related words in the ADDT. As long as these two types of words were matched in valence and arousal (among other variables), these results illustrate the need to consider other emotional dimensions (in this case, the approach-withdrawal dimension) beyond the two-dimensional perspective in order to account for the emotional effects in visual words processing and to describe how the affective space is organized. In addition, the results suggest a task-dependence effect: differential effects of fear and anger only emerged when participants were explicitly focused on the approach-withdrawal dimension. These findings are discussed in relation to motivationally-based mechanisms.

INTRODUCTION

Interest in the relationship between cognition and emotion has grown drastically in the last two decades (see Dolcos, Wang, & Mather, 2014, for an overview). A main research interest has been to examine how emotion influences on several cognitive processes, such as attention (e.g., Frings, Englert, Wentura, & Bermeitinger, 2010), memory (e.g., Xie & Zhang, 2018) and reasoning, problem-solving and decision-making (e.g., Druckman & McDermott, 2008). The present work is focused on the relationship between emotion and language, and more specifically, on the effects of the emotional content of words in their visual processing. In this context, one of the most widely used experimental procedures is the lexical decision task (LDT), in which participants are asked to decide, as quickly and accurately as possible, if each of a set of presented strings of letters is a word from a particular language or not (Katz et al., 2012). Regarding the effects of the emotional content of words in visual word recognition using the LDT, research has been predominantly conducted from a dimensional perspective. Briefly, the dimensional emotion perspective argues that the entire affective space could be described as combinations of certain continuous dimensions, among which *valence* (the hedonic subjective feeling that can oscillate between pleasant and unpleasant) and *arousal* (the level of activation that is experimented in a range between activated-excited and deactivated-calmed) are the most commonly accepted and experimentally tested (e.g., the Circumplex Model; see Posner, Russell, & Peterson, 2005). From this point of view, words can be either positive or negative regarding the valence dimension. Furthermore, they can vary in the degree of arousal elicited (e.g., Bradley & Lang, 1999; Guasch, Ferré, & Fraga, 2016; Monnier & Syssau, 2014; Soares, Comesaña, Pinheiro, Simões, & Frade, 2012; Võ et al., 2009). Despite having been intensively studied in recent years, the effects of the emotional content of words in visual word recognition using the LDT are still inconclusive: whereas there is quite consensus on the facilitative role of positive content (e.g., Kissler &

Koessler, 2011; Kousta, Vinson, & Vigliocco, 2009; Kuchinke et al., 2005; Schacht & Sommer, 2009, Experiment 1; Scott, O'Donnell, & Sereno, 2014; Yap & Seow, 2014; but see Briesemeister, Kuchinke, & Jacobs, 2014; Briesemeister, Kuchinke, Jacobs, & Braun, 2015), studies with negative words have yielded mixed findings, with reports of advantage (e.g., Kousta et al., 2009; Schacht & Sommer, 2009, Experiment 1; Yap & Seow, 2014), null effects (e.g., Kissler & Koessler, 2011; Kuchinke et al., 2005; Scott et al., 2014) and disadvantage for those words (e.g., Algom, Chajut, & Lev, 2004, Experiment 5; Briesemeister, Kuchinke, & Jacobs, 2012, Experiment 3; Ferré, Haro, & Hinojosa, 2017, Experiments 1 and 2).

Several explanations have been proposed for these inconsistences. Among them, the possible interactive effects of arousal with valence (e.g., Citron, Weekes, & Ferstl, 2014; Robinson, Storbeck, Meier, & Kirkeby, 2004; but see Vinson, Ponari, & Vigliocco, 2014) and the possible influence of participants' individual differences in terms of specific emotion sensitivity (e.g., Silva, Montant, Ponz, & Ziegler, 2012) or vocabulary and reading skills (e.g., Yap, Balota, Sibley, & Ratcliff, 2012). Another possible reason is the lack of control of some sublexical, lexical and semantic variables, which can interact with emotion effects (e.g., Larsen, Mercer, & Balota, 2006). Other more theoretically oriented accounts have been also proposed. In particular, some authors have noted the insufficiency of two-dimensional emotion theories (i.e., only considering valence and arousal dimensions) to explain the overall affective space and to account for the emotional effects observed in the distinct studies (e.g., Briesemeister, Kuchinke, & Jacobs, 2011a, 2011b; Fontaine, Scherer, Roesch, & Ellsworth, 2007; Trnka, 2011). One of the alternatives to the two-dimensional approach is the discrete emotion perspective, which posits the existence of a limited number of discrete emotional categories (the most widely accepted being happiness/joy, sadness, anger, fear and disgust) which are *natural kinds* and which are associated with specific and distinctive psychological-behavioral features (see Roseman, 2011), neurobiological basis (see Panksepp, 2010) and physiological-biological activity (e.g., Stephens, Christie, & Friedman, 2010). Another alternative to the two-dimensional approach is the consideration of additional dimensions (e.g., Fontaine et al., 2007; Trnka, 2011). Apart from valence and arousal, other suggested dimensions are *approach-withdrawal*[1] (the extent to which the emotion is associated with a behavioral tendency to approach or withdraw; Davidson, 1993, 1995), *control/dominance/potency* (the feeling of control that accompanies the emotion, ranging from being in control to being dominated; Bradley & Lang, 1999), *affect orientation* (degree to which the emotion elicits action tendencies towards the others and the environment [social-oriented] or towards the self [reflective or self-oriented]; Green & Sedikides, 1999), *deliberateness/intentionality* (degree to which the emotion is originated in and/or directed toward a specific object/person [e.g., fear] or not [e.g., anxiety]; Trnka, 2011), *unpredictability* (degree to which the emotion implies a novel/unfamiliar stimulus; Fontaine et al., 2007) and *origin of emotion* (the extent to which the emotion arises from automatic or reflective-deliberative evaluative processes; Jarymowicz & Imbir, 2015).

The first aim of the present research is to explore the need to consider additional emotional dimensions beyond valence and arousal in research on emotional word processing. In particular, we focused on the approach-withdrawal dimension. The reason is that it is probably one of the most relevant dimensions, since emotion and motivation are closely related (see Roseman, 2008) and motivational-behavioral tendencies seem to be one of the principal components of emotions (along with phenomenology, physiology and expression; see Roseman, 2011). It should be noted that the role of the approach-withdrawal dimension on word processing has been specially addressed within the framework of the valence-arousal conflict theory (Robinson et al., 2004). According to that theory, positive valence and low arousal would produce approach tendencies, while negative valence and high arousal would produce avoidance tendencies (e.g., Citron et al., 2014; Citron, Abugaber, & Herbert, 2016; Wang, Li, & Li, 2018). However, this proposal subordinates the approach-withdrawal dimension to valence and arousal, perpetuating the two-dimensional model. The novelty of our approach is that we investigate the role of that dimension on visual word processing per se, by focusing on words related to two distinct emotions –fear and anger– which are matched in valence and arousal. Hence, any difference obtained between them cannot be explained from the two-dimensional model.

The second aim of the present research is to explore whether there exists a task-dependence effect in relation to the approach-withdrawal dimension. The studies reviewed above have relied on the LDT, in that it is the most commonly used task in visual word processing research. Nevertheless, other tasks have also been used in research on the effects of emotional content on word processing. In fact, several studies have included a comparison across tasks (e.g., Delaney-Busch, Wilkie, & Kuperberg, 2016; Estes & Verges, 2008; Fischler & Bradley, 2006; Frühholz, Jellinghaus, & Herrmann, 2011; González-Villar, Triñanes, Zurrón, & Carillo-de-la-Peña, 2014; Hinojosa, Albert, López-Martín, & Carrieté, 2014; Hinojosa, Méndez-Bértolo, & Pozo, 2010; Huang, Baddeley, & Young, 2008; Mackay et al., 2004; Rinck & Becker, 2009; Schacht & Sommer, 2009; Siegle, Ingram, & Matt, 2002; Straube, Sauer, & Miltner, 2011). Although it is difficult to draw any firm conclusion from all these studies, since they are very diverse in terms of the controlled variables and the tasks compared (with even those few studies coinciding in the tasks compared not producing a consistent pattern of results), taken together, they suggest that the type of task can modulate the pattern of results. More specifically, while emotional effects almost always appear in affective-semantic tasks (such as the semantic categorization task, the concrete-abstract decision task or the valence decision task, VDT; see, for instance, Fischler & Bradley, 2006), they sometimes appear, yet sometimes do not, when participants perform more superficial tasks (such as naming the color of a word, deciding if words are presented in capital or lower letters, or deciding if sequences of letters constitute real words, LDT; see, for instance, Hinojosa et al., 2010).

There are some findings which suggest that task-dependence might be observed in relation to the approach-withdrawal dimension. In particular, Citron et al. (2016) tested the prediction of the valence-arousal conflict theory (Robinson et al., 2004), according to which motivationally congruent words (i.e., negative highly arousing words, eliciting avoidance tendencies and positive low arousing words, eliciting approach tendencies) would be responded to faster than motivationally incongruent words (i.e., negative low arousing words and positive highly arousing words). The results were in line with such predictions only when the task explicitly focused participants on the approach-withdrawal dimension (Experiment 1; participants had to decide if they would approach or withdraw from each word), but not when the task did not focus participants on this dimension (Experiments 2 and 3, in which participants had to spontaneously press the 'up' or 'down' arrow for each word; it was assumed here that reaction tendencies are implicitly associated with the vertical spatial axis; see, for example, Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010). Taken together, it seems clear that the feature or dimension on which participants focus their attention during the task determines the pattern of results obtained. Having this in mind, we explored in the present study whether there is a modulation by the task on the pattern of results obtained in relation to the approach-withdrawal dimension comparison.

In sum, in the present research we sought to explore the processing of emotional words, beyond the valence and arousal dimensions, in relation to the approach-withdrawal one. To that end, we compared fear-related and anger-related words matched in valence and arousal (in addition to other sublexical, lexical, semantic and affective variables). Fear and anger were chosen because they are two negative highly-arousing emotions (therefore, they are no different in terms of a two-dimensional perspective) that differ, among other features, in their motivational component: while fear is associated with withdrawal tendencies (see for example Cain & LeDoux, 2008; LaBar, 2016), anger is associated with 'moving against' approach tendencies (Davitz, 1969; Harmon-Jones & Harmon-Jones, 2016; see also Carver & Harmon-Jones, 2009, for a review of evidence supporting the approach motivational component of anger). If the two-dimensional perspective can entirely explain the effects of emotional content in word processing, no differences would be expected between fear-related and anger-related words. On the contrary, if the approach-withdrawal dimension is also relevant, differential effects would be expected between these two types of words. As stated above, we also aimed to explore the modulation of the effects by the type of task. For this, we carried out three experiments: in Experiment 1, participants did a LDT; in Experiment 2, they did a VDT; and in Experiment 3, they did an approach-distancing decision task (ADDT). The reason for choosing these tasks was to induce distinct types of processing by focusing participants' attention on distinct features of the stimuli (i.e., a non-emotional processing in the LDT, a valence-focused processing in the VDT, and a motivationally-focused processing in the ADDT). Considering that the influence of the approach-withdrawal dimension in word processing may emerge more clearly when participants are explicitly focused on it (Citron et al., 2016), we might expect the differential effects between fear-related words and anger-related words only to appear or to be stronger in Experiment 3 than in Experiments 1 and 2.

EXPERIMENT 1 (LDT)

Method

Participants. Fifty-one undergraduate Psychology students from the Universitat Rovira i Virgili (URV, Tarragona, Spain) participated in the experiment, but with one participant a computer error occurred and the data was not registered. In all the experiments, participants were recruited using convenience-volunteer sampling. The 50 valid participants (44 women) were Spanish-Catalan bilinguals aged between 18-43 years (M = 21.28, SD = 3.76). In all the experiments, participants gave informed written consent and received academic credits for their participation.

Design. The experimental design involved a single factor, Word Emotional Status (hereafter WES), with three levels: neutral words, fear-related words and anger-related words.

Materials. Ninety-three Spanish words were selected: 31 neutral words, 31 fear-related words and 31 anger-related words (see Appendix A). Words were selected considering both dimensional (valence, in a range from 1 [*completely sad/negative*] to 9 [*completely happy/positive*]; arousal, in a range from 1 [*completely calm*] to 9 [*completely energized*]) and discrete (happiness, sadness, fear, anger and disgust; all of them in a range from 1 [*nothing at all*] to 5 [*extrem*ely]) affective ratings. The criteria used to select the experimental words are presented in Table 1.

(Insert Table 1 here)

The affective ratings were obtained from several Spanish normative databases using the emoFinder online search engine (Fraga, Guasch, Haro, Padrón, & Ferré, 2018). The ratings for discrete emotions were obtained from the databases of Ferré, Guasch, Martínez-García, Fraga, and Hinojosa (2017), Hinojosa, Martínez-García, et al. (2016) and Stadthagen-González, Ferré, Pérez-Sánchez, Imbault, and Hinojosa (2018), while the ratings of valence and arousal were taken from the databases of Ferré, Guasch, Moldovan, and Sánchez-Casas (2012), Guasch et al. (2016), Hinojosa, Martínez-García, et al. (2016) and Stadthagen-Gonzalez, Imbault, Pérez Sánchez, and Brysbaert (2017). Independent t-tests were conducted to ensure that fear-related words and anger-related words were matched in valence (*p* = .587, BF_{10} = 0.29), arousal (*p* = .458, BF_{10} = 0.33), happiness (*p* = 1.000, BF_{10} = 0.26), sadness (*p* = .315, BF_{10} = 0.40), disgust (*p* = .201, BF_{10} = 0.52), the target emotion (i.e., the average value of fear for fear-related words vs the average value of anger for anger-related words; *p* = .221, BF_{10} = 0.49) and the contrast emotion (i.e., the average value of anger for fear-related words vs the average value of fear for anger-related words; *p* = .261, BF_{10} = 0.45). In addition, independent ANOVAs were conducted to ensure that the three sets of words were matched in many sublexical, lexical and semantic variables (all $p \geq .366$ and all $BF_{10} < 0.22$; see Table 2). The values of these variables were obtained from the following sources: the ratings of age of acquisition were taken from the databases of Alonso, Fernandez, and Díez (2015) and Hinojosa, Rincón-Pérez, et al. (2016); the ratings of concreteness and familiarity from the databases of Duchon, Perea, Sebastián-Gallés, Martí, and Carreiras (EsPal, 2013), Ferré et al. (2012), Guasch et al. (2016), and Hinojosa, Martínez-García, et al. (2016); the ratings of normalized Levenshtein distance between the Spanish words and their translations in Catalan (this variable was controlled in order to ensure that the degree of formal similarity between the Spanish experimental words and their Catalan translations was matched across conditions, as our participants were bilinguals of Catalan and Spanish) were taken from NIM (Guasch, Boada, Ferré, & Sánchez-Casas, 2013); the ratings of bigram frequency, number of higher frequency lexical neighbors, number of lexical neighbors, logarithm of contextual diversity, logarithm of lemma frequency, logarithm of word frequency, mean Levenshtein distance of the 20 closest words, number of syllables, trigram frequency and word length were taken from EsPal (Duchon et al., 2013). For certain words the values of some of these variables were not available in the aforementioned databases, and in such cases ratings were collected for age of acquisition, concreteness and familiarity following the same instructions and procedures of the published databases. In all the experiments, the matching was done using the K-means clustering procedure described by Guasch, Haro, and Boada (2017).

(Insert Table 2 here)

Given that some authors have found an effect of grammatical category in the LDT (e.g., Palazova, Mantwill, Sommer, & Schacht, 2011), the proportion of nouns and words that can be both nouns and adjectives was also matched across conditions (specifically: 27 nouns and 4 noun-adjectives in each condition). This classification was made according to the criteria of the electronic version of the official Spanish Dictionary (*Diccionario de la Lengua Española*, RAE, 2014; https://dle.rae.es).

Finally, 93 pseudowords were created for the purposes of the LDT with the pseudoword generator Wuggy (Keuleers & Brysbaert, 2010). These pseudowords were matched to the target words in subsyllabic structure, length and transition frequencies.

Procedure. Participants did the experiment in a quiet room in groups of four. They performed the LDT with the 93 critical words and the 93 pseudowords. Before starting the experiment, participants did 18 practice trials. Each trial began with a fixation cross (i.e., '+') appearing in the middle of the screen for 500 ms. Then, the stimulus replaced the fixation point (Arial font, size 11, lowercase), and participants had to decide whether the string was a Spanish word (pressing the 'yes' button with the index finger of the dominant hand) or not (pressing the 'no' button with the index finger of non-dominant hand). The trial finished when participants responded or after a time limit of 2000 ms. Feedback was provided ('correct', 'incorrect' or 'no response'). The trials were self-administered. In all the experiments, the DMDX software (Forster & Forster, 2003) was used to present the experimental stimuli and record participants' responses, the order of the stimuli being randomized for each participant.

Data analysis. The criterion for rejecting participants was that they committed more than 20% errors. No one was rejected for this reason. Data trimming included the removal of RTs that were lower than 300 ms or that exceeded 2000 ms and/or 2 SD of the mean RT of the participant (4.6% of the observations). In all the experiments, data analyses were conducted with IBM SPSS Statistics (version 25) and JASP (version 0.9.2.0). For all the experiments and analyses, the critical level of significance was $\alpha = .05$. Both RTs and ERs were analyzed with one-way two-tailed ANOVAs, including an analysis by participants (where the subscript 1 is used; i.e., F_1) and an analysis by items (where the subscript 2 is used; i.e.., F_2). In the analysis by participants, WES was a within-group factor, whereas in the analysis by items, it was a between-group factor. For each analysis, we report the *F* statistic with its degrees of freedom, the significance *p*-value, and the partial eta-squared (η_p^2) index of effect size. Furthermore, in case of significant effects in the ANOVA, Bonferroni corrected pairwise comparisons are conducted and the following information is reported: means difference and its 95% confidence interval, the *t* statistic with its degrees of freedom, the significance *p*-value and the Cohen's *d* index of effect size. Of note, when the sphericity assumption was not meet in the repeated measures ANOVA (analysis by participants), the corresponding correction was used (Huynh-Feldt when $\varepsilon \geq .75$, Greenhouse-Geiser when $\varepsilon < 0.75$). Similarly, when the homoscedasticity assumption was not met in the independent ANOVA (analysis by items), Welch's ANOVA was used.

Additionally, these 'traditional' frequentist analyses were complemented, when possible, with Bayesian analyses (the default options in JASP were left unchanged; e.g., Cauchy prior width of r = 0.707 in independent t-tests). We report the Bayes Factor (BF_{10}), which, broadly speaking, is a statistic that quantifies the relationship between the evidence received by one hypothesis in relation to another hypothesis in light of the data. In this case, it refers to how many times it is more plausible that the data support the alternative hypothesis (H_1) than the null hypothesis (H_0). To illustrate: a BF_{10} of 1 would mean that the data are as likely under H_1 as under H_0; a BF_{10} of 3 would mean that the data are three times more likely under H_1 than under H_0; a BF_{10} of 1/3 would mean that the data are three times more likely under H_0 than under H_1. Despite the fact that the BF_{10} has a continuous nature, the categorization proposed by Wagenmakers, et al. (2018, p. 67, Table 1) can be used to interpret its value: a BF_{10} between 1 and 3 would provide anecdotal evidence for H_1 (similarly, a BF_{10} between 1 and 1/3 would provide anecdotal evidence for H_0); moderate evidence for H_1 would be provided by a BF_{10} between 3 and 10 (similarly, moderate evidence for H_1 would be provided by a BF_{10} between 1/3 and 1/10); strong evidence for H_1 would be provided by a BF_{10} between 10 and 30 (similarly, strong evidence for H_0 would be provided by a BF_{10} between 1/10 and 1/30), etc. For a more complete introduction to the theory and practice of Bayesian analysis, we recommend the papers in the special issue edited by Vandekerckhove, Rouder, & Kruschke (2018)

Finally, concerning the data analyzed in this experiment, it has to be noted that pseudowords were filler stimuli which were needed to give participants the possibility to make the same number of 'yes' and 'no' responses. For that reason, responses to pseudowords were not analyzed.

Results and Discussion

The mean RT (in ms) for correct responses and the mean ER (in %) are presented in Table 3.

(Insert Table 3 here)

The ANOVAs on RTs showed a main effect of WES in the analysis by participants, $F_1(2,98) = 10.54$, $p < .001$, $\eta_p^2 = 0.18$, $BF_{10} = 292.30$, but was non-significant in the analysis by items, $F_2(2,90) = 1.69$, $p = .190$, $\eta_p^2 = 0.04$, $BF_{10} = 0.37$. Pairwise Bonferroni corrected comparisons carried out on the participants' analyses revealed that responses to neutral words were significantly faster than to both fear-related words (difference of 17.12 ms, 95% CI [3.75, 30.49]), $t_1(49) = 3.17$, $p = .008$, $d = 0.45$, and anger-related words (difference of 23.15 ms, 95% CI [10.66, 35.63]), $t_1(49) = 4.60$, $p < .001$, $d = 0.65$; meanwhile no significant differences were observed between fear-related words and anger-related words (difference of 6.02 ms, 95% CI [-7.00, 19.05]), $t_1(49) = 1.15$, $p = .771$, $d = 0.16$. Concerning the ERs, the main effect of WES was not significant, either in the analysis by participants $F_1(2,98) = 2.15$, $p = .123$, $\eta_p^2 = 0.04$, $BF_{10} = 0.44$, or in the analysis by items, $F_2(2, 90) = 0.44$, $p = .644$, $\eta_p^2 = 0.01$, $BF_{10} = 0.14$.

The results of this experiment replicated the disadvantage for negative words in comparison to neutral words observed in past LDT studies (Algom et al., 2004; Estes & Adelman, 2008; Briesemeister et al., 2012, Experiment 3; Kuperman, Estes, Brysbaert, & Warriner, 2014; Ferré, Haro, et al., 2017, Experiments 1 and 2), as both fear-related words and anger-related words were recognized more slowly than neutral words (in the analysis by participants). This result can be explained in terms of the Automatic Vigilance Hypothesis (AVH; Pratto & John, 1991; Wentura, Rothermund, & Bak, 2000), which states that negative stimuli have a preferential status in the human attentional system, either "attract[ing] more attention (preferential engagement) or hold[ing] attention longer (delayed disengagement) than neutral or positive stimuli" (Estes & Verges, 2008, p. 558), in order to rapidly detect threats and consequently to react so as to avoid harmful consequences. If this is the case, the reason for the disadvantage for negative words in comparison to neutral words observed in this experiment would be their capacity to attract attention preferentially and/or to hold it longer. This would result in fewer cognitive resources available to make the lexical decision.

More relevant for the purpose of this research is that no significant differences between fear-related words and anger-related words were observed in RTs or ERs. To the best of the authors' knowledge, the only study that compared fear-related words and anger-related words in a LDT is Briesemeister et al. (2011b). These authors compared words associated with all the basic negative emotions (except sadness), which were matched in valence and arousal (among other variables). The negative emotion that was most different from the others was disgust (i.e., there was a disadvantage for disgust-related words in both RTs and ERs), while fear-related words and anger-related words only differed in ERs (i.e., a disadvantage for fear-related words). The discrepancies observed between Briesemeister et al. (2011b) and the present experiment might be attributed to methodological factors that probably derived from the different number of conditions that are compared. In the present experiment fear-related words and anger-related words were matched in both the target emotion (fear for fear-related words vs anger for anger-related words) and the contrast emotion (anger for fear-related words vs fear for anger-related words). Furthermore, the values in other, non-target emotions (i.e., happiness, sadness and disgust) were kept low (in order to avoid emotionally-mixed words) and matched (in order to ensure that the presence/absence of significant differences is due to the critical emotions, not to differences in the non-target emotions) across the critical conditions. In contrast, in the experiment of Briesemeister et al. this accurate matching was not possible since they compared more than two conditions.

As observed in this experiment, fear-related words and anger-related words behave similarly in a LDT. However, as noted in the introduction above, there seems to be a modulation by task of emotion effects in word processing, the effects being more easily observed in affective-semantic than in more superficial tasks (e.g., Fischler & Bradley, 2006; Hinojosa et al., 2010). Similarly, it might be that differences in the processing of words related to distinct motivational tendencies are observed only in tasks involving affective-semantic processing. To test that possibility, we conducted the Experiment 2, in which we induced a valence-focused processing through a VDT, where participants had to decide if each word was positive or not.

EXPERIMENT 2 (VDT)

Method

Participants. Fifty-eight undergraduate Psychology students from the URV participated in the experiment. Nine of them were removed from the final sample because of the number of errors committed in the VDT (>20% errors). The 49 valid participants (41 women) were Spanish-Catalan bilinguals aged between 18-26 years (M = 20.18, SD = 1.78).

Design. The experimental design was the same as in Experiment 1.

Materials. The materials used in this experiment were the same as in Experiment 1, with an exception. As a consequence of the change from LDT to VDT, no pseudowords were needed but 93 positive happiness-related filler words were added in order to have an identical number of 'yes' and 'no' responses in the task (see Table 1 for the definition criteria). Independent t-tests were conducted to ensure that these positive happiness-related words were matched to the non-positive critical ones (i.e., neutral words, fear-related words and anger-related words were collapsed into a single group for matching) in the same aforementioned sublexical, lexical and semantic variables as in Experiment 1 (all $p \geq .217$ and all $BF_{10} < 0.33$). The data of these words were obtained from the same databases as in Experiment 1. The proportion of nouns, adjectives and noun-adjectives was also matched between positive and non-positive words (81 nouns and 12 noun-adjectives).

Procedure. Participants did the experiment in a quiet room in groups of four. They performed the VDT with the 93 critical words and the 93 positive happiness-related filler words. Before starting the experiment, participants did 18 practice trials. Each trial began with a fixation cross (i.e., '+') appearing in the middle of the screen for 500 ms. Then, the stimulus replaced the fixation point (Arial font, size 11, lowercase), and participants had to decide whether they considered that the word was positive (pressing the 'yes' button with the index finger of the dominant hand) or not (pressing the 'no' button with the index finger of the non-dominant hand). The trial finished when participants responded or after a time limit of 3000 ms (in which case the feedback 'no response' was given).

Data analysis. The criterion for rejecting participants was that they committed more than 20% errors. Nine participants were removed for this reason. Data trimming included the removal of RTs that were lower than 300 ms or that exceeded 3000 ms and/or 2 SD of the mean RT of the participant (4.4% of the observations). The statistical analyses were the same as in Experiment 1.

It should be noted that positive words had the same function here as the pseudowords in the LDT (Experiment 1): they were filler stimuli to give participants the possibility to make the same number of 'yes' and 'no' responses in the task. For that reason, responses to positive words were not analyzed.

Results and Discussion

The mean RT (in ms) for correct responses and the mean ER (in %) are presented in Table 4.

(Insert Table 4 here)

The ANOVAs on RTs revealed a significant main effect of WES in both the analysis by participants, $F_1(1.51, 72.42) = 30.27$, $p < .001$, $\eta_p^2 = 0.39$, $BF_{10} = 1.22$ e+8, and the analysis by items, $F_2(2, 90) = 8.32$, $p < .001$, $\eta_p^2 = 0.16$, $BF_{10} = 60.79$. Pairwise Bonferroni corrected comparisons revealed that responses to neutral words were significantly slower than to both fear-related words (difference in the analysis by participants of 77.69 ms, 95% CI [44.52, 110.86]; difference in the analysis by items of 53.02 ms, 95% CI [12.40, 93.65]), $t_1(48) = 5.81$, $p < .001$, $d = 0.83$, $t_2(60) = 3.18$, $p = .006$, $d = 0.78$, and anger-related words (difference in the analysis by participants of 84.18 ms, 95% CI [49.34, 119.02]; difference in the analysis by items of 63.28 ms, 95% CI [22.66, 103, 91]), $t_1(48) = 5.99$, $p < .001$, $d = 0.86$, $t_2(60) = 3.80$, $p = .001$, $d = 1.04$; meanwhile no significant differences were observed between fear-related words and anger-related words (difference in the analysis by participants of 6.49 ms, 95% CI [-12.56, 25.54]; difference in the analysis by items of 10.26 ms, 95% CI [-30.36, 50.89]), $t_1(48) = 0.85$, $p = 1.000$, $d = 0.12$, $t_2(60) = 0.62$, $p = 1.000$, $d = 0.15$. Concerning the ERs, a significant main effect of WES emerged in both the analysis by participants, $F_1(1.16, 55.59) = 36.36$, $p < .001$, $\eta_p^2 = 0.43$, $BF_{10} = 3.36$ e+10, and the analysis by items $F_2(2, 54.75) = 17.81$, p < .001, $\eta_p^2 = 0.37$, $BF_{10} = 1.27$ e+7. Pairwise Bonferroni corrected comparisons revealed that more errors were committed with neutral words in comparison to both fear-related words (difference in the analysis by participants of 16.51%, 95% CI [9.58, 23.44]; difference in the analysis by items 16.45%, 95% CI [10.01, 22.88]), $t_1(48) = 5.91$, $p < .001$, $d = 0.84$, $t_2(60) = 6.23$, $p < .001$, $d = 1.37$, and anger-related words (difference in the analysis by participants of 16.96%, 95% CI [10.49, 23.44]; difference in the analysis by items of 16.95%, 95% CI [10.52, 23.39]), $t_1(48) = 6.50$, $p < .001$, $d = 0.93$, $t_2(60) = 6.43$, $p < .001$, $d = 1.50$; but no significant differences were observed between fear-related words and anger-related words (difference in the analysis by participants of 0.46%, 95% CI [-

1.76, 2.67]; difference in the analysis by items of 0.51%, 95% CI [-5.93, 6.95]), $t_1(48) = 0.51$, $p = 1.000$, $d = 0.07$, $t_2(60) = 0.19$, $p = 1.000$, $d = 0.07$.

The results of this experiment revealed a disadvantage for neutral words in comparison to negative words: the valence decision-making was slower and less accurate with neutral words in comparison to both fear-related words and anger-related words. This advantage for negative words was also observed in previous VDT experiments (e.g., Siegle, Ingram, et al., 2002 Siegle, Steinhauer, Thase, Stenger, & Carter, 2002; Võ, Jacobs & Conrad, 2006). What this result suggests is that it is easier to decide that negative words are non-positive than to perform the same decision with neutral words. Logically, negative valence acted as a clearer signal of non-positivity than neutral valence.

As for the main comparison in relation to the aims of this research that is between fear-related words and anger-related words, no significant differences emerged either in RTs or in ERs. As noted in the introduction, the results of studies comparing different tasks suggest that emotion effects are easier to observe in affective-semantic tasks than in more superficial tasks (e.g., Fischler & Bradley, 2006; Hinojosa et al., 2010). Although this can be true in relation to emotion effects taken as a whole, the results of this experiment show that focusing on affectivity is not enough to allow subtler differences to emerge (i.e., those between fear-related words and anger-related words). Taking into account the aforementioned considerations derived from Citron et al. (2016), perhaps differential effects between fear-related and anger-related words would only emerge when participants are explicitly focused on the dimension that distinguishes these two emotions, i.e., the approach-withdrawal dimension. To test this possibility, we conducted an additional Experiment (Experiment 3) in which a motivational-focused processing was induced through an ADDT, where participants had to decide if they would approach or distance to each word.

EXPERIMENT 3 (ADDT)

Fear is an emotion associated with withdrawal tendencies (Cain & LeDoux, 2008; LaBar, 2016), whereas anger is associated with 'moving against' approach tendencies (Carver & Harmon Jones, 2009; Davitz, 1969; Harmon Jones & Harmon Jones, 2016). Such motivational properties should be also observed with words related to those emotions. However, it is possible that in spite of the approach motivational component of anger, since anger-related words involve negative situations and events, they could elicit a 'distancing' response, like fear-related words do. That would be in line with the proposed correspondence between positive valence and approach tendencies and between negative valence and withdrawal tendencies (e.g., Elliot, 2006; Norris, Gollan, Berntson, & Cacioppo, 2010). As a matter of fact, we asked a group of participants to fill in a questionnaire (i.e., a non-speeded, offline task) about approach-withdrawal tendencies: they had to decide if they would approach to or distance from the fear-related and anger-related words used in the Experiments. The results showed that anger-related words were consistently associated with a withdrawal response (see Appendix B). Taking into account these results, in Experiment 3, we conducted a speeded (online) approach-distancing decision task (ADDT). Our rationale was that, although participants' response was similar for fear-related words and anger-related words (i.e., distancing) in an offline task (i.e., the questionnaire), a difference between these two types of words might be observed in a more automatic, speeded (online) task (for an overview of the distinction between online and offline tasks, see García, Cieślicka, & Heredia, 2015; Veldhuis & Kurvers, 2012; see also Winskel, 2013, for an example of how the online-offline dichotomy modulates the effect of the emotional content of words). Concretely, if a 'distancing' response is given in that task for anger-related words despite their 'moving against' motivational component, there might be a conflict between the approach-related motivational tendencies and the withdrawal-related overt response (i.e., people would give a withdrawal-related response while an automatic activation of the approach motivational system by the emotion of anger would occur). In contrast, such conflict would not occur in fear-related words, because the ‘distancing’ response is congruent with the withdrawal-motivational tendencies. Taken together, slower ‘distancing’ responses in the online dichotomous decision between approach and distance would be expected for anger-related words in comparison to fear-related words. We investigated this possibility in Experiment 3.

Method.

Participants. Fifty undergraduate Psychology students from the URV participated in the experiment. The participants (38 women) were Spanish-Catalan bilinguals aged between 18-42 years (M = 20.76, SD = 3.64).

Design. The experimental design included the WES factor as in Experiments 1 and 2. The only difference was that in this experiment the WES factor had only two levels: fear-related words and anger-related words. This was due to the nature of the task involved: as it was a binary decision between to approach or to distance, neutral words were not suitable for the task, because they are not associated with either approach or withdrawal tendencies (see Appendix B).

Materials. The same fear-related words (n = 31) and anger-related words (n = 31) used in Experiments 1 and 2 were used in this experiment. In light of the results of the questionnaire previously administered (see Appendix B), a ‘distancing’ response was expected for both fear-related words and anger-related words. In order to have the same number of ‘approach’ and ‘distancing’ responses in the task, a set of 62 positive happiness-related words were selected from the ones used in Experiment 2. Independent t-tests were conducted to ensure that these positive happiness-related words were matched to the negative critical ones (fear-related words and anger-related words were collapsed into a single group for matching) in the same aforementioned sublexical, lexical and semantic variables as in the previous experiments (all $p \geq .130$ and all $BF_{10} < 0.55$). Additionally, they were matched in arousal ($p = .160$, $BF_{10} = 0.47$). The proportion of nouns, adjectives and noun-adjectives was also matched (54 nouns and 8 noun-adjectives).

Procedure. This task was an adaptation of the 'explicit approach and withdrawal task' of Citron et al. (2016, Study 1). The definitions of 'contacting emotions', 'distancing emotions' and 'attack emotions' described by Roseman (2011, p. 437) were also used for the instructions. Participants did the experiment in a quiet room in groups of four. They performed the ADDT with the 62 critical negative words and the 62 positive happiness-related words. Before starting the experiment, participants did 12 practice trials. Each trial began with a fixation cross (i.e., '+') appearing in the middle of the screen for 500 ms. Then, the stimulus replaced the fixation point (Arial font, size 11, lowercase). Participants were asked to think about the thing to which the word referred (i.e., its meaning) and to decide if they would distance themselves from it (pressing the 'distancing' button with the index finger of the dominant hand) or approach it (pressing the 'approach' button with the index finger of the non-dominant hand). The trial finished when participants responded or after a time limit of 3500 ms (in which case the feedback 'no response' was given).

Data analysis. The criterion for rejecting participants was that they committed more than 20% errors. No one was rejected for this reason. Data trimming included the removal of RTs that were lower than 300 ms or that exceeded 3500 ms and/or 2 SD of the mean RT of the participant (4.3% of the observations). The statistical analyses were the same as in the previous experiments. The only exception was that, because of the number of levels included in the WES factor (two instead of three), t-tests were carried out rather than ANOVAs.

Finally, similar to the VDT (Experiment 2), positive words were filler stimuli in this task, and they were included to give participants the possibility to make the same number of ‘yes’ and ‘no’ responses. For that reason, they were not analyzed.

Results and Discussion.

The mean RT (in ms) for correct responses and the mean ER (in %) are presented in Table 5.

(Insert Table 5 here)

The t-tests on RTs revealed a significant main effect of WES in the analysis by participants (difference of 19.53 ms, 95% CI [3.27, 35.80]), $t_1(49) = 2.41$, $p = .020$, $d = 0.34$, $BF_{10} = 2.12$, but it was non-significant in the analysis by items (difference of 13.75 ms, 95% CI [-27.56, 55.06]), $t_2(60) = 0.67$, $p = .508$, $d = 0.17$, $BF_{10} = 0.31$: participants responded faster to anger-related words than to fear-related words. Concerning the ERs, the difference between fear-related words and anger-related words was not significant either in the analysis by participants (difference of 0.92%, 95% CI [-1.16, 3.01]), $t_1(49) = 0.89$, $p = .377$, $d = 0.13$, $BF_{10} = 0.22$, or by items (difference of 0.96%, 95% CI [-3.64, 5.56]), $t_2(60) = 0.42$, $p = .678$, $d = 0.11$, $BF_{10} = 0.28$.

In this experiment we observed a significant difference in RTs between fear-related words and anger-related words (in the by participants’ analyses): anger-related words produced faster ‘distancing’ responses than fear-related words. Since fear-related words and anger-related words were matched in valence and arousal, the results of this experiment suggest that the two-dimensional approach cannot entirely explain the effects of the emotional content of words in their processing. Also, the present results reveal a task-dependent effect. Indeed, the differences between fear-related words and anger-related words were observed only in the ADDT, but not in the LDT or in the VDT (Experiments 1 and 2). This suggests that the differences only emerged when participants were explicitly working with the approach-withdrawal dimension (in line with Citron et al., 2016). It is worth mentioning, however, that the pattern of results was the opposite that we had predicted: we expected that if participants decided to 'distance' themselves from anger-related words, they would need more time to make such a decision than with fear-related words. The reason for this would be the existence of conflicting motivational information for anger-related words (i.e., giving a withdrawal-related response while the approach motivational system was activated). This point will be addressed in depth in the General Discussion.

GENERAL DISCUSSION

The main aim of the present research was to explore, in the context of affective variables influencing visual word processing, the role of additional emotional dimensions (in this case, the approach-withdrawal dimension) beyond valence and arousal. With this purpose in mind, fear-related words and anger-related words were compared. A second aim was to explore whether the task modulates the effects of such a dimension. To that end, different types of processing were induced. In the LDT (Experiment 1) and the VDT (Experiment 2), neutral words behaved differently than negative words, but no differences emerged between fear-related words and anger-related words. Nevertheless, in the ADDT (Experiment 3), differences were found between the two types of negative words: anger-related words produced faster 'distancing' responses than fear-related words.

The differences between neutral words and negative words observed in Experiments 1 and 2 may be accounted for by the emotional dimensions of valence and arousal (i.e., our negative words are more negatively-valenced and more arousing than neutral words). On the one hand, the disadvantage for negative words in comparison to neutral words observed in past LDT studies was replicated (e.g., Algom et al., 2004; Estes & Adelman, 2008; Briesemeister et al., 2012, Experiment 3; Kuperman et al., 2014; Ferré, Haro, et al., 2017, Experiments 1 and 2) was replicated, and can be explained as a consequence of the higher capacity of negative words to attract attention and/or to retain it (AVH; Pratto & John, 1991; Wentura et al., 2000), leaving fewer cognitive resources available to make the lexical decision. On the other hand, the disadvantage for neutral words in comparison to negative words observed in past VDT studies (e.g., Siegle, Ingram, et al., 2002; Siegle, Steinhauer, et al. 2002; Võ et al., 2006) was also replicated: negative valence is a clearer signal of non-positivity than neutral valence.

In Experiments 1 and 2, no effects of the approach-withdrawal dimension were found (i.e., fear-related words did not differ from anger-related words). In contrast, fear-related words and anger-related words differed significantly in the ADDT. This finding supports our predictions concerning a task-dependence effect: we expected that differences between fear-related words and anger-related words would only emerge or would be stronger when participants focused on the approach-withdrawal dimension (Experiment 3), but not when they focused on other features (i.e., non-emotional features in Experiment 1, valence in Experiment 2).

As discussed in the introduction, a review of studies comparing the effects of the emotional content of words across tasks suggests that these effects are task-dependent, being more clearly observed in affective-semantic tasks (e.g., Delaney-Busch et al., 2016; Estes & Verges, 2008; Fischler & Bradley, 2006; Frühholz et al., 2011; González-Villar et al., 2014;

Hinojosa et al., 2010; Hinojosa et al., 2014; Huang et al., 2008; Mackay et al., 2004; Rinck & Becker, 2009; Schacht & Sommer, 2009; Siegle, Ingram, et al., 2002; Straube et al., 2011). The cause might be that emotional content would require a minimum degree of activation and/or access to the semantic/conceptual level to produce effects in word processing (for a discussion on this topic see, for instance, Hinojosa et al., 2010). This would not necessarily happen in more superficial tasks, where the decision can be based purely on perceptual and/or lexical features and there is not an activation of the semantic-affective level strong enough to exert an influence. Our results are partially congruent with this idea. Indeed, the absence of differences between fear-related and anger-related words in the LDT (Experiment 1) could be produced because semantic-affective information was not sufficiently activated to enable the approach-withdrawal dimension to have an effect. However, the superficial vs affective-semantic dichotomy cannot explain why the same pattern of results was not the same in the VDT (Experiment 2) as in the ADDT (Experiment 3), since both can be considered to be affective-semantic tasks. Further explanations can be derived from Citron et al. (2016), the results of which suggested that the effect of the approach-withdrawal dimension only appears when the task explicitly focuses participants' attention on that emotional dimension. The issue pointed out by Citron et al. can explain why we found significant differences between fear-related words and anger-related words in the ADDT (i.e., a motivationally-focused task), but not in the VDT (i.e., a valence-focused task). It should be mentioned, however, that an alternative explanation to the task-dependence effect observed in this study is also possible. In particular, it concerns the overall increase in RTs when comparing the three experimental tasks (i.e., RTs are significantly larger in ADDT than in VDT and LDT, and RTs in VDT are in turn significantly larger than those in LDT)[2]. Such increase in RTs, probably due to the increase in the difficulty of the decision to make with the words, might leave more room for weak effects (like the difference between fear and anger related words) to emerge. In order to test this possibility, we divided participants of Experiment 3 in two groups, on the basis of the median of RTs. Hence, there was a group of fast participants and a group of slow participants. We re-analyzed the data of the ADDT by introducing group as a factor and failed to find any significant interaction by group. These results show that the magnitude of the difference between anger-related words and fear related-words does not depend on RTs. Hence, we favor an interpretation of our results in terms of the particular dimension in which participants focus while performing the task. However, further studies should be conducted in which the difficulty of the task is consistently manipulated to completely discard the explanation of the present results in terms of task complexity/RT length.

The differences between fear-related and anger-related words that emerged in the ADDT (Study 3), as long as they were matched in valence and arousal, underline the insufficiency of the two-dimensional perspective to explain emotion effects in visual word processing and to describe the human affective space. Thus, there is a need to consider other emotional features such as additional dimensions (in this case, the approach-withdrawal one), as previously suggested by other studies (e.g., Fontaine et al., 2007; Trnka, 2011). However, before drawing strong conclusions from these results, there are two points that deserve to be mentioned here. The first one is that the effect observed in the ADDT was small. Although this might be considered a limitation of this study, we would like to note that in the present study we have replicated the results of a pilot study in which we tested a distinct (and smaller) set of items in a different sample of participants. In that study, the results went in the same direction as the present findings (Huete-Pérez, Haro, Hinojosa, & Ferré, 2017; see Appendix C). This makes us confident that the effect, although small, is reliable. The other point refers to the interpretation of the results, as they were opposite of what we had predicted. We expected that if a withdrawal-related response (i.e., 'distancing' response) was given while an automatic activation of the approach motivational system by the emotion of anger occurred, slower RTs would be observed for anger-related words in comparison to fear-related words as a result of such conflicting motivational information. However, anger-related words in fact produced faster ‘distancing’ responses in the ADDT in comparison to fear-related words. Although these results may seem difficult to explain in relation to the approach-withdrawal dimension and the motivational systems, they could be accommodated if we consider the acting features associated with the approach-withdrawal dimension in anger and fear. Anger would be associated with a fight response (i.e., acting). The action pattern related to fear, in turn, would involve two distinct responses: when facing a threatening stimulus, people can produce either an active avoidance response in order to flight/escape from the threat (i.e., acting), or a passive avoidance response, like freezing, in an attempt to remain undetected by the threat (i.e., not acting) (see Cain & LeDoux, 2008; LaBar, 2016). In particular, as Valk, Wijnen, and Kret (2015, p. 1) pointed out, “whereas fearful stimuli might signal an environmental threat that requires further exploration before action, angry expressions signal a direct threat to the observer, asking for immediate action.” Therefore, anger-related stimuli might be associated with a greater tendency to act than fear-related stimuli. The results of Valk et al. (2015) support this possibility. These authors found that motor actions towards anger-related facial and corporal emotional expressions were faster than towards neutral ones, an effect that was not found for fear-related expressions. According to Valk et al., anger would partially prime an immediate reaction as a consequence of its approach motivational component (i.e., fight response); an explanation that could be termed, following the paper’s title, as the *anger-fosters-action* mechanism. Taking these results into consideration, it might be that, in our Experiment 3 (ADDT), participants responded faster to anger-related words than to fear-related words because of such a greater tendency to act associated with anger-related stimuli, regardless of the type of response (i.e., a ‘distancing’ response in this experiment). Based on the account of Valk et al. (2015), another possibility is that although fear could partially prime action by its active-withdrawal motivational component (i.e., flight/escape response), it might also slow down the response by partially priming the inhibition of action as a consequence of its passive-withdrawal motivational component (i.e., freezing response). This explanation could be termed the *fear-hinders-action* mechanism. It is worth noting that both mechanisms (i.e., a tendency to act associated with anger-related stimuli and a tendency to freeze associated with fear-related stimuli) predict the same pattern of results: anger-related stimuli would produce faster responses than fear-related stimuli. The cause is that anger would always be associated with acting, while fear would sometimes be associated with acting (active avoidance or flight/escape) and sometimes associated with not acting (passive avoidance or freezing). Future studies might usefully try to disentangle the issue of whether observed differences between fear-related words and anger-related words are due to the former or latter mechanism, or both.

There is a final point to be commented before concluding, in relation to the experimental conditions and our interpretation of the results. We selected fear-related words and anger-related words to study the contribution of the approach-withdrawal dimension to emotional word processing. Hence, we assumed that the differences that emerged between those words in the ADDT were due to the empirically-based differences between fear and anger in the approach-withdrawal dimension and their associated acting features. However, it might be argued that these two types of words differ in other aspects. On the one hand, fear-related words and anger-related words may differ, apart from in the tendency to approach or withdraw, in other emotional dimensions (e.g., potency). However, regarding our results, it is unlikely that they can be explained uniquely in terms of other emotional dimensions. The reason is that the difference between fear-related words and anger-related words only emerged when participants focused on the approach-withdrawal dimension. On the other hand, it should be noted that these two types of words are related to two distinct discrete emotions (Ekman, 1992). Recently, some studies have appeared showing that discrete emotions have a role in emotional word processing, although the effects are far from being consistent (see Briesemeister et al., 2011a, 2011b; Briesemeister et al., 2014; Briesemeister et al., 2015; Ferré, Haro, et al., 2017, for distinct patterns of findings). However, if we accept the premise that discrete emotions can be characterized as combinations of several emotional dimensions, as some authors have suggested (e.g., Mauss & Robinson, 2009, p. 211), it would make more sense to identify the emotional dimensions in which discrete emotions differ than to focus on discrete emotions per se. Future studies should explore the possible role of those additional dimensions in order to obtain a deeper understanding of the particularities of emotional word processing.

In sum, our results suggest that there is a modest contribution of the approach-withdrawal dimension to visual word processing, modulated by the type of task used. Additionally, our results add to the body of research that tries to shed some light on 'the great emotion debate' in terms of the nature of emotions that distinct emotion theories face (Lindquist, Siegel, Quigley, & Barret, 2013). Indeed, our results suggest that the two-dimensional perspective is insufficient, and that other dimensions have to be considered (Fontaine et al., 2007, Trnka, 2011). Future studies should test the relevance of the distinct proposed dimensions.

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FOOTNOTES

[1] Regarding the approach-withdrawal dimension, Davitz (1969) made explicit the differentiation of two types of approach: 'moving toward' (altruistic-constructive approach tendency) and 'moving against' (destructive approach tendency).

[2] We thank the reviewer Sebastian Schindler for this suggestion.

APPENDIX A. Words used in Experiment 1

Spanish word	English translation	Category	Condition
alfombra	carpet	N	Neutral
articulación	articulation	N	Neutral
bigote	moustache	N	Neutral
calculadora	calculator/calculating	NA	Neutral
chándal	tracksuit	N	Neutral
coleccionista	collector	NA	Neutral
corteza	crust/cortex	N	Neutral
dato	datum	N	Neutral
denominación	denomination	N	Neutral
estatura	height	N	Neutral
fragmento	fragment	N	Neutral
función	function	N	Neutral
garganta	throat	N	Neutral
hierro	iron	N	Neutral
índice	index	N	Neutral
índole	nature/character	N	Neutral
introducción	introduction	N	Neutral
localidad	locality	N	Neutral
mesilla	nightstand	N	Neutral
panza	belly	N	Neutral
parche	patch	N	Neutral
pincel	paintbrush	N	Neutral

placa	plaque/plate	N	Neutral
reglamento	regulation/rules	N	Neutral
rosario	rosary	N	Neutral
traductor	translator	NA	Neutral
tubería	pipe	N	Neutral
usuario	user	NA	Neutral
verja	gate	N	Neutral
vestíbulo	hall/lobby	N	Neutral
zona	zone/area	N	Neutral
aguijón	sting	N	Fear-related
amenaza	threat	N	Fear-related
asalto	assault	N	Fear-related
calavera	skull	NA	Fear-related
callejón	alley	N	Fear-related
chillido	screech	N	Fear-related
colisión	collision	N	Fear-related
daga	dagger	N	Fear-related
delirio	delusion	N	Fear-related
demonio	demon	N	Fear-related
diabetes	diabetes	N	Fear-related
dificultad	difficulty	N	Fear-related
dinamita	dynamite	N	Fear-related
emboscada	ambush	N	Fear-related
espanto	scariness	N	Fear-related
estallido	outbreak/burst	N	Fear-related

foso	pit	N	Fear-related
horror	horror	N	Fear-related
indecisión	indecision	N	Fear-related
interrogatorio	interrogation	N	Fear-related
inyección	injection	N	Fear-related
lanzallamas	flamethrower	N	Fear-related
mafioso	mobster	NA	Fear-related
oscuridad	darkness	N	Fear-related
pánico	panic	N	Fear-related
paralización	stoppage/paralysis	N	Fear-related
preso	prisoner	NA	Fear-related
radiactividad	radioactivity	N	Fear-related
sospechoso	suspect/suspicious	NA	Fear-related
vértigo	vertigo	N	Fear-related
vicio	vice	N	Fear-related
atasco	jam	N	Anger-related
burla	mockery	N	Anger-related
cólera	wrath	N	Anger-related
disconformidad	nonconformity	N	Anger-related
enemigo	enemy	NA	Anger-related
estupidez	stupidity	N	Anger-related
fastidio	nuisance	N	Anger-related
gamberro	rogue	NA	Anger-related
golpe	hit	N	Anger-related
imputación	imputation	N	Anger-related

incongruencia	incongruence	N	Anger-related
intranquilidad	restlessness	N	Anger-related
lucha	fight	N	Anger-related
mofa	taunt	N	Anger-related
negación	denial	N	Anger-related
ocultación	concealment	N	Anger-related
oponente	foe/opposing	NA	Anger-related
patada	kick	N	Anger-related
pellizco	pinch	N	Anger-related
portazo	door slam	N	Anger-related
prohibición	prohibition	N	Anger-related
querella	complaint	N	Anger-related
rabia	rage	N	Anger-related
retención	retention	N	Anger-related
rivalidad	rivalry	N	Anger-related
secretismo	secrecy	N	Anger-related
tardanza	tardiness	N	Anger-related
tirano	tyrant	NA	Anger-related
tráfico	traffic	N	Anger-related
venganza	revenge	N	Anger-related
victimismo	victimhood	N	Anger-related

Note. Spanish words used in Experiment 1 with their English translations, grammatical category and condition. N = noun; NA = noun-adjective.

APPENDIX B. Approach-distancing questionnaire (ADQ)

Previously to the ADDT experiment (which takes a binary response format), an approach-distancing questionnaire (which takes a graded scale response format) was elaborated. The aim was to explore if fear-related words and anger-related words are really differentiated according to participants in their motivational component (i.e., whether fear-related words are associated with withdrawal motivational tendencies [producing a 'distancing' response] and whether anger-related words are associated with approach ones [producing an 'approach' response]), as well as to explore if neutral words are not associated with any of them and if positive happiness-related words are associated with approach tendencies.

Method

Participants. The same 51 participants of Experiment 1 completed the questionnaire. The participants (45 women) were Spanish-Catalan bilinguals aged between 18-43 years (M = 21.31, SD = 3.73).

Materials. The same words used in Experiment 1 (31 neutral, 31 fear-related, 31 anger-related; see Appendix A) and the 62 positive happiness-related filler words used in Experiment 3 were included to be rated in the questionnaire.

Procedure. A questionnaire was elaborated, based on the instructions described by Citron et al. (2016, pp. 4-5) on the 'Procedure' section of their 'Study 1: explicit approach and withdrawal task' and on the definitions of 'contacting emotions', 'distancing emotions' and 'attack emotions' described by Roseman (2011, p. 437). Participants had to evaluate words in a 7-point scale that ranged from 1 (*distancing*) to 7 (*approach*), referring to the extent to which their attitude towards the word's concept/meaning would be *distancing* (increasing distance and/or reducing interaction with the stimulus in order to avoid or escape from it) or *approach* (reducing the distance and/or increasing the interaction with the stimulus, either because it is something that one wants to get or because it is something that one must confront). After the LDT of Experiment 1, participants completed the questionnaire in a quiet room in groups of four using TestMaker (Haro, 2012). They had no time limit to evaluate either each word or the entire questionnaire.

Results and discussion. The results are presented in Table B1. A one-way independent two-tailed ANOVA (with WES as a between-group factor) was conducted, and produced a significant main effect of WES, $F_2(3, 76.97) = 449.24$, $p < .001$, $\eta_p^2 = 0.91$, $BF_{10} = 1.34$ e+73. Pairwise Bonferroni corrected comparisons revealed that all the differences were significant (all *p*s < .001), with the exception of the difference between fear-related words and anger-related words (difference of 0.11, 95% CI [-0.27, 0.49]), $t_2(60) = 0.76$, $p = 1.000$, $d = 0.24$.

Table B1

Results of the approach-distancing questionnaire

Fear-related	Anger-related	Neutral	Positive / Happiness
1.95 (0.49)	2.06 (0.43)	3.82 (0.45)	5.80 (0.68)
[1.77, 2.13]	[1.90, 2.22]	[3.65, 3.99]	[5.63, 5.97]

Note. The approach-distancing questionnaire ranged from 1 (*distance*) to 7 (*approach*). The value indicated is the mean of all the stimuli in that condition, the standard deviations are in parentheses and the 95% CI are in brackets. All the values are rounded in the last decimal.

As it can be seen in Table B1, while neutral words were located more or less at the middle of the scale, positive happiness-related words were located close to the ‘approach’ endpoint and both fear-related and anger-related words were located close to the ‘distancing’ endpoint. These results suggests that neutral words are not associated with either approach or withdrawal tendencies and that positive happiness-related words are associated with approach tendencies. Moreover, they give support to the assumption that fear-related words are associated with withdrawal tendencies (Cain & LeDoux, 2008; LaBar, 2016). However, the results contradict the assumption of anger-related words being associated with 'moving against' approach tendencies (Carver & Harmon-Jones, 2009; Davitz, 1969; Harmon-Jones & Harmon-Jones, 2016): anger-related words also seem to be associated with withdrawal tendencies, as are fear-related words. A reason for this result may be the offline nature of the task. Questionnaires can be considered as an offline task because they involve a consciously influenced response based on the interpretation of one's own language (i.e., the participant would ask oneself, 'based on the meaning of that word, what I would do?'). Hence, it might be that, when filling the questionnaire, participants made their ratings by focusing on the positive/negative nature of the words, which is the most obvious aspect. In contrast, online measures are not likely to be consciously influenced, and thus they would reflect "unconscious natural language use and processing" (Veldhuis & Kurvers, 2012, p.168). Thus, an online measure (such as RTs) would be more suitable to detect differences between fear-related words and anger-related words in approach-avoidance tendencies.

APPENDIX C. Pilot experiments

Table C1

Analysis of the pilot LDT

	Analysis by participants	Analysis by items
RT	$F(2, 60) = 4.87$, $p = .011$, $\eta_p^2 = 0.14$, $BF_{10} = 4.04$	$F(2, 63) = 0.93$, $p = .400$, $\eta_p^2 = 0.03$, BF = 0.25
	$RT_{Neutral} < RT_{Fear}$ (21.60 ms, $p = .008$, $d = 0.59$)	
	$RT_{Neutral} < RT_{Anger}$ (16.33 ms, $p = .047$, $d = 0.46$)	
	$RT_{Fear} \approx RT_{Anger}$ (5.27 ms, $p = 1.000$, $d = 0.11$)	
ER	$F(2, 60) = 0.20$, $p = .819$, $\eta_p^2 < 0.01$, $BF_{10} = 0.12$	$F(2, 63) = 0.08$, $p = .927$, $\eta_p^2 < 0.01$, $BF_{10} = 0.13$

Note. Analysis of the pilot lexical decision task (LDT), which was conducted with 31 participants and 22 items per condition (they were different samples of participants and items with respect to Experiment 1). Only when the ANOVA was significant, pairwise Bonferroni corrected comparisons are reported.

Table C2

Analysis of the pilot VDT

	Analysis by participants	Analysis by items
RT	$F(1.14, 21.59) = 7.29$, $p = .011$, $\eta_p^2 = 0.28$, $BF_{10} = 16.83$	$F(2,63) = 2.35$, $p = .104$, $\eta_p^2 = 0.07$, $BF_{10} = 0.73$
	$RT_{Neutral} > RT_{Fear}$ (90.35 ms, $p = .046$, $d = 0.60$)	
	$RT_{Neutral} > RT_{Anger}$ (93.29 ms, $p = .030$, $d = 0.64$)	
	$RT_{Fear} \approx RT_{Anger}$ (2.94 ms, $p = 1.000$, $d = 0.07$)	
ER	$F(1.06, 20.17) = 19.61$, $p < .001$, $\eta_p^2 = 0.51$, $BF_{10} = 1.09$ e+5	$F(2, 34.07) = 18.07$, $p < .001$, $\eta_p^2 = 0.48$, $BF_{10} = 9.00$ e+6
	$ER_{Neutral} > ER_{Fear}$ (22.45%, $p = .001$, $d = 1.04$)	$ER_{Neutral} > ER_{Fear}$ (22.12%, $p < .001$, $d = 1.83$)
	$ER_{Neutral} > ER_{Anger}$ (21.03%, $p = .001$, $d = 0.96$)	$ER_{Neutral} > ER_{Anger}$ (20.66%, $p < .001$, $d = 1.60$)
	$ER_{Fear} \approx ER_{Anger}$ (1.43%, $p = .497$, $d = 0.32$)	$ER_{Fear} \approx ER_{Anger}$ (1.47%, $p = 1.000$, $d = 0.26$)

Note. Analysis of the pilot valence decision task (VDT), which was conducted with 20 participants and 22 items per condition (they were different samples of participants and items with respect to Experiment 2). Only when the ANOVA was significant, pairwise Bonferroni corrected comparisons are reported.

Table C3

Analysis of the pilot ADDT

	Analysis by participants	Analysis by items
RT	$RT_{Fear} > RT_{Anger}$ (15.08 ms, *p* = .037, *d* = 0.38, BF_{10} = 1.47)	$RT_{Fear} \approx RT_{Anger}$ (16.22 ms, *p* = .293, *d* = 0.32, BF_{10} = 0.47)
ER	$ER_{Fear} \approx ER_{Anger}$ (1.08%, *p* = .390, *d* = 0.15, BF_{10} = 0.26)	$ER_{Fear} \approx ER_{Anger}$ (1.26%, *p* = .587, *d* = 0.17, BF_{10} = 0.34)

Note. Analysis of the pilot approach-distancing decision task (ADDT), which was conducted with 33 participants and 22 items per condition (they were different samples of participants and items in comparison to Experiment 3).

Table 1

Definition criteria for each category of words

	Neutral	Fear-related	Anger-related	Positive happiness-related
Valence	4-6[a]	< 4	< 4	> 6
Arousal	< 5	≥ 5	≥ 5	≥ 5
Happiness	≤ 2.8	≤ 2.8	≤ 2.8	≥ 3
Sadness	≤ 2.8	≤ 2.8	≤ 2.8	≤ 2.8
Fear	≤ 2.8	≥ 3	≤ 2.8	≤ 2.8
Anger	≤ 2.8	≤ 2.8	≥ 3	≤ 2.8
Disgust	≤ 2.8	≤ 2.8	≤ 2.8	≤ 2.8

Note. Definition criteria of potential target words considering both dimensional (valence, in a range from 1 [*completely sad/negative*] to 9 [*completely happy/positive*]; arousal, in a range from 1 [*completely calm*] to 9 [*completely energized*]) and discrete (happiness, sadness, fear, anger and disgust; all of them in a range from 1 [*nothing at all*] to 5 [*extremely*]) affective variables.

[a] Both extreme values of the interval are included.

Table 2

Lexical, semantic and affective properties of the experimental stimuli in Experiment 1 (standard deviations in parentheses)

	Neutral	Fear-related	Anger-related
Valence	5.16 (0.42)	3.11 (0.51)	3.05 (0.45)
Arousal	4.53 (0.49)	6.83 (0.57)	6.72 (0.55)
Happiness	1.75 (0.39)	1.30 (0.29)	1.30 (0.23)
Sadness	1.29 (0.20)	2.26 (0.33)	2.35 (0.37)
Fear	1.28 (0.23)	3.40 (0.38)	2.35 (0.33)
Anger	1.32 (0.27)	2.23 (0.47)	3.29 (0.31)
Disgust	1.41 (0.36)	1.94 (0.50)	2.09 (0.44)
Concreteness	4.89 (1.11)	4.84 (0.97)	4.63 (0.72)
Familiarity	5.15 (0.74)	5.04 (0.76)	5.29 (0.83)
Age of acquisition	7.32 (1.86)	7.76 (1.49)	7.61 (2.00)
Logarithm of word frequency	0.73 (0.42)	0.83 (0.49)	0.66 (0.58)
Logarithm of lemma frequency	3.38 (0.59)	3.50 (0.73)	3.22 (0.98)
Number of letters	7.68 (2.43)	8.03 (2.39)	8.13 (2.55)
Number of syllables	3.13 (1.02)	3.39 (0.96)	3.26 (0.82)
Number of lexical neighbors	3.10 (5.00)	2.87 (5.17)	3.45 (5.14)
Number of HF lexical neighbors	0.65 (1.62)	0.45 (1.52)	0.68 (1.68)
OLD20	2.07 (0.58)	2.24 (0.74)	2.22 (0.81)
Bigram frequency	25016.72 (7176.34)	24255.42 (9765.30)	23342.46 (9239.50)
Trigram frequency	2822.86	2526.38	2851.68

	(1776.11)	(1796.46)	(2158.31)
Logarithm of contextual diversity	0.49 (0.32)	0.55 (0.37)	0.47 (0.43)
NL Spanish-Catalan	0.67 (0.31)	0.72 (0.24)	0.74 (0.26)

Note. The value indicated is the mean of all the words in that condition, and the standard deviations are in parentheses. All the values are rounded to the last decimal. HF = higher frequency; NL Spanish-Catalan = normalized Levenshtein distance between Spanish-Catalan translations; OLD20 = mean Levenshtein distance of the 20 closest words.

Table 3

Results of Experiment 1 (LDT)

	RT (in ms)	ER (in %)
Neutral	617.62 (93.53)	4.43 (4.49)
	[591.04, 644.20]	[3.15, 5.71]
Fear	634.74 (96.66)	6.18 (6.17)
	[607.27, 662.21]	[4.42, 7.93]
Anger	640.77 (103.98)	6.12 (4.86)
	[611.22, 670.32]	[4.74, 7.50]
Pseudowords	737.97 (109.71)	9.06 (7.48)
	[706.79, 769.15]	[6.94, 11.19]

Note. The value indicated is the mean of all the stimuli in each condition, the standard deviations are in parentheses, and the 95% CI are in brackets. All the values are rounded to the last decimal. RT = Response time; ER = Error rate.

Table 4

Results of Experiment 2 (VDT)

	RT (in ms)	ER (in %)
Neutral	873.74 (177.11) [822.86, 924.61]	21.34 (20.71) [15.40, 27.29]
Fear	796.05 (126.59) [759.69, 832.41]	4.84 (4.24) [3.62, 6.05]
Anger	789.56 (130.84) [751.97, 827.14]	4.38 (6.00) [2.66, 6.10]
Positive / Happiness	771.28 (106.81) [740.60, 801.96]	17.75 (8.60) [15.28, 20.22]

Note. The value indicated is the mean of all the stimuli in each condition, the standard deviations are in parentheses, and the 95% CI are in brackets. All the values are rounded to the last decimal. RT = Response time; ER = Error rate.

Table 5

Results of Experiment 3 (ADDT)

	RT (in ms)	ER (in %)
Fear	904.14 (196.29)	8.85 (6.86)
	[848.36, 959.93]	[6.90, 10.80]
Anger	884.61 (178.85)	7.92 (6.51)
	[833.78, 935.44]	[6.08, 9.77]
Positive / Happiness	841.50 (160.99)	8.74 (5.32)
	[795.75, 887.25]	[7.22, 10.25]

Note. The value indicated is the mean of all the stimuli in each condition, the standard deviations are in parentheses, and the 95% CI are in brackets. All the values are rounded to the last decimal. RT = Response time; ER = Error rate.