Análise Psicológica (2024), 42 (2): 141-154 doi: 10.14417/ap.2145

Valence word processing in preference *vs.* lexical decision tasks: Insights from muscle blocking procedures

Gonçalo Aires Oliveira* / Ana Domingos** / Teresa Garcia-Marques*

* ISPA – Instituto Universitário, William James Center for Research, Lisboa, Portugal; ** ISPA – Instituto Universitário, Lisboa, Portugal

Abstract: Processing is oriented by goals that determine the details of the stimuli to be attended. Previous studies claim that the determination of word valence (neutral, positive, or negative) is prioritized at early processing stages. This effect of immediate processing of affective information is supported by behavioral and psychophysiological evidence. Here we address this primacy of affect hypothesis in word processing by performing different blocking procedures on the facial muscles relevant for processing the affective dimension of the stimuli on preference (Experiment 1) and lexical decision tasks (Experiment 2). The results show that not only evaluative judgments were disturbed by blocking procedures, but that the same result occurred when the affective information was irrelevant to the task. Evidence shows similar interference from blocking facial muscle activity on affective word processing in both experiments, with procedures that immobilize the zygomatic muscle having a greater impact on the processing of positive words. We discuss the informative role of demonstrating these effects as occurring regardless of the processing goal, highlighting different patterns associated with the various blocking procedures.

Keywords: Affect, Processing goals, Embodiment, Muscle blocking.

Processing goals are the specific objectives or purposes individuals have when they engage in information processing. These goals influence how people attend to, interpret (see Aarts, 2012; Higgins, 1996), and remember information (e.g., Craik & Lockhart, 1972; Hamilton et al., 1989). Moreover, they can also shape the way individuals evaluate stimuli (Custers & Aarts, 2003; Moran et al., 2015) and make choices (Klaczynski et al., 1997; Laran, 2010). However, while many instances of information processing are driven by specific goals, not all processing is clearly goal oriented. In fact, there are several types of processing that seem to occur without a clear, deliberate goal, or where goals are less consciously defined, as it seems to be when the target of processing is affective information.

Affective reactions can occur spontaneously and without specific goals directing individuals to attend to the affective nature of the context (Zajonc, 1980). These affective reactions seem to occur independently of, and even prior to, the perceptual and cognitive processes typically thought to underlie stimuli evaluations. Furthermore, it has been suggested that these reactions are the first assessment of a percept, having primacy over its "cognitive processing", requiring only primitive stimulus analysis (see Peretz et al., 1998; Zajonc, 1980). This primacy of affect suggests that the affective system, which evaluates stimuli in terms of emotional valence (e.g., "Is this word good

Correspondence concerning this article should be addressed to: Gonçalo Aires Oliveira, ISPA – Instituto Universitário, William James Center for Research, Rua Jardim do Tabaco, 34, 1149-041 Lisboa, Portugal. Email: GOliveira@ispa.pt

or bad?"), operates separately and somewhat independently from the cognitive system, which focuses on identifying and categorizing stimuli (e.g., "Is this a word or not?"). This independence hypothesis is supported by neurophysiological and psychological research (see Damasio, 1994; LeDoux, 1996; Murphy & Zajonc, 1993; Zajonc, 2000). The argument that affect is likely primary in the information-processing chain is empirically supported by the fast activation of affective information (LeDoux, 1996; Murphy & Zajonc, 1993). This was corroborated by Murphy and Zajonc (1993) who subliminally exposed participants to either emotional faces or geometric shapes before they evaluated a set of unfamiliar, ambiguous stimuli (Chinese ideographs). In this experiment, only the affective stimuli influenced differently the evaluative judgments at a similar extension as a sub and supraliminal longer exposure. This finding, along with other studies (e.g., Bargh et al., 1989; Edwards, 1990; Hermans et al., 1996; Klauer, 1997), lends support to the hypothesis that the affective aspects of the stimuli are prioritized. Interestingly, these effects seem to extend to the processing of words, even when the goal is not focused on their affective dimension or evaluation. For instance, emotional words more likely to be remembered in recall tasks (Anooshian & Hertel, 1994; Ferré et al., 2009), and when semantic decisions are required affective words are better identified then neutral words (Eviatar & Zaidel, 1991; Kousta et al., 2009). Moreover, affect slows down colour processing latencies relatively to neutral words in affective Stroop task (more clearly for negative words; MacKay et al., 2004; see Bar-Haim et al., 2007; Fernandes et al., 2021). Together, these affective effects corroborate the view that word processing is impacted by the 'early' mechanism of attentional capture (e.g., Gaillard et al., 2006; Kousta et al., 2009) or the primacy of affect (Zajonc, 1980) which is assumed to be independent of processing goals.

However, some studies challenge the idea of a primacy of affect. The processing advantage of affect applied only to positive words, not negative ones in a lexical decision task (e.g., Chen et al., 2015; Kissler & Koessler, 2011; MacKay et al., 2004) and this was supported by EEG data (Kanske & Kotz, 2007). Moreover, Crossfield and Damian (2021) used a mouse tracking technique to analyse the development of a lexical decision response and reported a processing advantage for positive words over negative and neutral words, and no evidence of affect modulation on an emotional Stroop effect. These studies suggest that the specific objectives or purposes that individuals have when engaging in information processing, may increase or decrease the relevance of processing the affective features of the stimuli. Furthermore, other evidence suggests that different brain areas are involved in processing valence dependent on processing goals. For instance, Cunningham et al. (2005) identified that the frontal LPP was differently sensitive to the valence of the stimulus being processed, depending on the explicitness of the evaluative judgements. Behavioral data (e.g., Braticco et al., 2005; Mandler & Shebo, 1983) corroborates the dissociation in stimuli processing when the goal is to report liking versus the correctness of stimuli and that the processing goals may moderate the effect of propositional versus associative information on automatic evaluation (Moran et al., 2015). Overall, this research suggests that although we may observe by default the primacy of affect, this could result from the automatic activation of an evaluative processing goal (see Ferguson, 2008), upon which our survival depends (Lang et al., 1990; Mergen & Kuruoglu, 2017).

Here, we propose to contribute to the clarification of the role of the processing goal in processing the affective dimension of the stimuli by relying on the engagement of facial muscle feedback in assessing the affective nature of a stimuli.

Facial muscle feedback

Facial muscle feedback plays an important role in perceiving the emotional, or affective, nature of stimuli (e.g., Damasio, 1994; Decety & Jackson, 2004; Gallese, 2011; Niedenthal, Barsalou, Ric et al., 2005; Niedenthal, Barsalou, Winkielman et al., 2005) and has shown to be causally involved in the perception of others facial expression of emotions (Niedenthal et al., 2001) and emotion words concepts (Niedenthal et al., 2009). These experiments suggest that smiling while observing a positive stimulus can intensify the perception of it being pleasant, while frowning may amplify the sense of negativity when exposed to something aversive. Supposedly this muscle activation occurs because emotional concepts are represented by these body expressions (Barsalou, 1999). Congruent evidence can be found in Havas et al. (2007). In this study, participants judged whether a sentence described a pleasant or unpleasant situation, while holding a pen in their mouth, in a way that mimicked or inhibited smiling. The results suggest that smiling mimicry facilitated the comprehension of pleasant events, while the smile inhibition condition sped up the understanding of unpleasant events.

Critically, none of these studies using facial muscle blocking procedures showed evidence of its interference on a lexical decision task. This makes it relevant to examine the role of processing goals on the processing of valenced stimuli by preventing the use of facial muscles during the task. Different blocking procedures are known to reduce the somatic feedback that supports the construct activation, affecting the participants' accuracy or reaction time. Importantly, these blocking procedures selectively target different groups of facial muscles and seem to interfere with the responses to different emotions (Oberman et al., 2007). Below, we address these differences.

Hold a pen in the mouth with its tip out – We will refer this as the Strack procedure since it was first referred to in the Strack et al. (1988) paper. Instructions ask participants to hold a pen in the mouth with its tip out of the mouth, pressing with lips and preventing teeth from touching it. This procedure was originally expected to inhibit smiling and lowered the funniness ratings of a set of cartoons. The lips position has been assumed to suppresses the smile by engaging the *orbicularis oris* muscle, leading to lower EMG activity in the *zygomaticus major* and potentially increased activity in the *orbicularis or*is (Ekman et al., 1971; Ekman & Friesen, 1978; Hjortsjö, 1970; Izard, 1971; Soussignan, 2002). However, this is not without controversy since EMG evidence (see Oberman et al., 2007) suggest that this procedure promotes a pattern of facial muscle activation close to relaxation, having no differential activation of any muscle (*levator, zygomaticus, orbicularis oris or buccionator*).

Hold a pen horizontally *in the mouth with the lips (preventing teeth to touch it)* – We will refer this as the Niedenthal procedure (see Maringer et al., 2011). EMG evidence (Domingos, 2012) found support for the assumption that it interferes with the activation of lower face muscles, since it activates the *zygomaticus* usually associated with happy displays (Ekman et al., 1971; Ekman & Friesen, 1978; Hjortsjö, 1970; Izard, 1971). Congruently, Niedenthal et al. (2009; Experiment 3) found the procedure to selective impair the accuracy of judging joy words, as emotional.

*Hold a pen horizontally in the mouth exerting an active pressure with teet*h *(preventing lips to touch it)* – We will refer to this as the Oberman procedure (see Oberman et al., 2007). EMG evidence (Domingos, 2012; Oberman et al., 2007) suggests that the procedure exerts blocking through the hyperactivation of the *zygomaticus*. One possible criticism of this procedure is that it promotes a facial expression highly similar to a smile, as it raises the lip corners. This can be assumed to semantically prime the concept of "happiness". However, congruently with a blocking assumption, this manipulation has been shown to inhibit, instead of facilitating, the perception of happy faces (decreasing the accuracy of identifying them). In addition, evidence suggests that the blocking procedure is selective and does not impair the recognition accuracy of any other emotion.

The two procedures that promote hyperactivation of the *zygomatic* are expected to induce difficulties in the detection of positive features of stimuli, but not the negative ones. These procedures should promote different patterns of response than the Strack procedure. Although EMG evidence (Oberman et al., 2007) suggest that the Strack procedure is likely to promote results similar to a free mimicry condition, on the basis of Strack et al. (1988) behavioral data it is also likely that the procedure will lower the preference of positive words. However, and more relevant to our hypothesis, we will only expect these procedures to impact the judgments of valence vs neutral words, and of positive and negative words if muscle activity feedback plays a role in the processing of affective information. Moreover, if processing goals interfere with the primacy of affect, we expect that the pattern of results defined above to be clearer when the processing goal is to report preference compared to when participants must make a lexical decision.

Overview of experiments

The two experiments shared the same protocol and materials, varying only in the type of judgment requested to the participants. In Experiment 1, participants performed a preference task in which they were asked to evaluate how much they liked or not liked each single word or non-word presented on a computer screen. In Experiment 2, participants performed a lexical decision task (word or not a word) with the same material. Words were selected from Garcia Marques' (2003) valence and familiarity norms (evaluated on a 7-point scale). The materials used in both experiments were 40 positive words, 40 negative words, and 40 neutral words, selected from Garcia Marques' (2003) valence and familiarity norms (evaluated on a 7 point scale).

An equivalent number of abstract and concrete words were selected, all with low linguistic frequency (between 0 and 48) and low level of familiarity (above the mid-point of the scale M=3.91; SD=.95) ratings. Both lists had 40 evaluated as highly positive (above P_{75}=5.06) and 40 evaluated as highly negative (below P_{25}=3.31), In the remaining central percentiles we chose the 40 most neutral words ranging from 3.50 and 4.50.

A total of forty-five non-words neutral in valence and familiarity and with no relationship with any of the words to be presented were selected from Domingos and Garcia-Marques' (2008) and mixed in the list (Table 1).

Table 1

Mean valence and familiarity as a function of type of string

	Valence		Familiarity	
	Mean	*SD*	Mean	*SD*
Negative	2.04	.43	4.50	.60
Positive	5.47	.37	4.63	.61
Neutral	3.79	.21	3.59	.90
Nonword	3.68	.20	3.03	.52

General procedure

In both studies, participants were asked to evaluate different types of verbal stimuli. Upon arrival, participants were given a new pen and informed that they were going to place it in their mouths in different positions during the study. They were also informed that they should carefully read all the instructions given on screen, including the position of the pen. Participants then completed the experimental task in all four mimicry blocking conditions (orders were counterbalanced): Niedenthal et al. (2001), Oberman et al. (2007), Strack et al. (1988), and free mimicry. Each experimental condition was illustrated with a photo (Figure 1) and a written instruction: “hold the pen in the mouth sideways both with your teeth and lips”; “hold the pen in the mouth sideways only with your lips, do not use your teeth”; “hold the pen with its tip out of the mouth, exclusively with the lips, and preventing the teeth to touch it”.

Both experiments followed a within-subjects design defined by the factors Blocking (Niedenthal, Oberman, Strack, Free mimicry) and String of letters (Neutral, Positive, Negative). The nonwords stimuli was used as a filler and therefore not analysed. We have a conducted a power analysis in G*Power 3.0 following the validation article (Faul et al., 2007) instructions for within-subjects designs, which estimated N=13 as the minimum sample size for f=.25 and power=.80. All participants received credits in return for their collaboration.

Figure 1. Blocking procedures: A) Oberman et al. (2007); B) Niedenthal et al. (2001); C) Strack et al. (1988)

Experiment 1: Preference judgments

Participants and design

Seventeen (71% women) undergraduate students from the researchers’ institution with ages ranging from 18 to 42 years (M=22.65; SD=7.71), were randomly assigned to the experimental within-subjects design defined above.

Procedure

In this experiment, participants were informed that they should attend to a string of letters that could either be a word or non-word and express their preference for each of stimulus. In this task, participants were instructed to press as quickly as possible, the “L” key if they “like” the string or “S” if they “don’t like” the string (keys were reversed for half of the participants). Reaction times were recorded for all the responses.

Before debriefing, participants were asked about their perceived association between each facial posture and a particular emotion (a list of emotions were provided with “no association” as a possible response).

Results and discussion

Preference

To check if the blocking procedures interfered with the perception of stimulus valence, we calculated the proportion of responses matching preference with positive words and no-preference with negative words. Proportions were arcsine transformed to meet the normality assumptions of the ANOVA. Data is reported in the original scale to facilitate its' interpretation. Matching judgments were lower for negative words (M=.30; SD=.05) compared to positive words [M=.78; SD=.04; $F(1,16)=41.33$; $p<.001$; $\eta_p^2=0.72$], suggesting that participants were more likely to express preference for negative words than a no-preference for a positive word.

We have also found a blocking main effect, $F(3,48)=6.19$; $p=.001$; $\eta_p^2=0.28$, suggesting that blocking interfered with the preference judgments. All blocking procedures ($M_{\text{Niedenthal}}$=.52; SD=.04; M_{Strack}=.48; SD=.04; M_{Oberman}=.54; SD=.05) promoted less matching judgments, than the free mimicry condition [M=.62; SD=.04; $t(16)=3.75$; $p=.002$; d=.94]. No significant difference was detected between the blocking procedures, $t(16)<1$.

A marginal blocking x valence interaction, $F(3,48)=2.23$; $p=.096$; $\eta_p^2=.12$, seemed to occur because all blocking procedures reduced the preference for positive words ($M+$=.75; SD=.04; $M+_{\text{Niedenthal}}$=.76; SD=.04; $M+_{\text{Oberman}}$=.72; SD=.07; $M_{\text{Strack}}+$=.75; SD=.04) compared to the free mimicry condition ($M+$=0.89; SD=.03; $M-$=0.35; SD=0.08; all $ps<.05$). But only Niedenthal ($M-_{\text{Niedenthal}}$=.20; SD=.06; $M-_{\text{Oberman}}$=.36; SD=.07; $M-_{\text{Strack}}$=-.28; SD=.07) reduced the proportion of no-preference for negative words, $t(16)=2.09$; $p=.05$; d=.52.

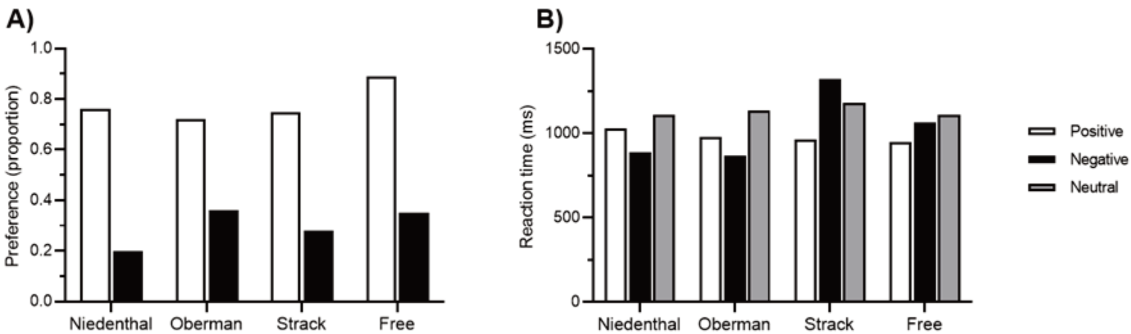

Figure 2. Preference task Mimicry x Valence interaction for: A) Preference to positive words and no-preference for negative words; B) Reaction times of the judgement of preference

Reaction times

To test the effect of the blocking procedures on preference judgment RT, we performed a mixed ANOVA 4 (blocking manipulations) x 3 (Neutral words *vs.* Positive words *vs.* Negative words) on the log-transformed RT's means (three missing data were substituted by means of their conditions, to not lose power in the analysis. Means will be presented in the original scale for interpretability). The main effect of the valence, $F(2,32)=6.79$; $p=.003$; $\eta_p^2=.30$) suggested that the two sets of valenced words were evaluated faster than the neutral [$M+$=939; SD=25; $M-_e$=1037; SD=54; M_n=1134; SD=59; $t(16)=3.18$; $p=.006$; d=.80]. No significant main effect of blocking procedures were found, $F(3,48)=1.49$; $p=.226$; $\eta^2_p=.09$.

The blocking procedures qualified the valence effect, $F(6,96)=7.64$; $p<.000$; $\eta_p^2=.32$. The free mimicry condition was used as a baseline to understand the effects. In this condition, we have found RT differences between neutral (M_n=1109; SD=75) and positive words [$M+$=783; SD=22; $t(16)=6.73$; $p<.001$; d=1.69], but no with negative words ($M-$=1067; SD=51; $t<1$). However, no such difference occurred for the conditions where the *zygomatic* was blocked; participants were slower on positive words compared to negative [$M_{\text{Niedenthal}}+$=1031; SD=45; $M_{\text{Niedenthal}}-$=890; SD=40; $M_{\text{Oberman}}+$=980; SD=39; $M_{\text{Oberman}}-$=869; SD=40; $t(16)=3.27$; $p<.004$; d=.82] and the specific blocking procedures did not qualified the effect ($t<1$). Only the Strack's procedure condition, where the *zygomatic* was not blocked, we find that the evaluation of negative words (M_{Strack}-=1324; *SD*=168) was slower than the positive words [M_{Strack}+=962; *SD*=54; $t(16)=2.50$; $p<.023$; $d=.63$]. This specific blocking procedure show the same pattern and not significantly differences from the free condition, $t<1$. No significant differences between blocking conditions were found for neutral words (M_{Strack}=1180; *SD*=125; *SD*=.01; $M_{Niedenthal}$=1112; *SD=55*; $M_{Oberman}$=1136; *SD*=89; M_{Free}=1109; *SD*=75; all contrasts show *t*s<1).

Testing for semantic interfere of procedures: Perceived association to an emotion

Because blocking procedures could be argued to induce semantic priming effects themselves by differently activate the concept of a positive or a negative emotion, we further analysed the perceived association of the three blocking procedures with an emotion.

The Niedenthal's procedure was not perceived to be associated with any emotion by 82% of the participants (the remaining 18% associated to a negative emotion), Oberman's procedure was associated by 76% of participants to a positive emotion (18% associated it with a negative emotions and 6% didn't associate to any emotion) and Stracks' procedure promoted an ambiguous display (41% of participants report no association, 35% an association with negative emotions and 24% to a positive emotions). These results suggest that only the Oberman's procedure effects would be able to be confounded with a semantic priming, turning the alternative semantic priming explanations unreliable.

Experiment 2: Lexical decision task

Participants and design

Fifteen participants (93.34% women) of ISPA – Instituto Universitário, and with ages ranging from 18 to 48 years (*M*=24.20; *SD*=8.85), were randomly assigned to the experimental within participants' design defined in the general procedure.

Procedure

In this experiment, participants were asked to perform a lexical decision task with the same material. As in Experiment 1, the response keys were "S" and "L" if the stimulus was judged to be a "word" or a "nonword", respectively. Response keys were reversed for half of the participants.

Results and discussion

Accuracy

To understand if the blocking procedures interfered with lexical decisions of different stimulus valence, we calculated the proportion of correct lexical identifications of positive and negative words in each experimental condition. Although the two sets of valenced words did not differ significantly between themselves ($t<1$), both of them (*M*+=.95; *SD*=0.01; *M*-=.96; *SD*=0.01) were better identified than neutral words [*M*=.92; *SD*=0.012; $F(2,34)=4.42$; $p=.019$; $\eta_p^2=.21$]. A main effect for the blocking conditions occurred, because the Strack procedure promoted lower accuracy

[M_{Strack}=.92; *SD*=.01; $M_{Niedenthal}$=.94; *SD*=.01; $M_{Oberman}$=.95; *SD*=.009; M_{Free}=.96; *SD*=.009; $F(3,51)=3.23$; $p=.029$; $\eta_p^2=.16$].

The valence effect was qualified by the blocking procedures, $F(6,102)=4.50$; $p<.001$; $\eta_p^2=.21$. As illustrated in Figure 3, only the Niedenthal procedure followed the same pattern of the free condition. The Oberman's procedure results turn the identification of negative words worse than neutral and positive words and the Strack procedure eliminate differences based on valence.

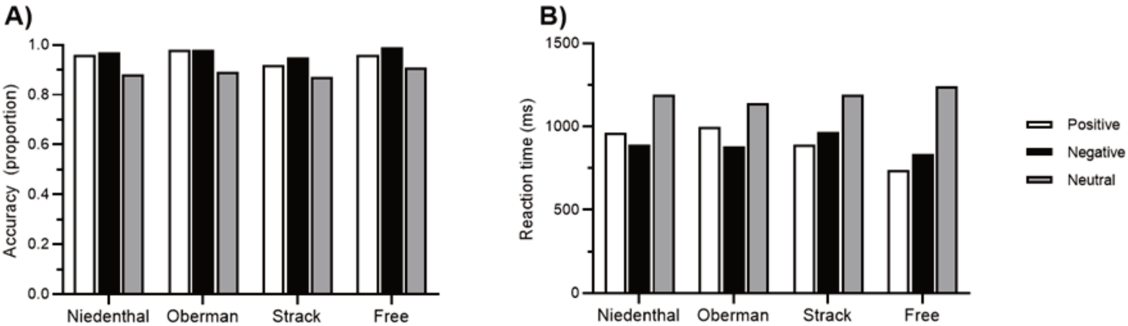

Figure 3. Lexical decision task Mimicry x Valence interaction for: A) Accuracy; B) Reaction times

Reaction times

A within-subjects ANOVA 4 (Blocking conditions) x 3 (Neutral words *vs.* Positive words *vs.* Negative words) was performed on log-transformed RT of correct responses (raw data are presented for interpretation). Valence impacted RTs, $F(2,34)=34.27$; $p<.001$; $\eta_p^2=.67$, only because decisions on positive words (M+=899; *SD*=42); and negative words (M-=894; *SD*=42) were faster than on neutral words [M_n=1252; *SD*=84; $t(14)=6.28$; $p<.001$; $d=1.68$].

Blocking conditions in general did not produce different RTs [$M_{Niedenthal}$=1038; *SD*=645; $M_{Oberman}$=1023; *SD*=57; M_{Strack}=1040; *SD*=58; M_{free}=958; *SD*=56; $F(3,51)=1.97$; $p=.130$; $\eta_p^2=.10$]. However, conditions qualified the valence effect, $F(6,102)=5.16$; $p=.001$; $\eta_p^2=.23$. Although neutral words were classified at the same speed in all experimental conditions (all *ts*<1) the same did not occurred for valenced words. Figure 3 shows that valence effects were equally for the Strack and the free mimic condition, and equal for the Niedenthal and Oberman's conditions, although the two set differ between them. Whereas in the first two conditions participants were faster responding to positive words, in the second two conditions, where the zygomatic is blocked, they were faster I identified as a word a negative word.

General discussion

In these experiments, we have tested if different facial muscle blocking procedures interfered with the primacy of affect in word processing when the affective dimension of the stimuli was necessary to meet the task goals (Experiment 1) and when it was irrelevant to the task (Experiment 2). Our results suggest that the primacy of processing affective information can be disrupted in both situations. This effect is likely to result from our blocking procedures interference with the facial muscle feedback associated with emotional expressions, thereby altering the access and relevance of the affective dimension of the stimuli.

The evidence suggests that participants were less influenced by the affective nature of the stimuli when the facial muscle activity that supports its apprehension was blocked. Importantly, this effect occurred when the affective information was relevant for task performance (Experiment 1) and when it was not relevant (Experiment 2). More efficient responses were found for affective stimuli compared to neutral, and valence impacted accuracy and response latencies on preference judgments and lexical decisions. The results on Experiment 1 supports the hypothesis that blocking facial muscles interferes with preference judgments, as previously shown (Havas et al., 2007; Niedenthal et al., 2001, 2009). However, on Experiment 2, we provide the first data suggesting that this type of interference also occurs on a lexical decision task. This evidence implies that the blocking effect previously identified in the literature does not seem to depend on the processing goals of the task.

Together, these experiments indicate that the affective experiencing in processing the information interferes with access to affective information and that the role of affect in facilitating information processing is independent upon processing goals. These effects likely to result from the influence of the affective dimension of the stimuli that occurs at the early stages of information processing, as proposed by the affect primacy hypothesis. Moreover, it is possible that this occurs before participants have access to the semantic nature of the stimuli, which could in fact be facilitated by the affective dimension of the stimuli. This interpretation of the results match ERP evidence suggesting that there are two phases of information processing eliciting two different emotion-related ERP components: an early posterior negativity (EPN) that typically starts 150-200 after stimulus onset and a late positive complex (LPC) system that occurs at a later stage of information processing (around 300ms). The first component refers to a reflect a reflex-like allocation of visual attention, enhancing the sensory encoding of the stimuli and the selection of relevant information for further processing (Potts & Tucker, 2001; Rellecke et al., 2011). The later provide access to the significance of the stimuli (Schacht & Sommer, 2009; Schupp et al., 2000). Interestingly, both ERPs have been found in tasks that do not require overt decisions based on the emotional valence of the words, suggesting that valence is automatically processed independent of task demands (Herbert et al., 2006; Kissler et al., 2009), which further supports our claims. Although some research suggest that the effect of emotional valence occurs only after the onset of the lexicality effect (Kissler et al., 2007, 2009; Schacht & Sommer, 2009), the data of our experiments by suggesting the independence of processing goal, is likely more akin to research showing as likely a pre-semantic detection of the emotional properties of the stimuli (ex., Rellecke et al., 2011; Scott et al., 2009).

Across the two experiments, we have also found consistent differences between the blocking procedures, suggesting that they could be mapping distinct valence effects (differences between processing positive and negative words relative to each other). The two procedures known to block the zygomatic, Oberman's and Niedenthal's, contrasted with how the Strack and the free mimic condition, impacted the valence effect. When the zygomatic is blocked, participants were faster both when evaluating and identifying a negative word as a word, compared to positive words. When the facial muscles were generally more relaxed (Strack procedure) or free, the opposite effect occurred and participants were faster responding to positive words than to negative words. On this matter, the results associated with response accuracy were less informative. While in Experiment 1 all blocking procedures elicited a general reduction of accuracy (matching), in Experiment 2 the effects on accuracy were highly dependent of the blocking procedure being used. The Niedenthal procedure followed the same pattern of the free condition, while Oberman's procedure impaired the identification of negative words compared to neutral and positive words and the Strack procedure eliminated the differences based on valence. The disparity of these results should be further investigated as they illustrate that there could be other underlying differences in the blocking procedures and their effects.

In conclusion, in these experiments we report that interfering with facial muscle feedback during the processing of valenced words impacts information processing independently of the task goals and adds corroborating evidence to the primacy of effect hypothesis and to the causal role of facial embodiments in valence processing. This finding nicely extends the previous evidence for the involvement of facial expressions in emotion processing (Niedenthal et al., 2001; Oberman et al., 2007) to a context where valence is not a relevant dimension of the stimuli to attend to.

Funding

This work is funded with national funds from FCT – Fundação para a Ciência e Tecnologia, I.P., in the context of the project SFRH/BD/28950/2006 award to the second author and the UID/04810/2020, award to the first and third authors.

Authors contribution

Conceptualization: AD, TGM; Data curation: AD, TGM; Writing – Original draft: AD, TGM; Writing – Review and edit: GO, TGM.

All the authors read and approved the final manuscript.

References

Aarts, H. (2012). Goals, motivated social cognition and behavior. In S. T. Fiske & C. N. Macrae (Eds.), *The SAGE handbook of social cognition* (pp. 75-79). SAGE Publications Inc.

Anooshian, L. J., & Hertel, P. T. (1994). Memory for emotional and neutral words. *Memory & Cognition, 22*(2), 169-180. https://doi.org/10.3758/BF03202708

Bar-Haim, Y., Lamy, D., & Reuveni, A. (2007). Attentional bias for threat in the dot-probe paradigm: A meta-analysis. *Psychological Bulletin, 133*(1), 32-64. https://doi.org/10.1037/0033-2909.133.1.32

Bargh, J. A., Chen, M., & Burrows, L. (1989). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology, 62*(2), 219-230. https://doi.org/10.1037/0022-3514.62.2.219

Barsalou, L. W. (1999). Perceptions of perceptual symbols. *Behavioral and Brain Sciences, 22*(4), 637-638. https://doi.org/10.1017/S0140525X99002079

Brattico, E., Kuusi, T., & Tervaniemi, M. (2005). Brain mechanisms of musical chord categorization are modulated by expertise. In B. G. Bara, L. Barsalou, & M. Bucciarelli (Eds.), *Proceedings of the Annual Meeting of the Cognitive Science Society*. Cognitive Science Society.

Chen, P., Lin, J., Chen, B., Lu, C., & Guo, T. (2015). Processing emotional words in two languages with one brain: ERP and fMRI evidence from Chinese-English bilinguals. *Cortex, 71*, 34-48. https://doi.org/10.1016/j.cortex.2015.06.002

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11*(6), 671-684. https://doi.org/10.1016/S0022-5371(72)80001-X

Crossfield, E., & Damian, M. F. (2021). The role of valence in word processing: Evidence from lexical decision and emotional Stroop tasks. *Acta Psychologica, 218*, 103359. https://doi.org/10.1016/j.actpsy.2021.103359

Cunningham, W. A., Espinet, S. D., DeYoung, C. G., & Zelazo, P. D. (2005). Attitudes to the right-and left: Frontal ERP asymmetries associated with stimulus valence and processing goals. *NeuroImage, 28*(4), 827-834. https://doi.org/10.1016/j.neuroimage.2005.04.044

Custers, R., & Aarts, H. (2003). On the role of processing goals in evaluative judgments of environments: Effects on memory-judgment relations. *Journal of Environmental Psychology*, *23*(3), 289-299. https://doi.org/10.1016/S0272-4944(02)00076-2

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain*. Putnam.

Decety, J., & Jackson, P. L. (2004). The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews, 3*(2), 71-100. https://doi.org/10.1177/1534582304267187

Domingos, A. (2012). *The impact of blocking the activation of facial muscles in the processing of subsequent emotional information, and its mechanism*. [Doctoral thesis, Ispa – Instituto Universitário]. Repositório do Ispa – Instituto Universitário. http://hdl.handle.net/10400.12/1739

Domingos, A., & Garcia-Marques, T. (2008). Normas de valência e familiaridade de "não-palavras" portuguesas. *Laboratório de Psicologia, 6*(1), 49-74.

Edwards, K. (1990). The interplay of affect and cognition in attitude formation and change. *Journal of Personality and Social Psychology, 59*(2), 202-216. https://doi.org/10.1037/0022-3514.59.2.202

Ekman, P., & Friesen, W. V. (1978). *Facial action coding system (FACS): A technique for the measurement of facial actions*. Consulting Psychologists Press.

Ekman, P., Friesen, W. V., & Tomkins, S. S. (1971). Facial affect scoring technique: A first validity study. *Semiotica, 3*(1), 37-58. https://doi.org/10.1515/semi.1971.3.1.37

Eviatar, Z., & Zaidel, E. (1991). The effects of word length and emotionality on hemispheric contribution to lexical decision. *Neuropsychologia, 29*(5), 415-428. https://doi.org/10.1016/0028-3932(91)90028-7

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. https://doi.org/10.3758/BF03193146

Ferguson, M. J. (2008). On becoming ready to pursue a goal you don't know you have: Effects of nonconscious goals on evaluative readiness. *Journal of Personality and Social Psychology, 95*(6), 1268-1294. https://doi.org/10.1037/a0013263

Fernandes, A., Garcia-Marques, T., Prada, M., & Martins, J. (2021). Emotional interference in isolation and in others' presence. *Current Psychology, 40*, 5783-5792. https://doi.org/10.1007/s12144-019-00534-0

Ferré, P., García, T., Fraga, I., Sánchez-Casas, R., & Molero, M. (2009). Memory for emotional words in bilinguals: Do words have the same emotional intensity in the first and in the second language?. *Cognition and Emotion*, *24*(5), 760-785. https://doi.org/10.1080/02699930902985779

Gaillard, R., Del Cul, A., Naccache, L., Vinckier, F., Cohen, L., & Dehaene, S. (2006). Nonconscious semantic processing of emotional words modulates conscious access. *Proceedings of the National Academy of Sciences of the United States of America, 103*(19), 7524-7529. https://doi.org/10.1073/pnas.0600584103

Gallese, V. (2011). Embodied simulation theory: Imagination and narrative. *Neuropsychoanalysis*, *13*(2), 196-200. https://doi.org/10.1080/15294145.2011.10773675

Garcia-Marques, T. (2003). Avaliação da familiaridade e valência de palavras concretas e abstractas em língua portuguesa. *Laboratório de Psicologia, 1*(1), 21-44.

Hamilton, D. L., Driscoll, D. M., & Worth, L. T. (1989). Cognitive organization of impressions: Effects of incongruency in complex representations. *Journal of Personality and Social Psychology*, *57*(6), 925-939. https://doi.org/10.1037/0022-3514.57.6.925

Havas, D. A., Glenberg, A. M., & Rinck, M. (2007). Emotion simulation during language comprehension. *Psychonomic Bulletin & Review, 14*, 436-441. https://doi.org/10.3758/BF03194085

Herbert, C., Kissler, J., Junghöfer, M., Peyk, P., & Rockstroh, B. (2006). Processing of emotional adjectives: Evidence from startle EMG and ERPs. *Psychophysiology, 43*(2), 197-206. https://doi.org/10.1111/j.1469-8986.2006.00385.x

Hermans, D., De Houwer, J., & Eelen, P. (1996). Evaluative decision latencies mediated by induced affective states. *Behaviour Research and Therapy, 34*(5-6), 483-488. https://doi.org/10.1016/0005-7967(96)00017-4

Higgins, E. T. (1996). Knowledge activation: Accessibility, applicability, and salience. In E. T. Higgins & A. Kruglanski (Eds.), *Social Psychology: Handbook of basic principles* (pp. 133-168). Guilford Press.

Hjortsjö, C. H. (1970). *Man's face and mimic language*. Studentlitteratur.

Izard, C. E. (1971). *The face of emotion*. Appleton-Century-Crofts.

Kanske, P., & Kotz, S. A. (2007). Concreteness in emotional words: ERP evidence from a hemifield study. *Brain Research*, *1148*, 138-148. https://doi.org/10.1016/j.brainres.2007.02.044

Kissler, J., Herbert, C., Peyk, P., & Junghofer, M. (2007). Buzzwords: Early cortical responses to emotional words during reading. *Psychological Science*, *18*(6), 475-480. https://doi.org/10.1111/j.1467-9280.2007.01924.x

Kissler, J., Herbert, C., Winkler, I., & Junghofer, M. (2009). Emotion and attention in visual word processing: An ERP study. *Biological Psychology*, *80*(1), 75-83. https://doi.org/10.1016/j.biopsycho.2008.03.004

Kissler, J., & Koessler, S. (2011). Emotionally positive stimuli facilitate lexical decisions: An ERP study. *Biological Psychology*, *86*(3), 254-264. https://doi.org/10.1016/j.biopsycho.2010.12.006

Klaczynski, P. A., Gordon, D. H., & Fauth, J. (1997). Goal-oriented critical reasoning and individual differences in critical reasoning biases. *Journal of Educational Psychology, 89*(3), 470-485. https://doi.org/10.1037/0022-0663.89.3.470

Klauer, K. C. (1997). Affective priming. *European Review of Social Psychology*, *8*(1), 67-103. https://doi.org/10.1080/14792779643000083

Kousta, S. T., Vinson, D. P., & Vigliocco, G. (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, *112*(3), 473-481. https://doi.org/10.1016/j.cognition.2009.06.007

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. *Psychological Review, 97*(3), 377-395. https://doi.org/10.1037/0033-295X.97.3.377

Laran, J. (2010). The influence of information processing goal pursuit on postdecision affect and behavioral intentions. *Journal of Personality and Social Psychology, 98*(1), 16-28. https://doi.org/10.1037/a0017422

LeDoux, J. (1996). Emotional networks and motor control: A fearful view. *Progress in Brain Research, 107*, 437-446. https://doi.org/10.1016/S0079-6123(08)61880-4

MacKay, D. G., Shafto, M., Taylor, J. K., Marian, D. E., Abrams, L., & Dyer, J. R. (2004). Relations between emotion, memory, and attention: Evidence from taboo Stroop, lexical decision, and immediate memory tasks. *Memory & Cognition, 32*, 474-488. https://doi.org/10.3758/BF03195840

Mandler, G., & Shebo, B. J. (1983). Knowing and liking. *Motivation and Emotion, 7*, 125-144. https://doi.org/10.1007/BF00992897

Maringer, M., Krumhuber, E. G., Fischer, A. H., & Niedenthal, P. M. (2011). Beyond smile dynamics: Mimicry and beliefs in judgments of smiles. *Emotion, 11*(1), 181-187. https://doi.org/10.1037/a0022596

Mergen, F., & Kuruoglu, G. (2017). A comparison of Turkish-English bilinguals' processing of emotion words in their two languages. *Eurasian Journal of Applied Linguistics*, *3*(2), 89-98. https://doi.org/10.32601/ejal.460969

Moran, T., Bar-Anan, Y., & Nosek, B. A. (2015). Processing goals moderate the effect of co-occurrence on automatic evaluation. *Journal of Experimental Social Psychology*, *60*, 157-162. https://doi.org/10.1016/j.jesp.2015.05.009

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality and Social Psychology, 64*(5), 724-739. https://doi.org/10.1037/0022-3514.64.5.724

Niedenthal, P. M., Barsalou, L. W., Ric, F., & Krauth-Gruber, S. (2005). Embodiment in the acquisition and use of emotion knowledge. In L. F. Barrett, P. M. Niedenthal, & P. Winkielman (Eds.), *Emotion and consciousness* (pp. 21-50). The Guilford Press.

Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, and emotion. *Personality and Social Psychology Review, 9*(3), 184-211. https://doi.org/10.1207/s15327957pspr0903_1

Niedenthal, P. M., Brauer, M., Halberstadt, J. B., & Innes-Ker, Å. H. (2001). When did her smile drop? Facial mimicry and the influences of emotional state on the detection of change in emotional expression. *Cognition & Emotion*, *15*(6), 853-864. https://doi.org/10.1080/02699930143000194

Niedenthal, P. M., Winkielman, P., Mondillon, L., & Vermeulen, N. (2009). Embodiment of emotion concepts. *Journal of Personality and Social Psychology, 96*(6), 1120-1136. https://doi.org/10.1037/a0015574

Oberman, L. M., Winkielman, P., & Ramachandran, V. S. (2007). Face to face: Blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience*, *2*(3-4), 167-178. https://doi.org/10.1080/17470910701391943

Peretz, I., Gaudreau, D., & Bonnel, A. M. (1998). Exposure effects on music preference and recognition. *Memory & Cognition, 26*(5), 884-902.

Potts, G. F., & Tucker, D. M. (2001). Frontal evaluation and posterior representation in target detection. *Cognitive Brain Research*, *11*(1), 147-156. https://doi.org/10.1016/S0926-6410(00)00075-6

Rellecke, J., Palazova, M., Sommer, W., & Schacht, A. (2011). On the automaticity of emotion processing in words and faces: Event-related brain potentials evidence from a superficial task. *Brain and Cognition*, *77*(1), 23-32. https://doi.org/10.1016/j.bandc.2011.07.001

Schacht, A., & Sommer, W. (2009). Time course and task dependence of emotion effects in word processing. *Cognitive, Affective, & Behavioral Neuroscience*, *9*(1), 28-43. https://doi.org/10.3758/CABN.9.1.28

Schupp, H. T., Cuthbert, B. N., Bradley, M. M., Cacioppo, J. T., Ito, T., & Lang, P. J. (2000). Affective picture processing: The late positive potential is modulated by motivational relevance. *Psychophysiology*, *37*(2), 257-261. https://doi.org/10.1111/1469-8986.3720257

Scott, G. G., O'Donnell, P. J., Leuthold, H., & Sereno, S. C. (2009). Early emotion word processing: Evidence from event-related potentials. *Biological Psychology*, *80*(1), 95-104. https://doi.org/10.1016/j.biopsycho.2008.03.010

Soussignan, R. (2002). Duchenne smile, emotional experience, and autonomic reactivity: A test of the facial feedback hypothesis. *Emotion, 2*(1), 52-74. https://doi.org/10.1037/1528-3542.2.1.52

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology*, *54*(5), 768-777. https://doi.org/10.1037/0022-3514.54.5.768

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*(2), 151-175. https://doi.org/10.1037/0003-066X.35.2.151

Zajonc, R. B. (2000). Feeling and thinking: Closing the debate over the independence of affect. In J. P. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 31-58). Cambridge University Press.

Processamento da valência das palavras em tarefas de preferência *vs.* decisão lexical: Insights dos procedimentos de bloqueio muscular

Resumo: O processamento é orientado por objetivos que determinam os detalhes dos estímulos a serem atendidos. Estudos anteriores indicam que a determinação da valência das palavras (neutra, positiva ou negativa) é priorizada nas etapas inicias do processamento. Este efeito do processamento imediato da informação afetiva é apoiado por evidências comportamentais e psicofisiológicas. Neste artigo, abordamos a hipótese da primazia do afeto no processamento de palavras, através da realização de diferentes procedimentos de bloqueamento dos músculos faciais relevantes para o processamento da dimensão afetiva dos estímulos em tarefas de preferência (Experiência 1) e decisão lexical (Experiência 2). Os resultados mostram que não apenas os julgamentos avaliativos foram prejudicados pelos procedimentos de bloqueamento, mas que o mesmo resultado ocorreu quando a informação afetiva era irrelevante para a tarefa. A evidência sugere uma interferência semelhante do bloqueio da atividade dos músculos faciais no processamento de palavras afetivas em ambas as experiências, sendo que os procedimentos que imobilizam o músculo zigomático têm um impacto maior no processamento de palavras positivas. Discutimos o papel informativo de mostrar que esses efeitos ocorrem independentemente do objetivo de processamento, destacando os diferentes padrões associados aos vários procedimentos de bloqueamento.

Palavras-chave: Afeto, Objetivos de processamento, Corporalização, Bloqueamento muscular.

Submitted: 24/10/2024 *Accepted:* 29/10/2024