Received: 27 April 2017 | Revised: 25 December 2017 | Accepted: 2 January 2018
DOI: 10.1111/psyp.13067

ORIGINAL ARTICLE

WILEY PSYCHOPHYSIOLOGY SPR SOCIETY FOR PSYCHOPHYSIOLOGICAL RESEARCH

Loser! On the combined impact of emotional and person-descriptive word meanings in communicative situations

Lana Rohr | **Rasha Abdel Rahman**

Department of Psychology, Humboldt-Universität zu Berlin, Berlin, Germany

Correspondence
Lana Rohr or Rasha Abdel Rahman, Humboldt-Universität zu Berlin, Rudower Chaussee 18, 12489 Berlin, Germany.
Email: lana.rohr@hu-berlin.de; rasha.abdel.rahman@hu-berlin.de

Funding information
German Research Council (grant AB 277/5) to R. A. R.

Abstract

Humans have a unique capacity to induce intense emotional states in others by simple acts of verbal communication, and simple messages such as *bad* can elicit strong emotions in the addressee. However, up to now, research has mainly focused on general emotional meaning aspects and paradigms of low personal relevance (e.g., word reading), thereby possibly underestimating the impact of verbal emotion. In the present study, we recorded ERPs while presenting emotional words differing in word-inherent person descriptiveness (in that they may or may not refer to or describe a person; e.g., winner vs. sunflower). We predicted stronger emotional responses to person-descriptive words. Additionally, we enhanced the relevance of the words by embedding them in social-communicative contexts. We observed strong parallels in the characteristics of emotion and descriptiveness effects, suggesting a common underlying motivational basis. Furthermore, word-inherent person descriptiveness affected emotion processing at late elaborate stages reflected in the late positive potential, with emotion effects found only for descriptive words. The present findings underline the importance of factors determining the personal relevance of emotional words.

KEYWORDS

communication, descriptive words, emotional words, ERPs

1 | INTRODUCTION

Humans have a unique capacity to induce intense emotional states in others by simple acts of verbal communication. For instance, with short utterances as "hands up," "well-done," or "bitch," we can elicit strong emotions of fear, pride, or insult in the addressee. However, verbal messages may vary considerably in their potential significance to the listener or reader. Particularly, emotional words have been shown to be preferentially processed as they may convey highly relevant information (e.g., Lang, 1995; Lang, Bradley, & Cuthbert, 1998). Yet, even within this class of preferentially processed verbal stimuli, there are systematic differences in the degree to which the words transport messages that may be directly relevant for the listener by being, for example, socially evaluative.

In the present study, we investigate with EEG-derived ERPs whether the power of emotional words to induce affective responses can be enhanced by manipulating their significance as meaningful messages that are directly and personally relevant for the addressee. We did so by contrasting emotional (and neutral) person-descriptive words with words that are in this sense not person descriptive. Specifically, we presented nouns and adjectives that can potentially refer to or describe a person (e.g., bitch, colleague, competent, etc.) while nondescriptive words cannot (e.g., war, table, lucrative, etc.). Thus, person-descriptive words (referred to as descriptive words in the following) are highly relevant in the sense that they can potentially describe and evaluate a person and may directly relate to the listener or reader. In contrast to many other studies on effects of personal relevance (see below), our stimuli do not contain individual (e.g., biographical) information matched for each participant. Instead, we presented identical stimuli to all participants that generally refer to or describe persons and their possible attributes.

 © 2018 Society for Psychophysiological Research

Furthermore, we did not present context words (e.g., *my* vs. *his* car) to mark personal relevance and instead manipulated this factor as an item-inherent feature, allowing clearer conclusions about the time course of personal relevance effects than contextual manipulations (for details, see below).

Finally, person-descriptive words are words that may be encountered frequently in the context of social situations and can refer to other persons or to the listener/reader. To enhance the impression of direct communication and evaluation, the words were presented in the context of short video sequences showing a speaker uttering the words. Indeed, recent studies by Schindler and colleagues (Schindler, Wegrzyn, Steppacher, & Kissler, 2014, 2015) have demonstrated that the mere belief of being socially evaluated strongly affects the emotional impact of words, and Rohr and Abdel Rahman (2015) have demonstrated that effects of emotional words are boosted in communicative situations (i.e., when directly communicated by a speaker).

Our definition of descriptiveness by itself is independent of emotional valence. However, descriptiveness and emotion should be intimately related in that they bear potential intrinsic relevance and capture attention. Indeed, personal relevance seems to vary on dimensions that have been linked predominantly to emotion, namely, valence and arousal. Studies that varied the personal relevance of stimuli by their presentation context reported increasing arousal levels and stronger valence ratings for stimuli embedded in relevant contexts compared to the identical stimuli presented in less relevant conditions (e.g., Bayer, Ruthmann, & Schacht, 2017; Fields & Kuperberg, 2012; Herbert, Herbert, Ethofer, & Pauli, 2011; Rohr & Abdel Rahman, 2015). However, while valence and/or arousal may systematically vary with descriptiveness, this factor is determined by whether or not words can potentially refer to or describe a person and may thus be directly relevant for the addressee, and is therefore distinct from emotion.

Concerning stimuli that relate to the individual recipient such as own name/own objects (Miyakoshi, Nomura, & Ohira, 2007), the perceiver's own face (Tacikowski & Nowicka, 2010), or autobiographical facts (Gray, Ambady, Lowenthal, & Deldin, 2004; Tacikowski & Nowicka, 2010), recent evidence suggests strong parallels in the processing of emotional and personally relevant stimuli. They are better remembered (e.g., Herbert, Pauli, & Herbert, 2011), capture attention automatically, and affect early stages of sensory perception (e.g., Fields & Kuperberg, 2012) and late elaborate processing (e.g., Fields & Kuperberg, 2012, 2015a; Gray et al., 2004; Tacikowski & Nowicka, 2010). Thus, in line with our discussion above, it has been suggested that emotion and personal relevance relate to similar mechanisms of motivated attention (Gray et al., 2004; Schindler et al., 2015; Tacikowski & Nowicka, 2010).

As mentioned above, recent studies have established personally relevant contexts by preceding discourse information, verbal markers, or the presentation contexts (e.g., Bayer et al., 2017; Fields & Kuperberg, 2012, 2015a; Herbert, Herbert et al., 2011; Herbert, Pauli, & Herbert, 2011; Rohr & Abdel Rahman, 2015; Schindler et al., 2014, 2015; Wieser et al., 2014). For instance, Herbert and colleagues (Herbert, Herbert et al., 2011; Herbert, Pauli, & Herbert, 2011) presented visual emotional words preceded by attributes such as *my*, *the*, or *his/her*, and observed enhanced emotional responses in ERPs only at late elaborate processing stages, but not at earlier stages. Likewise, when emotional words are embedded in sentences that may or may not provide a personally relevant context, interactions between emotion and personal relevance at later processing stages have been reported (Fields & Kuperberg, 2012, 2015a). To our knowledge, all studies on interactions between emotion and personal relevance in word processing manipulated relevance by tasks or words or text passages preceding the target, whereas emotional meaning is typically an item-inherent feature. As a consequence, top-down triggered expectations and context-induced effects prior to the onset of the critical word may contribute to relevance, but not to emotion effects, complicating direct comparisons. Furthermore, until now only few studies have crossed emotion and personal relevance in word processing using implicit tasks instead of explicit classifications, even though, arguably, implicit processing of emotional verbal messages may be more natural than (manual) classifications.

In the present study, we manipulated emotional valence and relevance as item-inherent factors by presenting emotional and neutral words that are or are not descriptive—in the sense that they can refer to or describe a person or not. We assume that high relevance boosts emotion effects independent of how the relevance is established—which means it operates for contextual or biographical information as well as for the descriptive stimuli we used here. Additionally, we introduced a social-communicative context manipulation by presenting video clips of an active speaker (contrasting this to a noncommunicative condition), assuming stronger influences of person-descriptive emotional words when they are experienced as verbal messages during face-to-face communication (see Rohr & Abdel Rahman, 2015). The study of Rohr and Abdel Rahman showed that emotion effects are intensified in communicative contexts from early sensory to late evaluative processing. Thus, in that study, we characterized the role of context-induced relevance in emotion processing. Here, we focus on relevance on a semantic level by assuming that emotion effects in general as well as their boost by communicative contexts should be most pronounced in the case of person-descriptive words due to their potential social and self-relevance.

According to appraisal theories (e.g., Scherer, Schorr, & Johnstone, 2001), many cues may be used for appraisal processes that determine emotional responses. This has been discussed, for instance, in the context of emotional expressions, where gaze direction has been shown to play a role (for a more detailed discussion, see N'Diaye, Sander, & Vuilleumier, 2009; Sander, Grandjean, Kaiser, Wehrle, & Scherer, 2007). In the present context, a global appraisal including different available sources of information may therefore naturally include personal relevance, whether it be determined by the potential of words as descriptions and evaluations of the own person or being directly addressed by a speaker uttering such evaluations. Adapting appraisal-based accounts of gaze direction effects on expression perception (N'Diaye et al., 2009) to the present investigation of emotion and personal relevance in social-communicative contexts, we assume that the appraisal of emotional content is influenced by the descriptiveness of words (being potentially evaluated in general) and the communicative context in which the words are encountered (being directly evaluated by another person). Thus, the aversive or appetitive impact of negative and positive emotion words should increase with descriptiveness, and, accordingly, both manipulations should enhance the experienced relevance of emotional words and should therefore augment emotional responses. Furthermore, descriptiveness effects on emotion should even be increased in social-communicative situations.

Concerning ERPs for visually presented emotional words (the most commonly employed modality), distinct components known from other visual emotional stimuli have been described for early reflexive arousal-driven attentive emotion processing associated with perception (early posterior negativity, EPN) and later more elaborate evaluations (late positive potential, LPP; e.g., Flaisch, Hacker, Renner, & Schupp, 2011; Herbert, Junghofer, & Kissler, 2008; Kissler, Herbert, Peyk, & Junghofer, 2007; Recio, Sommer, & Schacht, 2011; Schacht & Sommer, 2009a, 2009b; Schupp, Junghofer, Weike, & Hamm, 2003; Schupp et al., 2004; for reviews, see Kissler, Assdollahi, & Herbert, 2006; Citron, 2012). In contrast to visual processing, little is known about emotion effects in the auditory modality. Auditory emotion has often been investigated using nonverbal stimuli as, for instance, the sound of a crying baby or a rollercoaster (e.g., Bradley & Lang, 2000; Plichta et al., 2011; Thierry & Roberts, 2007). Similar to vision, auditory emotional stimuli direct attention (e.g., Kanske & Kotz, 2011; Thierry & Roberts, 2007) and elicit psychophysiological reactions (e.g., Bradley & Lang, 2000). In ERPs, auditory processing generally yields a characteristic pattern of auditory components at frontocentral regions, the P1-N1-P2 complex (e.g., Martin, Tremblay, & Korczak, 2008). Early influences of emotional content occur already within this complex. For instance, modulations of the P2 have been associated with nonverbal (e.g., prosodic) emotional cues (e.g., Paulmann, Bleichner, & Kotz, 2013; Paulmann, Jessen, & Kotz, 2009). Recently, influences of verbal emotional contents have also been reported in the frontal auditory P2 (Graß, Hammerschmidt, Bayer, & Schacht, 2014; Rohr & Abdel Rahman, 2015). Later components such as the P3/LPP (e.g., Thierry & Roberts, 2007; Wambacq & Jerger, 2004) and the N400 have been attributed to meaning-related emotion processing (for a review, see Kotz & Paulmann, 2011).

Based on the discussion above, descriptiveness effects should be similar to emotion effects. Indeed, for visually presented stimuli, personal relevance has been shown to induce EPN-like effects (Herbert, Herbert et al., 2011; Wieser et al., 2014) as well as ERP modulations in the P3 or LPP time window (e.g., Fields & Kuperberg, 2012, 2015a; Gray et al., 2004; Tacikowski & Nowicka, 2010; Watson, Dritschel, Obonsawin, & Jentzsch, 2007). Thus, in ERPs, preferential processing of descriptive and emotional words should be associated with modulations in early reflexive and later more elaborate ERP components. Because in our study the words were presented aurally, ERP modulations at frontocentral regions in the time range of the auditory P2 may be expected (Rohr & Abdel Rahman, 2015) instead of posterior EPN effects (but see Graß, Bayer, & Schacht, 2016, for the discussion of an "auditory EPN"). Later processing of emotional and descriptive stimuli as well as their interactions should arise in the LPP component, with increasing amplitudes as relevance increases. We assume that descriptiveness enhances the subjective valence of emotional words and/or the arousal they induce (Lang, 1995; Lang et al., 1998; Lang, Greenwald, Bradley, & Hamm, 1993), and should therefore intensify emotional experiences associated with descriptive emotional words similar to the findings of the recent study on contextual relevance by Fields and Kuperberg (2015a). Theoretically, and based on the presumed similarities between the effects of emotion and person descriptiveness, interactions may be found in early and late effects. However, since studies using visual words suggest that early automatic emotion processing is independent of verbal context relevance (e.g., Fields & Kuperberg, 2012; Herbert, Herbert et al., 2011; Herbert, Pauli, & Herbert, 2011), it is more likely that the interactions are confined to comparatively late processing stages reflected in the LPP component.

To summarize the discussions above, we assume that person-descriptive emotional words such as compliments or insults should induce enhanced emotional responses relative to neutral words. Furthermore, because social evaluation can be seen as a communicative act, the effects of emotional person-descriptive words should be most pronounced during face-to-face communication. The analyses and discussion will focus on the presumed interactions of emotion and person descriptiveness.

TABLE 1 Mean values of the controlled parameters of the selected stimuli

	Person-descriptive			Nondescriptive		
	Neutral	Positive	Negative	Neutral	Positive	Negative
Letters	7.5 (1.9)	7.4 (1.3)	7.5 (1.4)	7.2 (1.1)	7.2 (1.2)	7.3 (1.0)
Syllables	2.5 (0.8)	2.5 (0.5)	2.3 (0.6)	2.4 (0.7)	2.3 (0.5)	2.4 (0.6)
Orthographic neighbors	3.6 (3.5)	2.8 (2.2)	3.8 (5.0)	3.2 (2.7)	3.8 (4.3)	2.8 (3.5)
Frequency/million	9.0 (16.4)	6.4 (7.5)	5.5 (8.3)	7.5 (9.8)	8.5 (10.0)	5.9 (7.2)
Valence (rating)	2.8 (0.5)	2.0 (0.4)	4.1 (0.3)	2.9 (0.4)	2.1 (0.4)	4.0 (0.4)
Arousal (rating)	2.1 (0.6)	2.7 (0.6)	3.1 (0.4)	2.0 (0.5)	2.6 (0.6)	2.8 (0.6)
Descriptiveness	4.3 (0.3)	4.0(1.0)	4.3 (0.5)	1.9 (1.0)	2.3 (1.1)	2.1 (1.0)
Word duration [ms]	658.7 (127.5)	672.9 (95.6)	652.1 (104.0)	638.7 (79.2)	649.3 (99.8)	655.2 (87.9)
Word onset [ms]	540.6 (69.6)	553.0 (90.7)	547.3 (66.2)	525.3 (75.7)	547.5 (80.7)	539.2 (82.7)
Sound intensity [dB]	75.1 (1.9)	75.6 (1.6)	75.2 (1.7)	75.3 (1.8)	75.5 (1.4)	74.8 (2.0)
Valence (FaceReader)	-.28 (0.06)	-.27 (0.05)	-.26 (0.06)	-.27 (0.06)	-.27 (0.05)	-.27 (0.05)

Note. Standard deviations are given in parentheses.

2 | METHOD

2.1 | Participants

Thirty-eight native speakers of German (all women, right-handed, mean age: 25 years, range 18–37) were recruited from a local participant's database via email. We did not systematically register their education level, but most of the participants were students enrolled at different universities in Berlin. They gave informed consent and received payment or course credit for participation. All participants reported normal hearing and normal or corrected-to-normal vision. Data of two participants were excluded due to EEG artifacts. The experiment was approved by the local ethics committee and conducted in accordance with the declaration of Helsinki. Participants were partially overlapping with our earlier study (Rohr & Abdel Rahman, 2015); however, the sample size was increased here to accommodate the increased number of factors we analyzed in this study.

2.2 | Materials

We used the stimulus materials described in Rohr and Abdel Rahman (2015), consisting of 240 German nouns and adjectives of neutral, negative, and positive valence that were split each into two groups of person-descriptive and nondescriptive stimuli. A complete stimulus list is provided in the online supporting information, Table S1. As described in the Introduction, descriptiveness was defined as the predefined potential of a word's meaning to be attributed to a person, for example, student, pragmatic (person-descriptive) versus acoustic, tray (not person-descriptive). Because German nouns are gender marked, female word forms were selected and only female participants were included in the study to maximize the personal relevance of the words. Based on normative values taken from dlex (Heister, 2011; accessible via www.dlexdb.de), the words were matched for length (letters, syllables), word frequency, and number of orthographic neighbors (see Table 1). We matched for orthographic instead of phonological neighborhood because there are no appropriate norms for phonological neighborhood in German covering our stimuli.

All words were rated on 5-point SAM scales (Self-Assessment-Manikin; Bradley & Lang, 1994) by 12 participants who did not participate in the main experiment for valence (pleasant to unpleasant) and arousal (low to high arousal). Additionally the raters indicated on a 5-point descriptiveness scale, newly developed for this experiment, whether the respective word could be used to describe a person. These ratings (Table 1) confirmed our preexperimental classification into words with high and low descriptiveness, $F(1, 11) = 836.47$; $p < .001$, $\eta^2 = .99$, for all emotion conditions, $ts(11) \geq 17$, $ps \leq .001$. The effect of emotion was significant in valence, $F(2, 22) = 151.85$; $p < .001$, $\eta^2 = .93$, and arousal ratings, $F(2, 22) = 9.72$; $p = .006$, $\eta^2 = .47$, with negative words being rated more negative and arousing than neutral words, $F(1, 11) = 122.75$; $p < .001$, $\eta^2 = .918$, and $F(1, 11) = 16.76$; $p = .002$, $\eta^2 = .604$, and positive words being rated as more positive and arousing than neutral words, $F(1, 11) = 197.9$, $p < .001$, $\eta^2 = .947$, and $F(1, 11) = 34.97$;

PSYCHOPHYSIOLOGY SPR

$p < .001$, $\eta^2 = .761$. Furthermore, descriptive words were rated as more arousing than nondescriptive words, $F(1, 11) = 11.81$; $p < .006$, $\eta^2 = .518$, for negative and neutral words, $ts(11) \geq 2.4$, $ps \leq .04$ (positive: $t(11) = 1.5$, $p = .151$). Valence values were more positive for descriptive than for nondescriptive positive and neutral words, $ts(11) \leq 2.3$, $ps \leq .035$, and more negative for descriptive than for nondescriptive negative words, $t(11) = 3.1$, $p = .009$. To summarize, the selected words yielded clear emotion effects in valence and arousal. Furthermore, descriptiveness increased valence and arousal ratings, replicating previous studies (e.g., Fields & Kuperberg, 2012; Wieser et al., 2014) in which different valence/arousal levels were found even for identical words, depending on presentation context, demonstrating that they are inherent in personal relevance. Thus, in our opinion, eliminating those differences by further matching would be like cutting out a natural element of relevance. We will return to this point in the Discussion.

We used videos containing close-ups of a female speaker who pronounced the single words with gaze directed straight into the camera. In the noncommunicative control condition, 20 additional video clips of the speaker with closed mouth and eyes were used. To avoid confounding influences from contextual emotional sources, the speaker was instructed to keep prosody and facial expressions neutral during recording. The absence of emotional expression differences between conditions was confirmed using FaceReader software. We calculated the average valence values over all frames within each utterance. According to those values, the speaker's facial expression was slightly negative in all conditions (Table 1) but affected neither by emotion, $F(2, 237) = .71$, $p = .493$, $\eta^2 = .006$, nor by descriptiveness, $F(1, 238) = .148$, $p = .700$, $\eta^2 = .001$.

The audio files were identical in the different communicative conditions and did not differ in mean articulation duration, mean word onset time (in milliseconds after video onset), or mean sound intensity between emotion and descriptiveness conditions (Table 1). In the communicative condition, the words were presented along with their original video recordings. For the noncommunicative condition, the auditory words were presented with a randomly selected video of the nonarticulating speaker with closed eyes and mouth to keep the visual input in the communicative and noncommunicative condition as similar as possible. In a third presentation mode, the auditory words were combined with a video of the empty studio to prevent habituation to the presence of a face. Those trials were not included in the analyses.

2.3 | Procedure

All videos were presented at an approximate size of 10.5 × 12 cm at a viewing distance of 90 cm (7.6° visual angle). Each trial started with a white fixation cross on a black

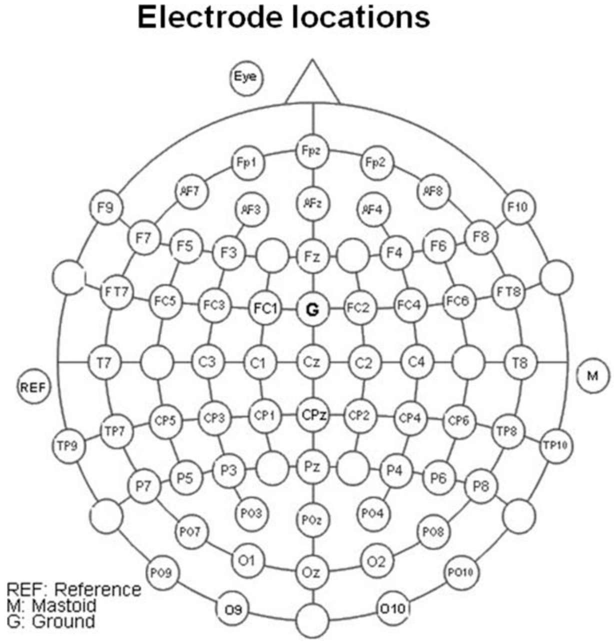

FIGURE 1 Schematic overview of the electrode locations used in the experiment

background. After 400 ms, the audio file started and the fixation cross was replaced by the respective (communicative or noncommunicative) video. Each clip started 200 ms before the first articulatory movement was visible in the communicative condition. All videos were presented for 1,700 ms. To enhance participant's attention to the stimuli, they indicated via button press in control trials interspersed randomly after 7, 9, 11, or 13 trials if they had heard a specific word earlier in the experiment. The order of conditions was randomized with the restriction that no more than 4 consecutive trials included the same emotion or communicative condition. Each word was presented twice in each condition, resulting in 80 trials per emotion in each condition and a total of 1,440 trials (including the fillers without face), with a duration of approximately 90 min.

2.4 | EEG recording and analysis

The EEG was recorded with BrainAmp DC amplifiers (Brain Products), from 62 electrodes distributed equally over the scalp surface according to the extended 10–20 system with Ag/AgCl electrodes (see Figure 1 for the complete montage we used), referenced to the left mastoid. EEG data were recorded at a sampling rate of 5 kHz, and downsampled to 500 Hz using a low cutoff of 0.016 Hz and a high cutoff of 1000 Hz. The ground electrode was located at FCz.

Impedances were kept below 5 kΩ. Electrodes attached to the left and right canthi of the eyes and above and below the left eye were used to record the horizontal and vertical electrooculograms. Offline, the EEG was rereferenced to an average reference and low-pass filtered (30 Hz, Butterworth

Zero Phase Filter 2nd order, 24 dB/oct). Eye movement artifacts were corrected using a spatiotemporal dipole modeling procedure (Multiple Source Eye Correction; Berg & Scherg, 1991) implemented in the BESA software (brain electric source analysis, MEGIS Software GmbH). Instructed blinks, and vertical and horizontal eye movements were averaged to obtain individual blink topographies for each participant. The estimated eye movement activity was then subtracted from the EEG signal. Remaining artifacts were rejected semiautomatically (amplitudes and amplitude changes > 200 μV, voltage steps > 50 μV/ms). Artifact-free EEG was segmented time-locked to the auditory word onset and corrected to a 100-ms baseline before word onset (BrainVision Analyzer, Brain Products). No channels were interpolated. On average, 5.01% of the trials of each participant were excluded by the artifact rejection procedures. The number of rejected trials did not differ between conditions, $F(11, 385) = 1.415$, $p = .246$, $\eta^2 = .039$. ERP analyses were conducted on mean amplitudes.

As described in the Introduction, we expected an interaction between emotion and descriptiveness associated perhaps with early reflexive, but specifically with later evaluative, processes in the LPP time window presumably at central electrodes.

To identify the electrode locations and time windows involved in that interaction, we performed cluster-based permutation tests (CBPTs) as implemented in FieldTrip (Maris & Oostenveld, 2007, version 20161024; with the function *ft_timelockstatistics*) with 1,000 permutations on the time window between 100 and 800 ms after word onset in the communicative condition. To get information about a possible Emotion × Descriptiveness interaction, we used a double subtraction procedure to compare the emotion effects in the descriptive to the emotion effects in the nondescriptive condition separately for positive and negative words. Thus, the differences positive minus neutral and negative minus neutral were computed, and the permutation tests were employed to test whether these differences differed between the person-descriptiveness conditions. Based on the CBPT results, we selected the regions and time windows of interest, for which we calculated an analysis of variance (ANOVA) that included all levels of all factors (emotion, descriptiveness, communicative situation) to characterize the interaction more precisely. Interactions were followed up with separate ANOVAs. Main effects of emotion were followed up with planned contrasts to check whether positive words, negative words, or both differed from neutral words. Huynh-Feldt corrections were applied when the sphericity assumption was violated.

3 | RESULTS

Using CBPTs, we identified significant ($ps < .05$) differences at central electrodes between the emotion effects in the descriptive and the nondescriptive condition for both positive and negative words, starting at 402 ms (negative words) or 506 ms (positive words), respectively, that lasted until 800 ms (Figure 2). No earlier effects were found. Based on these results, we selected the representative electrodes Cz, CPz, Pz, CP1, and CP2 in the time window of 500 to 800 ms because these electrodes and time windows were involved in both detected clusters for the ANOVA including all factors.

The ANOVA including all factors revealed a significant main effect of communicative condition, $F(1, 35) = 38.573$, $p < .001$, $\eta^2 = .524$, that did not interact with the other factors, $Fs(2, 70) \leq 1.716$, $ps \geq .187$, $\eta^2 \leq .047$. We also found a significant main effect of descriptiveness, $F(1, 35) = 23.783$, $p < .001$, $\eta^2 = .405$, in the form of a central positivity that was more pronounced for descriptive than for nondescriptive words, while the main effect of emotion was not significant in this time window, $F(1, 35) = 1.644$, $p = .201$, $\eta^2 = .045$. Emotion and descriptiveness interacted, $F(2, 70) = 18.657$, $p < .001$, $\eta^2 = .348$. The follow-up tests revealed emotion effects for descriptive and nondescriptive words, (descriptive: $F(2, 70) = 9.442$, $p < .001$, $\eta^2 = .212$; nondescriptive: $F(2, 70) = 9.051$, $p < .001$, $\eta^2 = .205$). However, the planned contrasts revealed that both positive and negative emotion affected ERPs in the descriptive condition, $Fs(1, 35) \geq 13.407$, $ps \leq .002$, $\eta^2 \geq .277$, while emotion effects in the nondescriptive condition were significant only for negative words, $F(1, 35) = 19.918$, $p < .001$, $\eta^2 = .363$, but not for positive words, $F(1, 35) = 4.014$, $p = .053$, $\eta^2 = .103$. Emotion effects an opposite polarity in the descriptive and nondescriptive conditions. While in the descriptive condition emotion effects were reflected in a central positivity, emotion effects in the nondescriptive condition corresponded to a central negativity (Figure 3).

CBPTs revealed an additional cluster at frontotemporal sites in the analysis of the negative words (Figure 2). To test the effects in this cluster more closely, we analyzed the three representative electrodes F8, F10, and FT8 between 444 and 548 ms because this covers the broad time window of this cluster. The pattern of results resembled the central cluster exactly, except that here additionally the main effect of emotion reached significance, $F(2, 70) = 3.655$, $p < .031$, $\eta^2 = .095$, which was driven by the positive words (positive: $F(1, 35) = 7.745$, $p = .009$, $\eta^2 = .181$, negative: $F(1, 35) = 0.024$, $p = .878$, $\eta^2 = .001$).

As mentioned above, our analyses were built around the presumed interaction between emotion and person descriptiveness. Therefore, main effects of both factors are not described in Results for the time windows in which they did not show an interaction in the CBPTs. For those who are interested in these effects, we additionally provide an exploratory omnibus ANOVA in supporting information, Appendix S1, in which the early main effects can be seen in more detail. Interestingly, the early emotion and descriptiveness

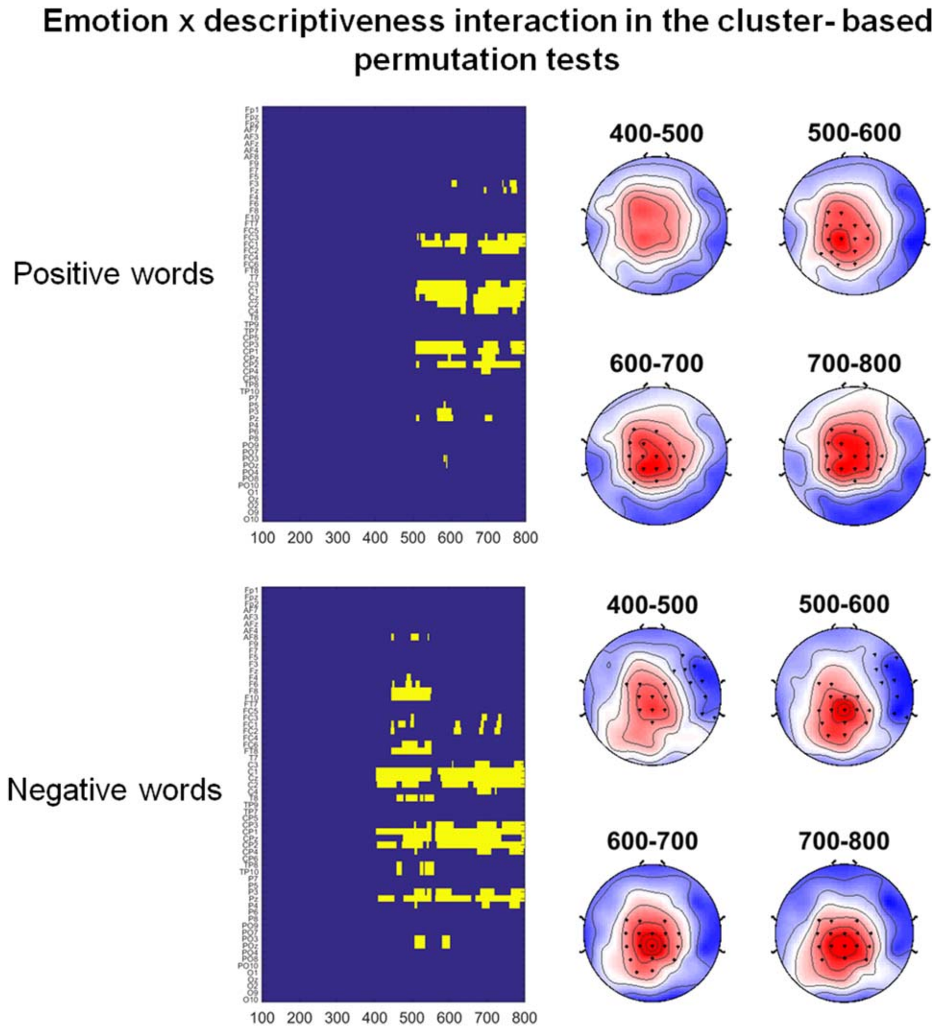

FIGURE 2 Results of the cluster-based permutation tests on the interaction of emotion and person descriptiveness for positive (top) and negative words (bottom). Left: Matrix of all significant time windows and electrode sites. Right: Electrodes involved in the significant clusters detected by the test for four time windows of 100 ms between 400 and 800 ms

effects showed a similar distribution in the form of a fronto-central negativity and a positive deflection at posterior sites.

4 | DISCUSSION

In this study, we tested how the processing of words and, in particular, emotional words, is affected by their potential of containing personally relevant evaluative messages. We hypothesized that word-inherent person descriptiveness enhances the personal relevance and thereby the emotional impact of words, and that this effect would be most pronounced in communicative situations (e.g., being addressed by someone as a winner). In line with the first assumption, our findings suggest that the intrinsic relevance is important for evaluating affective contents, as reflected in emotional LPP effects only for person-descriptive words. However, and in contrast to the second assumption, word-inherent descriptiveness seems to be sufficient to enhance emotional processes reflected in the LPP, and no influence of communicative contexts on interactions between emotion and evaluation at late processing stages was detected.

Overall, main effects of person descriptiveness were found in the social-communicative and the noncommunicative condition and distributed as a LPP. Corroborating earlier reports (e.g., Fields & Kuperberg, 2012, 2015a; Gray et al., 2004; Tacikowski & Nowicka, 2010), late effects of descriptiveness led to an increased LPP, reflecting intense stimulus evaluations. This finding demonstrates that stimulus-inherent factors within single words relating to relevance are important also for nonautobiographical information. This holds even for subtle manipulations such as the one realized here. The words are not directly personally relevant in the sense that they exclusively refer to the listener. Instead, they are only indirectly relevant in the sense that they refer to or evaluate persons and may therefore potentially refer to and evaluate the listener personally. The similarity of emotion and descriptiveness effects adds further evidence to the idea of

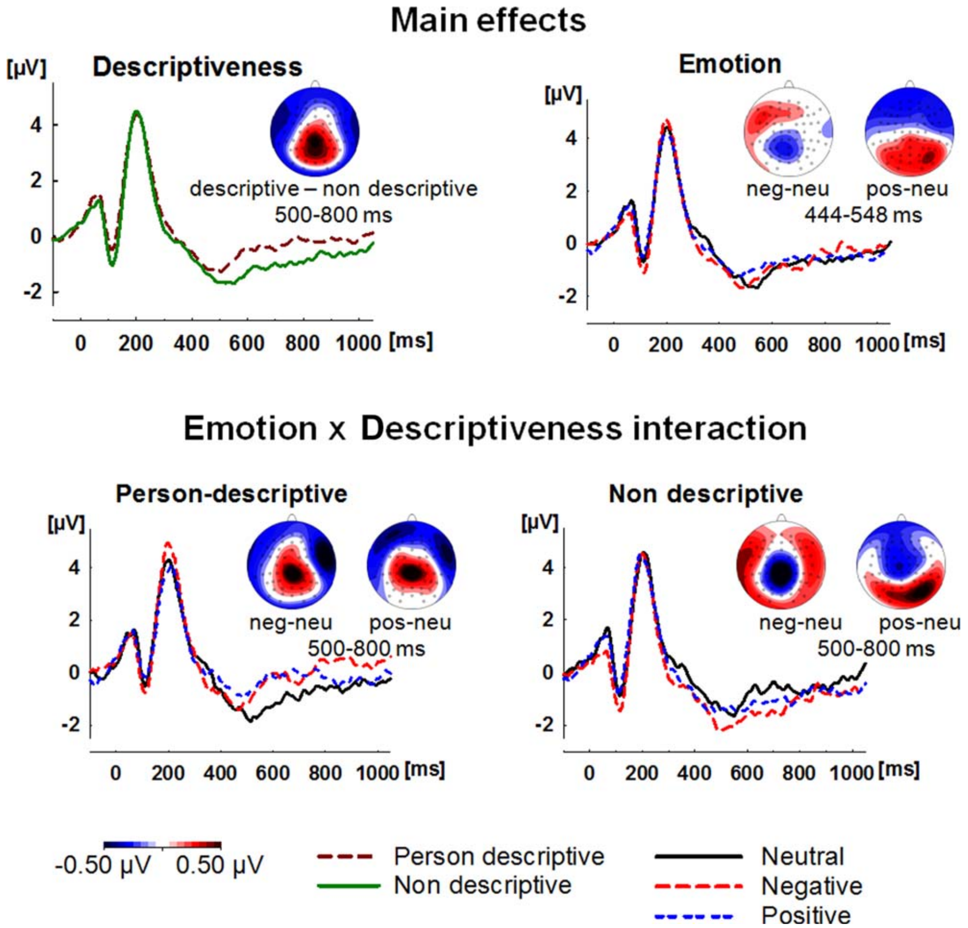

FIGURE 3 Time course and interaction of emotion and descriptiveness effects in ERPs at electrode CPz. The distributions of the effects are depicted for the time window over which the ANOVAs were calculated

common underlying mechanisms of enhanced attention allocation to intrinsically relevant stimuli discussed in the motivated attention literature (Gray et al., 2004; Schindler et al., 2015; Tacikowski & Nowicka, 2010) and in appraisal theories (e.g., N'Diaye et al., 2009; Sander et al., 2007).

The region of interest analyses revealed descriptiveness-dependent emotional LPP effects that did not interact with the communicative conditions. Thus, personally relevant aspects of emotional words augment stimulus evaluations in communicative and noncommunicative situations, suggesting that, in contrast to our initial assumptions, this factor has a strong impact on emotion word processing that is not or only weakly enhanced by communicative contexts. We cannot fully preclude that the effects of communicative context on interactions between emotion and descriptiveness would be more pronounced if the study design was even closer to natural language perception, with, for example, a real person articulating the stimuli. However, to take only one step at a time, this study used the above described videos to maximize control over visual and auditory input.

For words that are not person descriptive, we also observed late emotion effects. However, with their topographical distributions, these modulations resemble an N400 for negative words instead of the LPP effect yielded by descriptive emotional words in our study and typically found for emotional words in general in the literature. Modulations of the N400 (Fields & Kuperberg, 2015b) and similarly distributed effects (Watson et al., 2007) have been related to a mismatch between the individual (usually positive) self-concept and negative word meaning. However, because this effect was most pronounced for nondescriptive words, this may not explain the present findings. As an alternative explanation, N400 modulations could relate to semantic aspects of auditory emotional word processing (e.g., Paulmann & Pell, 2010; Schirmer & Kotz, 2003) or ongoing modulations of auditory processing (see also Rohr & Abdel Rahman, 2015, for a more detailed discussion of the possible mechanisms underlying the topographical distribution of emotion effects in this paradigm).

Another important finding is that the interaction between emotion and relevance was confined to late elaborate processing stages. This is in line with earlier studies on the interaction of emotion and relevance that report interactions only in the LPP component (e.g., Fields & Kuperberg, 2012; Herbert, Herbert et al., 2011; Herbert, Pauli, & Herbert, 2011). Although both word-inherent and social-communicative manipulations of stimulus relevance can affect emotion processing, these effects set in at different points in time. The study by Rohr and Abdel Rahman (2015) demonstrates that communicative contexts also induce early modulations of emotional processing starting at 150 ms, with relevance possibly being established via visual input even before auditory word onset. This is in line with the findings of Fields and Kuperberg (2012), who reported effects of an a priori established discourse context on early perceptual processes reflected in the P1, N1, and P2, which they accounted for with top-down amplifications of sensory processing. In contrast, word-inherent relevance conveyed by person descriptiveness affects emotion processing only at later stages in the LPP range. Indeed, emotion-induced LPP effects were present only for person-descriptive words, which is similar to the findings of Fields and Kuperberg (2015a), who reported LPC effects for emotional words to be restricted to a self-relevant context. Because the presence of emotion effects in the LPP has been associated with the depth of stimulus processing and the task relevance of emotion (e.g., Hinojosa, Mendez-Bertolo, & Pozo, 2010; Rellecke, Palazova, Sommer, & Schacht, 2011; Schacht & Sommer, 2009b), this finding suggests that the potential of emotional words to signal social evaluation enhances the relevance of these words, triggering even more enhanced stimulus evaluations. Since Schacht and colleagues (2009) have demonstrated that word class (adjective vs. noun) may interact with emotion effects, it might be interesting for future studies to test whether person descriptiveness interacts with word class. This has not been done in the present study.

As discussed in the Introduction, studies varying relevance by contexts have demonstrated a close relation between personal relevance, valence, and arousal (e.g., Fields & Kuperberg, 2012, 2015a; Herbert, Herbert et al., 2011; Rohr & Abdel Rahman, 2015). As in contextual relevance manipulations, our stimuli had higher arousal values in the person-descriptive than in the nondescriptive condition. As described above, we assume arousal to contribute to descriptiveness effects. However, the ratings of our materials additionally revealed more positive valence ratings for positive words and more negative valence ratings for negative words in the descriptive condition. Thus, one could argue that emotion effects in our study are generally larger in the descriptive condition because of this wider range of the valence scale covered by descriptive words (descriptive: 2.0–4.1; nondescriptive: 2.1–4.0; Table 1). However, note that the reported emotion effects are based on differences between emotional and neutral conditions rather than on absolute values of valence and arousal. These differences were identical (positive minus neutral words) or almost identical (negative minus neutral words) for descriptive and nondescriptive words and therefore cannot explain the pattern of results we found here. This is because, first, such an explanation would predict only small and quantitative modulations of emotion effects by descriptiveness. However, emotion effects were differentially distributed in the descriptive and the nondescriptive condition (see Figure 3, bottom), which cannot be easily explained by a mere difference in absolute valence values. Second, if the differences in ERP effects between the descriptiveness conditions were caused (only) by those valence and arousal differences, they should be restricted to the negative emotion condition—as were the differences in the ratings.

As discussed in the Introduction, many studies demonstrated an effect of perceived personal relevance induced by the presentation context, manifesting in altered valence and arousal perception even for identical words. This holds not only for explicit ratings (e.g., Bayer et al., 2017; Fields & Kuperberg, 2012; Herbert, Herbert et al., 2011; Rohr & Abdel Rahman, 2015) but also affects the electrophysiological reactions that the words elicit in a way that cannot easily be explained by mere arousal differences. For example, the study by Bayer and colleagues reports a prolonged EPN duration, while arousal differences would be expected to lead only to an amplitude increase (Bayer et al., 2017). Thus, instead of the slight differences of valence and arousal, we assume similar mechanisms of subjectively perceived relevance/appraisal to contribute to the increased emotion effects here. Therefore, our descriptiveness effects are not caused by matching differences but instead can be viewed as a consequence of potential social evaluation and thereby offer first insight into parameters beyond a simple emotional/neutral distinction that can be used to optimize future studies on language and emotion.

To summarize, we describe how different facets of personal relevance, specifically, word-inherent person descriptiveness (being potentially evaluated) and social-communicative contextual relevance (being evaluated directly by another person) shape our responses to emotional words.

ACKNOWLEDGEMENTS

We thank Julia Baum, Marie Borowikow, Philipp Glage, Martin Maier, and Johannes Rost for their help during data collection, Guido Kiecker for technical assistance, and Anna Eiserbeck for support carrying out the CBPTs.

REFERENCES

Bayer, M., Ruthmann, K., & Schacht, A. (2017). The impact of personal relevance on emotion processing: Evidence from event-related potentials and pupillary responses. *Social Cognitive and Affective Neuroscience*, *12*, 1470–1479. https://doi.org/10.1093/scan/nsx075

Berg, P., & Scherg, M. (1991). Dipole modelling of eye activity and its application to the removal of eye artefacts from the EEG and MEG. *Clinical Physics and Physiological Measurement*, *12*(Suppl A), 49–54. https://doi.org/10.1088/0143-0815/12/A/010

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavioral Therapy and Experimental Psychiatry*, *25*(1), 49–59. https://doi.org/10.1016/0005-7916(94)90063-9

Bradley, M. M., & Lang, P. J. (2000). Affective reactions to acoustic stimuli. *Psychophysiology*, *37*(2), 204–215. https://doi.org/10.1017/S0048577200990012

Citron, F. M. (2012). Neural correlates of written emotion word processing: A review of recent electrophysiological and hemodynamic neuroimaging studies. *Brain and Language*, *122*(3), 211–226. https://doi.org/10.1016/j.bandl.2011.12.007

Fields, E. C., & Kuperberg, G. R. (2012). It's all about you: An ERP study of emotion and self-relevance in discourse. *NeuroImage*, *62*(1), 562–574. https://doi.org/10.1016/j.neuroimage.2012.05.003

Fields, E. C., & Kuperberg, G. R. (2015a). Dynamic effects of self-relevance and task on the neural processing of emotional words in context. *Frontiers in Psychology*, *6*, 2003. https://doi.org/10.3389/fpsyg.2015.02003

Fields, E. C., & Kuperberg, G. R. (2015b). Loving yourself more than your neighbor: ERPs reveal online effects of a self-positivity bias. *Social Cognitive and Affective Neuroscience*, *10*, 1202–1209. https://doi.org/10.1093/scan/nsv004

Flaisch, T., Hacker, F., Renner, B., & Schupp, H. T. (2011). Emotion and the processing of symbolic gestures: An event-related brain potential study. *Social Cognitive and Affective Neuroscience*, *6*(1), 109–118. https://doi.org/10.1093/scan/nsq022

Graß, A., Bayer, M., & Schacht, A. (2016). Electrophysiological correlates of emotional content and volume level in spoken word processing. *Frontiers in Human Neuroscience*, *10*, 326. https://doi.org/10.3389/fnhum.2016.00326

Graß, A., Hammerschmidt,W., Bayer, M., Schacht, A. (2014). Emotion effects in spoken and written word processing: Evidence from ERPs in cross-modal comparison. Poster presented at the European Society for Cognitive and Affective Neuroscience Conference 2014, Dortmund, Germany.

Gray, H. M., Ambady, N., Lowenthal, W. T., & Deldin, P. (2004). P300 as an index of attention to self-relevant stimuli. *Journal of Experimental Social Psychology*, *40*(2), 216–224. https://doi.org/10.1016/S0022-1031(03)00092-1

Heister, J. (2011). dlex-DB eine lexikalische Datenbank für die psychologische und linguistische Forschung. [dlex-DB: A lexical database for psychological and linguistic research]. *Psychologische Rundschau*, *62*(1), 10–20. https://doi.org/10.1026/0033-3042/a000029

Herbert, C., Herbert, B. M., Ethofer, T., & Pauli, P. (2011). His or mine? The time course of self-other discrimination in emotion processing. *Society for Neuroscience*, *6*(3), 277–288. https://doi.org/10.1080/17470919.2010.523543

Herbert, C., Junghofer, M., & Kissler, J. (2008). Event-related potentials to emotional adjectives during reading. *Psychophysiology*, *45*(3), 487–498. https://doi.org/10.1111/j.1469-8986.2007.00638.x

Herbert, C., Pauli, P., & Herbert, B. M. (2011). Self-reference modulates the processing of emotional stimuli in the absence of explicit self-referential appraisal instructions. *Social Cognitive and Affective Neuroscience*, *6*(5), 653–661. https://doi.org/10.1093/scan/nsq082

Hinojosa, J. A., Mendez-Bertolo, C., & Pozo, M. A. (2010). Looking at emotional words is not the same as reading emotional words: Behavioral and neural correlates. *Psychophysiology*, *47*(4), 748–757. https://doi.org/10.1111/j.1469-8986.2010.00982.x

Kanske, P., & Kotz, S. A. (2011). Positive emotion speeds up conflict processing: ERP responses in an auditory Simon task. *Biological Psychology*, *87*(1), 122–127. https://doi.org/10.1016/j.biopsycho.2011.02.018

Kissler, J., Assadollahi, R., & Herbert, C. (2006). Emotional and semantic networks in visual word processing: Insights from ERP studies. *Understanding Emotions*, *156*, 147–183. https://doi.org/10.1016/S0079-6123(06)56008-X

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

Kotz, S. A., & Paulmann, S. (2011). Emotion, language, and the brain. *Language and Linguistics Compass*, *5*(3), 108–125. https://doi.org/10.1111/j.1749-818X.2010.00267.x

Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, *50*(5), 372–385. https://doi.org/10.1037/0003-066X.50.5.372

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1998). Emotion, motivation, and anxiety: Brain mechanisms and psychophysiology. *Biological Psychiatry*, *44*(12), 1248–1263. https://doi.org/10.1016/S0006-3223(98)00275-3

Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, *30*(3), 261–273. https://doi.org/10.1111/j.1469-8986.1993.tb03352.x

Maris, E., & Oostenveld, R. (2007). Nonparametric statistical testing of EEG-and MEG-data. *Journal of Neuroscience Methods*, *164*(1), 177–190. https://doi.org/10.1016/j.jneumeth.2007.03.024

Martin, B. A., Tremblay, K. L., & Korczak, P. (2008). Speech evoked potentials: From the laboratory to the clinic. *Ear and Hearing*, *29*(3), 285–313. https://doi.org/10.1097/AUD.0b013e3181662c0e

Miyakoshi, M., Nomura, M., & Ohira, H. (2007). An ERP study on self-relevant object recognition. *Brain Cognition*, *63*(2), 182–189. https://doi.org/10.1016/j.bandc.2006.12.001

N'Diaye, K., Sander, D., & Vuilleumier, P. (2009). Self-relevance processing in the human amygdala: Gaze direction, facial expression, and emotion intensity. *Emotion*, *9*(6), 798–806. https://doi.org/10.1037/a0017845

Paulmann, S., Bleichner, M., & Kotz, S. A. (2013). Valence, arousal, and task effects in emotional prosody processing. *Frontiers in Psychology*, *4*, 345. https://doi.org/10.3389/fpsyg.2013.00345

Paulmann, S., Jessen, S., & Kotz, S. A. (2009). Investigating the multimodal nature of human communication. *Journal of Psychophysiology*, *23*(2), 63–76. https://doi.org/10.1027/0269-8803.23.2.63

Paulmann, S., & Pell, M. D. (2010). Contextual influences of emotional speech prosody on face processing: How much is enough? *Cognitive, Affective, & Behavioral Neuroscience*, *10*(2), 230–242. https://doi.org/10.3758/CABN.10.2.230

Plichta, M. M., Gerdes, A. B. M., Alpers, G. W., Harnisch, W., Brill, S., Wieser, M. J., & Fallgatter, A. J. (2011). Auditory cortex activation is modulated by emotion: A functional near-infrared spectroscopy (fNIRS) study. *NeuroImage*, *55*(3), 1200–1207. https://doi.org/10.1016/j.neuroimage.2011.01.011

Recio, G., Sommer, W., & Schacht, A. (2011). Electrophysiological correlates of perceiving and evaluating static and dynamic facial emotional expressions. *Brain Research*, *1376*, 66–75. https://doi.org/10.1016/j.brainres.2010.12.041

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 Cognition*, *77*(1), 23–32. https://doi.org/10.1016/j.bandc.2011.07.001

Rohr, L., & Abdel Rahman, R. (2015). Affective responses to emotional words are boosted in communicative situations. *NeuroImage*, *109*, 273–282. https://doi.org/10.1016/j.neuroimage.2015.01.031

Sander, D., Grandjean, D., Kaiser, S., Wehrle, T., & Scherer, K. R. (2007). Interaction effects of perceived gaze direction and dynamic facial expression: Evidence for appraisal theories of emotion. *European Journal of Cognitive Psychology*, *19*(3), 470–480. https://doi.org/10.1080/09541440600757426

Schacht, A., & Sommer, W. (2009a). Emotions in word and face processing: Early and late cortical responses. *Brain Cognition*, *69*(3), 538–550. https://doi.org/10.1016/j.bandc.2008.11.005

Schacht, A., & Sommer, W. (2009b). 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

Scherer, K. R., Schorr, A., & Johnstone, T. (2001). *Appraisal processes in emotion: Theory, methods, research:* Oxford, UK: Oxford University Press.

Schindler, S., Wegrzyn, M., Steppacher, I., & Kissler, J. (2014). It's all in your head—How anticipating evaluation affects the processing of emotional trait adjectives. *Language Sciences*, *5*, 1292. https://doi.org/10.3389/fpsyg.2014.01292

Schindler, S., Wegrzyn, M., Steppacher, I., & Kissler, J. (2015). Perceived communicative context and emotional content amplify visual word processing in the fusiform gyrus. *Journal of Neuroscience*, *35*(15), 6010–6019. https://doi.org/10.1523/JNEUROSCI.3346-14.2015

Schirmer, A., & Kotz, S. A. (2003). ERP evidence for a sex-specific Stroop effect in emotional speech. *Journal of Cognitive Neuroscience*, *15*(8), 1135–1148. https://doi.org/10.1162/089892903322598102

Schupp, H. T., Junghofer, M., Weike, A. I., & Hamm, A. O. (2003). Emotional facilitation of sensory processing in the visual cortex. *Psychological Science*, *14*(1), 7–13. https://doi.org/10.1111/1467-9280.01411

Schupp, H. T., Öhman, A., Junghöfer, M., Weike, A. I., Stockburger, J., & Hamm, A. O. (2004). The facilitated processing of threatening faces: An ERP analysis. *Emotion*, *4*(2), 189–200. https://doi.org/10.1037/1528-3542.4.2.189

Tacikowski, P., & Nowicka, A. (2010). Allocation of attention to self-name and self-face: An ERP study. *Biological Psychology*, *84*(2), 318–324. https://doi.org/10.1016/j.biopsycho.2010.03.009

Thierry, G., & Roberts, M. V. (2007). Event-related potential study of attention capture by affective sounds. *NeuroReport*, *18*(3), 245–248. https://doi.org/10.1097/WNR.0b013e328011dc95

Wambacq, I. J., & Jerger, J. F. (2004). Processing of affective prosody and lexical-semantics in spoken utterances as differentiated by event-related potentials. *Cognitive Brain Research*, *20*(3), 427–437. https://doi.org/10.1016/j.cogbrainres.2004.03.015

Watson, L. A., Dritschel, B., Obonsawin, M. C., & Jentzsch, I. (2007). Seeing yourself in a positive light: Brain correlates of the self-positivity bias. *Brain Research*, *1152*, 106–110. https://doi.org/10.1016/j.brainres.2007.03.049

Wieser, M. J., Gerdes, A. B. M., Büngel, I., Schwarz, K. A., Mühlberger, A., & Pauli, P. (2014). Not so harmless anymore: How context impacts the perception and electrocortical processing of neutral faces. *NeuroImage*, *92*(0), 74–82. https://doi.org/https://doi.org/10.1016/j.neuroimage.2014.01.022

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

Table S1
Appendix S1

How to cite this article: Rohr L, Abdel Rahman R. Loser! On the combined impact of emotional and person-descriptive word meanings in communicative situations. *Psychophysiology*. 2018;e13067. https://doi.org/10.1111/psyp.13067