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Lack of habituation to shocking words: The attentional bias to their spatial origin is context free

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Following a suggestion made by Aquino and Arnell (2007), we assumed that the processing of emotional words is influenced by their context of presentation. Supporting this idea, previous studies using the emotional Stroop task in its visual or auditory variant revealed different results depending on the mixed versus blocked presentation of the stimuli (Bertels, Kolinsky, Pietrons, & Morais, 2011; Richards, French, Johnson, Naparstek, & Williams, 1992). In the present study, we investigated the impact of these presentation designs on the occurrence of spatial attentional biases in a modified version of the beep-probe task (Bertels, Kolinsky, & Morais, 2010). Attentional vigilance to taboo words as well as non-spatial slowing effects of these words were observed whatever the mixed or blocked design, whereas attentional vigilance to positive words was only observed in the mixed design. Together with the results from our previous study (Bertels et al., 2010), the present data support the reliability of the effects of shocking stimuli, while vigilance to positive words would only be observed in a threatening context.

Keywords: Emotion; Attention; Taboo; Emotional context; Beep-probe task; Spoken words.

Emotions are labile and liable to change. Hence, even when stimuli such as words have an intrinsic affective value, one cannot neglect the influence of the emotional context in which these words are presented. More specifically, the actually experienced or felt emotional value of a word, presented in a succession of words, may diverge to some extent from its intrinsic or average value. This point was raised by Aquino and Arnell (2007), who argued that “the context in which specific words are shown (i.e., what other words are presented when, and how often) may play a role in determining which words capture attention and for how long” (p. 434). Hence, there are reasons to suspect the conditions of presentation of the stimuli to affect the occurrence of so-called...
attentional biases. The aim of the present work was to investigate whether and how blocking versus mixing the stimuli affects the influence of emotional words on the spatial orienting of attention, using an auditory variant of the dot-probe task, the beep-probe task (Bertels, Kolinsky, & Morais, 2010).

While in mixed presentations neutral and various types of emotional stimuli (e.g., negative and positive ones) are presented in the same block of trials, in blocked presentations a single type of stimuli is presented in each block. Predictions regarding the impact of presentation design on the occurrence of attentional biases depend on the presumed origin of these effects. Some authors attribute the effects of emotional words on attention grabbing to a surprise reaction interrupting ongoing processing (Harris & Pashler, 2004). If this were the case, given that by definition no surprise effect occurs with blocked presentations, attentional biases linked to emotional words would only occur with mixed but not with blocked presentations. Other authors assume that blocked presentation of emotional stimuli might induce a congruent mood, with, for example, negative stimuli causing prolonged rumination effects (Holle, Neely, & Heimberg, 1997; Richards, French, Johnson, Naparstek, & Williams, 1992) or a change in affective state (Rutherford & Raymond, 2010). Under such a view, attentional biases to negative stimuli would be stronger in blocked than in mixed design.

Contextual effects linked to presentation design have been largely investigated using the visual emotional and taboo Stroop tasks (e.g., Holle et al., 1997; Schmidt & Saari, 2007) and, more recently, the auditory variant of these tasks (Bertels, Kolinsky, Pietrons, & Morais, 2011) and a variant of the emotional cuing paradigm in which emotional pictures served as targets (Rutherford & Raymond, 2010). Supporting the idea of a contextual influence, larger attentional biases were usually obtained with blocked than mixed presentations.

To the best of our knowledge, no study so far has examined the contextual modulation of spatial attentional biases, namely to what extent the influence of emotional words on spatial attentional orienting is modulated by the mixed versus blocked presentation design of the stimuli. Rather, in most of the studies using the dot- or beep-probe tasks that allow the investigation of such biases, stimuli were randomly mixed (but see Brosschot, de Ruiter, & Kindt, 1999).

Specifically, in Bertels et al.’s (2010) beep-probe task, positive, negative, taboo and neutral pairs of spoken words (constituted by one neutral and one positive, negative, taboo or neutral word, respectively) were mixed within the same block of trials. On critical trials, a beep was presented after the pair, in the spatial location previously occupied by either the emotional or the neutral word. Participants had to detect the beep, and they did it faster when the beep was presented at the same location as the taboo word of a pair than when it occurred at the same location as the neutral word, at least when the taboo word was right presented, revealing attentional vigilance to these words. In addition, taboo words led to a general non-spatial inhibitory effect, namely to overall longer reaction times (RTs) to beeps following taboo pairs than to beeps following other types of emotional or neutral pairs.

The present study comes within the scope of Bertels et al.’s (2010) study, and compared the attentional biases observed in the mixed and blocked designs (Experiments 1 and 2, respectively) of a modified version of their beep-probe task in which as many neutral pairs as pairs from each type of emotional pairs were presented.

Consistently with Bertels et al.’s (2010) results, attentional biases linked to taboo words as well as a general inhibitory effect of these words were expected in Experiment 1, which used a mixed presentation. If this attentional bias to taboo words were merely due to a surprise effect, one might expect it not to occur with blocked presentation (Experiment 2). Conversely, the observation of an attentional bias with blocked (Experiment 2) but not mixed (Experiment 1) presentation would suggest that this bias reflect a congruent mood effect.

Moreover, we predicted the spatial bias to occur only for right-, not left-, presented emo-
tional words. The use of binaurally presented verbal material is indeed believed to activate the left hemisphere preponderantly (Kinsbourne, 1970), favouring the occurrence of spatial attentional biases when emotional words are presented in the contralateral (i.e., right) side of space, as observed by Bertels et al. (2010).

**EXPERIMENT 1: MIXED PRESENTATIONS**

The first experiment consisted of a variant of the beep-probe task used in our previous study (Bertels et al., 2010). In that study, we attempted to follow as exactly as possible the original version of the dot-probe task (MacLeod, Mathews, & Tata, 1986), in which the probe occurred more often when an emotional word was presented in the pair than when two neutral words were presented. However, Mogg and Bradley (1998) criticised this experimental design, arguing that the presence of an emotional word might then become predictive of the occurrence of the probe. For this reason, following their recommendations, in the present study we equated the number of neutral trials with the number of trials for each emotional category, hence reducing the proportion of emotionally neutral pairs. Also, all pairs were followed by the occurrence of a beep that had to be localised as fast as possible.

**Method**

**Participants.** Participants were 24 undergraduate students of the Université Libre de Bruxelles (18 women; 2 left-handed), ranging from 18 to 24 years (Mean = 19.3). They were given course credits or were paid (seven of them) for their participation. All participants spoke French for at least 10 years.

Previous studies investigating attentional biases in the visual modality pointed to the robustness of this phenomenon only in selected groups of participants such as anxious (e.g., Mogg & Marden, 1990), repressors (e.g., Dawkins & Furnham, 1989) and depressed people (e.g., Bradley, Mogg, Millar, & White, 1995). Therefore, after the beep-probe task participants were presented with personality questionnaires assessing anxiety and depression levels (the Spielberger Trait-State Anxiety Inventory, STAI-Y; Spielberger, 1983, and the Beck Depression Inventory, BDI-II; Beck, Steer, & Brown, 1996, respectively), as well as willingness to be socially desirable (the Marlowe-Crowne Scale of Social Desirability, SDS; Crowne & Marlowe, 1960) in order to check for any correlation between these scores and the emotional effects. Table 1 displays the average scores obtained in these questionnaires.

**Material and apparatus.** Words were orally presented. They were pronounced by a French-speaking female theatre student in a neutral tone of voice and digitally recorded on a Sony MiniDisc. Stimuli were then transferred to a Macintosh Powerbook G3 via the interface Digidesign Digi 002 Rack and were cleaned and normalised with the Protools Digidesign 6.2.2. software. The mean word duration was 732 ms (SD = 131 ms).

The stimulus set consisted in 128 pairs of mono- or disyllabic words: 96 were emotional pairs, in which one of the words was emotionally charged, and 32 were neutral pairs, consisting of two emotionally neutral words. Emotional pairs included 32 positive, 32 negative and 32 taboo pairs (named in this way because the emotional word in the pair was positive, negative or taboo). These words were chosen according to control studies made on the words’ emotional valence described in Bertels et al. (2010). Statistical
analyses showed that the emotional valence, assessed on a 1 (very negative) to 7 (very positive) scale, differed between the emotional types of words, $F(2, 95) = 966.321$, $MSE = 159.901$, $p < .001$, each type differing from the others, all $R_s < .001$ (Bonferroni corrected), with negative words judged as more negative than taboo and positive words (1.975, 2.768 and 6.182, respectively). We also checked for the words’ shock value, assessed on a 1 (normal) to 5 (very taboo, shocking) scale. It differed between the emotional types of words, $F(2, 95) = 236.359$, $MSE = 38.341$, $p < .001$, each type differing from the others, $R_s < .001$ for all (Bonferroni corrected), with taboo words judged as more shocking than negative and positive words (3.35, 2.56 and 1.1875, respectively). For each pair we also calculated the difference in either emotional valence or shock value between the emotional word and its neutral associate. The effect of the type of emotional pair was significant for both emotional valence and shock value, $F(2, 95) = 433.808$, $MSE = 156.295$ and $F(2, 95) = 193.456$, $MSE = 37.466$, both $p < .001$, each type differing from all others, all $R_s < .001$ (Bonferroni corrected). For emotional valence, negative pairs led to the greatest difference, followed by taboo and positive pairs (Mean = −2.43, −1.618, and 1.738, respectively). For the shock value, taboo pairs led to the greatest difference, followed by negative and positive pairs (Mean = 2.2, 1.433 and 0.064, respectively).

Each category of emotional words was matched to the set of neutral words associated with them in a pair, according to the number of phonological neighbours, literary frequency and web frequency (cf. Lexique 2; New, Pallier, Ferrand, & Matos, 2001), the latter being crucial for taboo words given that it better reflects their frequency of use than the literary frequency. Hence, this matching ensures that attentional orienting towards the spatial location of either type of word is not due to these lexical factors. Using the same criteria, we also matched all emotional words to all neutral associated words and the two groups of neutral words constituting the neutral pairs. Finally, we matched these four sets of material. No significant difference was observed on these lexical measures at $p = .05$.

Each pair was presented diotically, namely with simultaneous presentation of the two members of a pair through lateralisued loudspeakers. Words within each pair were synchronised at their onset and offset using the Protools Digidesign 6.2.2. software. This was facilitated by the fact that words in a pair had the same syllabic structure and were uttered at a constant rate. All pairs were followed by a 100 ms beep.

**Procedure.** Participants sat in front of a computer. The two loudspeakers were situated at 45 cm on their left and right, with an anterior deviation of 60 degrees in relation to the sagittal plane. Stimulus presentation and timing as well as data collection were controlled using the Psypsych button box and 1.2.5. PPC software (Cohen, MacWhinney, Flatt, & Provost, 1993) running on a Macintosh Performa 6320.

Each session began with detailed instructions. Participants were told they would hear pairs of different words, presented simultaneously, one on the left and one on the right, and that, on each trial, a beep would be presented immediately after the pair of words, either on the left or on the right, on a 50/50 basis. The participant’s task was to localise the beep as quickly and accurately as possible by pressing the left or right key of a button box.

Each trial started with the presentation of a 750 ms fixation cross in the middle of the screen. Then, a pair of auditory words was presented. On each trial, immediately after the offset of the words, a beep was presented, at the location of one of the words. The participant had 2,500 ms to answer. The interval between the response and the next trial was 2,000 ms. Trials were pseudo-randomly presented: a beep was presented never more than three times in a row on the same presentation side and, similarly, a word of the same emotional type was presented never more than two times in a row on the same presentation side. The experiment started with a 16-trial practice block, during which participants received
feedback regarding their performance. Next, each participant was presented with two 48-trial blocks, without any feedback. Thus, a participant was presented with each pair only once insofar as assignment of a specific word to one side (e.g., “beauté–bateau” vs. “bateau–beauté”) and beep location were counterbalanced between participants.

**Results**

As errors (misses and wrong localisations) were very infrequent (0.1%, on average), the analyses focused only on RT data. Both erroneous responses and three RTs longer than 2,500 ms were excluded from further analyses. Mean correct RTs are presented in Table 2.

First, we examined non-spatial effects of emotional versus neutral words, namely whether the presence of an emotional word of a particular valence affected the response to the beep. For this purpose, a 4 (Type of Emotional Pair: neutral/negative/positive/taboo) × 2 (Beep Location: left/right) repeated-measures analysis of variance (ANOVA) was applied on RTs. The effect of Type of Emotional Pair was significant, $F(3, 69) = 26.59, MSE = 18,645.613, p < .01$, and Beep Location, $F(1, 23) = 6.39, MSE = 15,367.088, p < .025$, both reflecting the same differences as in the previous analysis. The interaction between beep location and emotional word location was significant, $F(1, 23) = 25.72, MSE = 8,640.404, p < .01$. Interestingly, it was part of a three-way interaction between Type of Emotional Pair, Beep Location and Emotional Word Location, $F(2, 46) = 3.54, MSE = 1,738.062, p < .05$.

To further examine this interaction, we analysed separately the results for each type of emotional pair. The interaction between beep location and emotional word location was significant for taboo and positive pairs, $F(1, 23) = 16.45, MSE = 6,908.599$, and $F(1, 23) = 16.77, MSE = 5,172.366$, both $p < .01$, but not for negative pairs, $F < 1$. For taboo pairs, the interaction between beep location and emotional word location reflected the fact that, for right-presented

<table>
<thead>
<tr>
<th>Type of emotional pair</th>
<th>Neutral</th>
<th>Negative</th>
<th>Positive</th>
<th>Taboo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beep Left</td>
<td>340 (11)</td>
<td>332 (11)</td>
<td>329 (10)</td>
<td>354 (12)</td>
</tr>
<tr>
<td>Emotional word Left</td>
<td></td>
<td>334 (9)</td>
<td>339 (11)</td>
<td>367 (11)</td>
</tr>
<tr>
<td>Emotional word Right</td>
<td>330 (11)</td>
<td>320 (12)</td>
<td>332 (12)</td>
<td>353 (13)</td>
</tr>
<tr>
<td>Beep Right</td>
<td></td>
<td>319 (10)</td>
<td>312 (10)</td>
<td>332 (15)</td>
</tr>
<tr>
<td>Emotional word Left</td>
<td></td>
<td>326 (9)</td>
<td>328 (10)</td>
<td>351 (11)</td>
</tr>
<tr>
<td>Emotional word Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>335 (10)</td>
<td>326 (9)</td>
<td>328 (10)</td>
<td>351 (11)</td>
</tr>
</tbody>
</table>
taboo words, participants localised right-presented beeps faster that left-presented beeps, $p = .005$. There was no difference when the taboo word was left presented, $p > .10$ (see Figure 1a, dotted line). A similar effect was observed for positive pairs: the beep was localised faster when it was right presented than when it was left presented only when the positive word was right presented, $p = .001$, not when it was left presented, $p > .10$ (see Figure 1b, dotted line). These attentional biases linked to taboo (35 ms) and positive (27 ms) words did not differ significantly from each other, $p > .10$. They were not correlated with any of the scores on the personality questionnaires (for taboo words: STAI-state: $r = .16$, STAI-trait: $r = .15$, BDI-II: $r = -.17$, SDS: $r = .02$, all $p > .10$; for positive words: STAI-state: $r = .27$, $p > .10$, STAI-trait: $r = .39$, $p = .06$, BDI-II: $r = .12$, $p > .10$, SDS: $r = -.02$, $p > .10$).

We tried to determine the origin of the observed spatial biases, namely if these biases reflect attentional vigilance towards the right-presented taboo or positive words, or if they reflect difficulties in disengaging attention from the spatial location where these stimuli were presented. Koster, Crombez, Verschuere, and De Houwer (2004) suggested that facilitation of congruent trials would reflect attentional vigilance, namely facilitated attentional engagement to emotional words, whereas interference in incongruent trials would indicate difficulties in disengaging attention from these words. In order to distinguish between facilitation and interference effects, one needs a baseline. Koster et al. (2004) suggested using RT on neutral trials with this aim, but this was strongly criticised (Mogg, Holmes, Garner, & Bradley, 2008). Indeed, non-spatial effects of emotional words (such as the interference effects of taboo words observed in the present experiment) might contaminate any RT difference between congruent or incongruent (emotional) trials and neutral trials. Given that in the present study attentional biases were only observed when taboo and positive words were right presented, we rather used as a baseline the average RTs on congruent and incongruent trials observed when the emotional words were left presented (see Bertels et al., 2010, for a similar procedure).

For both taboo and positive pairs, RTs on congruent trials (emotional word right/beep right) were shorter than RTs on trials in which the emotional word was left presented, taboo: 332 vs. 353 ms, $t(23) = 2.83$, $p = .02$; positive: 312 vs. 330 ms, $t(23) = 3.28$, $p < .01$ (Bonferroni corrected). RTs on incongruent trials (emotional word right/beep left) did not differ from RTs on trials in which the emotional word was left presented, taboo: 366 vs. 353 ms, $t(23) = 1.7$, $p > .10$; positive: 339 vs. 330 ms, $t(23) = 1.56$, $p > .10$ (see Figure 1a and 1b, solid lines).

**Discussion**

As predicted, we observed an attentional bias towards right-presented taboo words: a beep following a right-presented taboo word was localised faster when it was presented in the congruent than in the incongruent location. Interestingly, RTs on these congruent trials were shorter than RTs on beeps following left-presented taboo words. This suggests attentional vigilance towards taboo words rather than difficulties in disengaging from them. Also, taboo words generated a general, non-spatial effect: whatever the location of the taboo word in the pair and the location of the following beep, RTs on beeps following taboo pairs were longer than RTs on beeps following the other pair types. These data thus replicate results from our previous study (Bertels et al., 2010).

Participants were also particularly vigilant to positive words when these were right presented. The fact that we equated the number of neutral trials with the number of trials for each emotional category following Mogg and Bradley’s (1998) recommendation might be crucial to explain this unexpected effect of positive words. As a matter of fact, this modified the emotional context: whereas only one sixth of the trials contained a word evaluated as emotionally negative (i.e., negative or taboo) in our previous study (Bertels et al., 2010), negatively valenced words occurred in half of the trials in the present study. Hence, being especially
Figure 1. Target localisation latencies observed in Experiment 1, as a function of the emotional word and beep locations, for taboo (a) and positive (b) pairs, respectively.
vigilant to positive words could be a way of restoring a kind of emotional homeostasis: when the emotional context is considered as threatening, participants would need to focus on positive trials. In line with this idea, Gotlib, McLachlan, and Katz (1988) showed that non-depressed people display a positive bias, which makes them attend to manic-content words when they are presented with depressed-content ones.

EXPERIMENT 2: BLOCKED PRESENTATIONS

Method

Participants. Participants were 48 undergraduate students of the Université Libre de Bruxelles (38 women; 4 left-handed), ranging from 17 to 47 years (Mean = 21.5). They were given course credits or were paid (16 of them) for their participation. All participants spoke French for at least the last 10 years. Average scores on three personality questionnaires evaluating anxiety and depression levels as well as willingness to be socially desirable are displayed in Table 1.

Material and apparatus. Material and apparatus were the same as in Experiment 1.

Procedure. The procedure was the same as in Experiment 1, except that pairs of words of the same emotional valence were presented by blocks. Hence, each participant was presented with four 32-trial blocks: one negative (containing negative pairs), one positive (containing positive pairs), one taboo (containing taboo pairs) and one neutral block (containing neutral pairs). As in Experiment 1, a participant was presented with each pair only once insofar as assignment of a specific word to one side, beep location and block order were counterbalanced between participants.

Results

Errors (misses and wrong localisations) were rare, 0.68% on average. Therefore, as in the former experiment the analyses focused on RT data only. RTs on erroneous trials were excluded from further analyses. Table 3 displays the mean correct RTs.

As in the former experiment we first examined if the presence of an emotional word of a particular valence affected the RTs to the beep, using a 4 (Type of Emotional Pair) × 2 (Beep Location) repeated-measures ANOVA. The only significant factor was Type of Emotional Pair, \( F(3, 141) = 11.23, \text{MSE} = 12,096.799, p < .001 \). Bonferroni adjusted post hoc comparisons revealed that overall taboo pairs led to significantly longer RTs than negative, neutral and positive pairs, respectively, all \( p < .001 \). No other comparison was significant, all \( p > .10 \).

The same effect was observed in the 3 (Type of Emotional Pair) × 2 (Beep Location) × 2 (Emotional Word Location) repeated-measures ANOVA, \( F(2, 94) = 13.9, \text{MSE} = 31,555.006, p < .001 \). The effect of Emotional Word Location was also significant, \( F(1, 47) = 5.23, \text{MSE} = 2,532.25, p < .05 \); participants localised the beep faster when the emotional word was right presented (299 ms) than when it was left presented (304 ms).

<table>
<thead>
<tr>
<th>Beep and emotional word locations</th>
<th>Neutral</th>
<th>Negative</th>
<th>Positive</th>
<th>Taboo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Left</td>
<td>295 (6)</td>
<td>301 (6)</td>
<td>297 (7)</td>
<td>317 (8)</td>
</tr>
<tr>
<td>Emotional word Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional word Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef Right</td>
<td>292 (6)</td>
<td>297 (7)</td>
<td>289 (7)</td>
<td>321 (7)</td>
</tr>
<tr>
<td>Emotional word Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional word Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>293 (6)</td>
<td>296 (6)</td>
<td>292 (6)</td>
<td>316 (7)</td>
</tr>
</tbody>
</table>
The predicted interaction between Type of Emotional Pair, Beep Location and Emotional Word Location was significant, $F(2, 94) = 3.65$, $MSE = 1,796.467$, $p < .05$. Considering each type of emotional pair separately, we found the interaction between Beep Location and Emotional Word Location to be significant for taboo pairs, $F(1, 47) = 10.1$, $MSE = 5,144.916$, $p < .005$, but not for negative or positive pairs, both $F$s $< 1$. For right-presented taboo words, participants localised the beep faster by 17 ms when it was also right presented than when it was left presented, $p < .001$ (Bonferroni corrected). No difference between RTs on right- or left-presented beeps was found when the taboo word was left presented, $p > .10$ (see Figure 2a, dotted lines). The bias for right-presented taboo words was not correlated with any of the scores on the personality questionnaires (STAI-state: $r = .22$, STAI-trait: $r = .001$, BDI-II: $r = -.09$, SDS: $r = -.14$, all $ps > .10$).

As in the previous experiment, we compared RTs on congruent and incongruent taboo trials when these were right presented to RTs on trials in which a taboo word was left presented, whatever the beep location. Congruent trials led to shorter RTs than trials in which a taboo word was left presented (305 vs. 319 ms), $t(47) = 3.402$, $p < .005$ (Bonferroni corrected). No difference was observed with incongruent trials (322 vs. 319 ms), $t < 1$ (see Figure 2a, solid lines).

**Discussion**

Attentional biases towards right-presented taboo words were observed in the present experiment, replicating results from Experiment 1 and from Bertels et al. (2010).\(^1\) Hence, whatever the mixed or blocked presentation and whatever the proportion of emotionally negative (i.e., negative or taboo) words presented during the experiment, participants were particularly vigilant to taboo words, arguing against the idea that these biases are primarily due to a surprise effect. Non-spatial interference effects of these words were also replicated.

However, using blocked presentations of the emotional pairs, contrary to what happened with the mixed presentation of Experiment 1, no attentional bias was observed anymore for positive words (see Figure 2b). Results from a cross-experiments one-way ANOVA on the attentional biases linked to right-presented positive words corrected for the difference in RT between experiments revealed that these biases differed significantly between Experiments 1 and 2, $F(1, 71) = 4.572$, $MSE = 0.06$, $p < .05$. This is in accordance with the idea that the vigilance to positive words observed in the first experiment was linked to the threatening emotional context in which the words were presented.

**GENERAL DISCUSSION**

In the present study, we investigated how attention to taboo and other emotional words is affected by whether these words are blocked together or, instead, mixed with each other as well as with non-emotional words. Indeed, whereas some authors have suggested that surprise would be crucial for the occurrence of attentional biases to emotional words (Harris & Pashler, 2004), others have proposed that the blocked presentation of emotional stimuli elicits stronger effects by inducing a congruent mood (e.g., Richards et al., 1992). Coherently with the idea of such contextual effects, several studies have reported that the interference effects observed for negative and taboo words in both visual and auditory modalities are largely influenced by the homogeneity of these

\(^1\) Obviously, attentional biases linked to right-presented taboo words observed in Experiment 1 were twice as large as the ones observed in Experiment 2 (35 vs. 17 ms, respectively), which was probably related to the fact that the average RTs were significantly longer in Experiment 1 than in Experiment 2 (335 vs. 299 ms, respectively), $F(1, 71) = 11.955$, $MSE = 20,274.297$, $p = .001$. However, the relative size of the effect did not differ significantly across experiments, as revealed by the comparison of the attentional biases linked to right-presented taboo words in Experiments 1 and 2 when corrected for overall RT difference (i.e., using the attentional bias divided by the average RT for each participant as the dependant variable of a cross-experiments one-way ANOVA), $F(1, 71) = 2.985$, $MSE = 0.05$, $p > .05$.  

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Figure 2. Target localisation latencies observed in Experiment 2, as a function of the emotional word and beep locations, for taboo (a) and positive (b) pairs, respectively.
emotional words within the same block (e.g., Bertels et al., 2011; Rutherford & Raymond, 2010; see Phaf & Kan, 2007, for a review of visual emotional Stroop studies). In the present study, contextual effects were investigated using the beep-probe task (Bertels et al., 2010). While in Experiment 1, negative, positive, taboo and neutral pairs were mixed in the same blocks of trials, in Experiment 2 they were presented by blocks.

Consistent with our predictions, general non-spatial effects of taboo words as well as attentional biases to these words were observed with mixed presentations, replicating results from Bertels et al. (2010). Moreover, participants were particularly vigilant to positive words. Using blocked presentations, the only effects that were significant were those associated with taboo words in Experiment 1.

Consistent with Bertels et al.’s (2010) findings, attentional biases in both experiments were only observed when emotional words were right, but not left presented. As argued in the previous paper, this laterality effect is most probably due to the joint influence of two attentional mechanisms, a “hemispheric” and an “emotional” one. First, as shown by Demakis and Harrison (1994), both neutral and affective words are mainly or more efficiently processed by the left hemisphere, at least when the emotional content of the word is irrelevant to the task. Moreover, according to Kinsbourne’s (1970) theory, the presentation of verbal material would prime the left hemisphere, leading to an orientation bias to the contralateral hemifield. Second, an emotional word would catch more attentional resources than its paired neutral word, thus activating to a greater extent the hemispheric contralateral to its side of presentation. The combination of these two mechanisms favours the processing of a right-sided beep preceded by a right-sided presented emotional word (see Bertels et al., 2010, for a more thorough discussion of this laterality effect and its evolutionary relevance).

The effects of taboo words will be discussed first. Afterwards, we will consider the attentional bias towards positive words observed with mixed but not with blocked presentations.

Robust spatial and non-spatial effects of taboo words

Both general inhibitory effects of taboo words and attentional biases to these words were observed in Experiments 1 and 2. Indeed, when a taboo pair was presented, relative to other types of pairs, participants localised the beep slower, whatever its spatial location. In addition, when taboo words were right presented, participants localised the beep faster in congruent than in incongruent trials. Interestingly, these congruent taboo trials led to shorter RTs than trials in which the taboo word was left presented (whatever the beep location), supporting the idea that attentional biases to taboo words are due to attentional vigilance to these words followed by an engagement of attention to the position where they were presented.

Crucially for our present concern, these effects of taboo words were observed in both mixed and blocked presentations. Given that by definition no surprise effect occurs with blocked presentations, these results argue against the idea that the effects of taboo words only depend on their unexpected shocking value. Rather, their outrageous nature would elicit attentional disturbances regardless of prior knowledge of their content. Coherently with these results, Aquino and Arnell (2007) observed the attention-grabbing effects of sexually explicit words for over 100 trials, whereas there was no effect of threatening words. Also, in a recent event-related potential (ERP) study, Carmen Pastor et al. (2008) reported increased attention and orienting prompted by erotic pictures that was unaffected by the mixed versus blocked presentation. Hence, spatial and non-spatial influences of taboo stimuli seem to be rather robust phenomena, depending neither on attentional load (Bertels et al., 2010) nor on contextual effects linked to the presentation conditions of the stimuli.

Attentional biases to positive words depend on the emotional context

We observed attentional biases to right-presented positive words with mixed presentation of the stimuli (Experiment 1), an effect that was no
longer observed when pairs were presented by blocks (Experiment 2). Similarly to what occurred for taboo words, these attentional biases reflected attentional vigilance to positive words.

The most probable explanation for the observation of such isolated effects, namely attentional bias towards positive words in Experiment 1 but not in Bertels et al. (2010), probably lies in contextual effects. In particular, a contextual effect specific to the mixed presentation of stimuli could be responsible for these diverging patterns of results. As a matter of fact, the only difference between the experimental designs used in Bertels et al.’s study and in the first experiment of the present study consisted in the proportion of emotional trials. Indeed, as we mentioned in the introduction to Experiment 1, we wanted to palliate to Mogg et al.’s (1998) criticisms regarding the fact that, in the original version of the attentional deployment task (used in Bertels et al., 2010), the probe occurred more often after an emotional than after a neutral pair. Hence, in the present study, to tally the best with the version they proposed, a beep was presented on each trial and the number of neutral pairs was equated with the number of each type of emotional pair. By doing this we increased the proportion of emotional (negative, positive and taboo) pairs from one to three quarters. Crucially for our argumentation, given that both negative and taboo pairs could be considered as threatening, this probably created a particularly frightening emotional context within the mixed presentation. This context would have induced participants to be vigilant for positive words in Experiment 1. Consistent with this idea, in a study in which most of the pairs were considered as threatening, Gotlib et al. (1988) observed that non-depressed participants attended more to manic-content words than to depressed- and neutral-content words, which these authors later called a positive bias (McCabe & Gotlib, 1995). Thus, a particularly threatening emotional context may be necessary for an attentional bias to positive words to occur in healthy participants. Coherently with this idea, vigilance for positive words was not observed with blocked presentations.

The potential weight of the emotional context may also be related to the notion of emotional homeostasis (Cannon, 1935): to maintain no net change in their emotional state, participants would develop a vigilant checking mode in order to protect themselves from threat or negative feelings and hence to feel better by lowering anxiety. According to Damasio (1999, 2003), emotions are part of homeostatic regulation. One of their functions is to regulate the internal state of the organism in order to prepare it to react efficiently to a situation. Specific events trigger specific emotions, according to learning processes, and these emotions give information on the past experiences of the organism. Emotions would thus be useful to know if one’s attention has to be allocated to an object or, on the contrary, if it has to be redirected. Following this idea, the threatening context of the modified version of the attentional deployment task used in Experiment 1 may have provoked negative emotions, triggering a homeostatic process to regulate the anxiety linked to this situation, which would result in participants becoming particularly vigilant for positive words. Thus, in addition to hidden physiological processes, cognitive homeostatic processes would have taken place.

Similarly, attentional vigilance towards positive words could be explained through the notion of emotion regulation, which refers to the processes by which we assess, control, and modify our spontaneous emotional responses in order to achieve goals (Luminet, 2002). Indeed, recent emotion regulation theory assumes attentional deployment to be a major mechanism of emotion regulation (Gross & Thompson, 2007). Attentional vigilance to positive words in a threatening context might thus be considered as such an emotion regulation strategy.

In these circumstances, it is not surprising that no effect of negative, non-taboo words was observed in the present study. As a matter of fact, the threatening context would not only be responsible for the occurrence of attentional biases to positive words, but also for the absence of attentional biases to negative words. Indeed, the threatening nature of negative words would not
pop out in this context, contrary to the outrageous nature of taboo words. Rather, participants would rapidly habituate to negative words, although some surprise effect would be necessary to lead to negatively biased adaptive vigilance (Harris & Pashler, 2004). The fact that no attentional bias to negative words was observed with blocked presentations is consistent with this idea.

Obviously, the effect of the threatening emotional context might be considered as a kind of “mood effect”, similar to the one expected with blocked presentations. However, rather than leading to a “congruent mood effect” eliciting attentional biases towards emotional stimuli congruent with the induced mood, the present mood effect would lead to attentional biases to stimuli of the opposite emotional valence.

To conclude, spatial and non-spatial effects of spoken taboo words were observed whatever the mixed or block presentations of the stimuli, suggesting that effects of taboo words are not only due to a surprise reaction. By contrast, spatial attentional vigilance to positive words was only observed with mixed presentations. We argue that the latter effect only develops when the overall emotional context is considered as threatening.

REFERENCES


