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No laughing matter: How the presence of laughing witnesses changes the perception of insults.

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ABSTRACT

Insults always sting, but the context in which they are delivered can make the effects even worse. Here we test how the brain processes insults, and whether and how the neurocognitive processing of insults is changed by the presence of a laughing crowd. Event-related potentials showed that insults, compared to compliments, evoked an increase in N400 amplitude (indicating increased lexical-semantic processing) and LPP amplitude (indicating emotional processing) when presented in isolation. When insults were perceived in the presence of a laughing crowd, the difference in N400 amplitude disappeared, while the difference in LPP activation increased. These results show that even without laughter, verbal insults receive additional neural processing over compliments, both at the lexical-semantic and emotional level. The presence of a laughing crowd has a direct effect on the neurocognitive processing of insults, leading to stronger and more elongated emotional processing.

Imagine that someone calls you a "worthless nobody." This could be quite insulting. Now imagine that a number of people witness the situation and laugh at you. The introspective experience suggests that such a public insult might be processed differently, and experienced more humiliating. In this study we explored the neurocognitive consequences of personal insults, using event-related potentials (ERPs). We also tested whether the implied presence of a laughing crowd of onlookers critically changed the neural processing of insults.

Social context is relevant to how people deal with insults. For example, the context of a culture, which brings with it a range of cultural values, is very important for how people perceive and react to insults. Two centuries ago, it was not uncommon that a Londoner who was publicly insulted would challenge the insulter to a deadly duel (Shoemaker, 2001). In contrast, the average Londoner brought up within the modern-day British culture would not consider a duel a proper response to an insult. However, nowadays the cultural context of the insulted is still relevant. People will, for example, respond more violently to insults or humiliation when they are from an honor culture than in the context of a non-honor culture (Cohen, Nisbett, Bowdle, & Schwarz, 1996; Doosje, Jonas, Jasini, Sveinsdóttir, & Erbas, submitted; Rodriguez

Mosquera, Fischer, Manstead, & Zaalberg, 2008). On the other hand, for people from a collectivistic culture, an insult is more acceptable when the insulter has high social status, while for people from a non-collectivistic culture these insults are equally negative, independent of the status of the insulter (Bond, Wan, Leung, & Giacalone, 1985).

Cultural values are not the only social factor relevant for the perception of insults. The social context in which an insult is presented is also relevant. Within social context, one factor that seems especially important is publicity: Experiencing an insult privately or in front of others. There is a diverse body of evidence suggesting that negative social interactions are experienced more intensely when they take place publicly. Studies of bullying, for example, show that bullying has more detrimental effects when the bully acts in front of peers, compared to when the bully and the victim are alone (Pellegrini, Bartini, & Brooks, 1999; Sticca & Perren, 2013). This is also the case when the onlookers do not take part in the bullying (Sticca & Perren, 2013), which indicates that the publicity itself is the exacerbating factor.

One way in which onlookers can accentuate their presence in the background of an altercation is through laughter. A recent study by Mann and colleagues (Mann, Feddes, Leiser, Doosje, & Fischer, submitted)

shows that this laughter in itself can influence the experience of an insult: Insults evoked stronger feelings of humiliation, shame and anger when a laughing crowd was present during the insulting interaction, than when the onlookers were silent. The increased emotional reaction to insults suggests that the presence of the laughing crowd increases the negative load of the insult. A recent study by Klages and Wirth (2014) indeed shows that laughter can be an amplifying factor in negative social experiences. In this study participants remembered events in which they were excluded as much more hurtful when laughter had been involved than when no laughter had been involved. It thus seems that the presence of a laughing crowd of onlookers leads to deeper, more intense processing of negative social experiences such as insults or exclusion.

These findings might be slightly surprising, given the fact that laughter is often treated as a purely positive emotional utterance. Indeed, laughter is universally recognized as an expression of joy (Sauter, Eisner, Ekman, & Scott, 2010), and it is associated with bonding, agreement, and affection (Scott, Lavan, Chen, & McGettigan, 2014). Moreover, laughter is often seen as a way in which negative emotional experiences can be "de-escalated" (Bloch, Haase, & Levenson, 2014; Scott et al., 2014; Yuan, McCarthy, Holley, & Levenson, 2010). Yet, we all know from experience that laughter is not unidimensionally positive. There are few people who enjoy being laughed at. Moreover, laughter does not always signal joy in the person who is laughing. Laughter can also be used to communicate negative emotions such as contempt (Schröder, 2003). A study that used spontaneous spoken dialogs showed that listeners were able to correctly distinguish positive laughs from negative laughs (Devillers & Vidrascu, 2007), confirming that in general people are aware that laughter does not always signal a positive emotion.

To summarize the findings presented above, laughter can also carry negative meaning, and in the case of negative social interactions such as altercations (Mann et al., submitted), bullying (Pellegrini et al., 1999), and exclusion (Klages & Wirth, 2014), the presence of laughing others enhances reported negative experience of the social interaction, as well as the negative response to the interaction. The amplified negative consequences of adverse social interactions accompanied by laughter can result from two different pathways. Laughter could directly amplify the emotional response to the negative social interaction. This means that the public context is immediately integrated with the event so that the initial emotional experience of the insult, bullying, or exclusion is altered, leading to a stronger emotional reaction even in the first stages of the perception of the negative event.

On the other hand, laughter, and the publicity of the event could also have its effect in a (much) later stage, when the perceiver (consciously) interprets and (re-)evaluates the event. One example of such an explicit, relatively slow evaluation of a negative event is the threat of losing "face": the possibility of losing respect and status within one's social group as a consequence of the negative social interaction (Zane & Yeh, 2002). The presence of (laughing) onlookers indicates that word about the "weakness" of the perceiver could spread quickly, resulting in permanent damage to one's public image. Detecting the presence of potential damage to one's public image and thinking about ways to counter the threat requires awareness and deliberation (Tedeschi & Felson, 1994). In this case, the initial emotional perception of the public and private negative events will be similar, and differences should only arise after the perceiver has had time to evaluate the situation.

This division of direct and extended emotional processing is in line with several accounts of (social) cognition that indicate fast and slow mental processes as separate additive parts of our cognitive system (Haidt, 2012; Kahneman, 2011). It indicates that publicity and laughter can directly influence the emotional perception of a social interaction, or it can change the slower, more explicit and conscious evaluations of the social interaction. Studies that show differential responses (in the form of behavior, evaluations, valence ratings, reports of emotional states, etc.) depending on social context (Klages & Wirth, 2014; Mann et al., submitted; Pellegrini et al., 1999) could be taken to suggest that the initial emotional experience of social interaction is shaped by its social context. However, these results could also depend on much later interpretation and evaluation of the event, such as concerns about damage of one's public image, that do not change the early emotional processing of the interaction, but shape the slower, explicit stages of social perception.

One indication that the initial emotional experience of negative social interactions is directly affected by publicity comes from a study by Vasquez and colleagues (Vasquez et al., 2013). This study shows that public insults evoke stronger emotional experiences (as measured by a questionnaire) than private insults independent of face-saving motivation. This suggest that a public negative social interaction immediately evokes stronger emotional processing and experience, compared to one-on-one negative social interaction. Here we propose to use the ongoing neural processing of the brain, as measured at millisecond level by the electro-encephalogram (EEG), to directly test whether the immediate emotional reaction to negative social interactions (personal humiliating insults) is changed by the presence of laughing onlookers.

Although little is known about the effects of social context on the immediate neural processing of spoken or written insults, psycholinguistic research does show that social context can have a direct effect on neurolinguistic processing. For instance, Van Berkum and colleagues (Van Berkum, Van Den Brink, Tesink, Kos, & Hagoort, 2008) showed that social context influences the perception of spoken language. In one example of the stimuli used in this experiment, participants heard a man with a strong lower class accent talk about his preference for opera. In this context the word "opera" evoked a larger N400, a component in the ERP that indicates (lack of) contextual fit, than when that same sentence was spoken by a man with an upper class accent. This shows that a speaker's social status directly affects how their utterance is processed. In a similar vein, Regel and colleagues (Regel, Coulson, & Gunter, 2010) showed that knowledge about the personality of specific people influences language perception. Previous research on sarcasm processing has shown that ironic or sarcastic statements evokes a larger late positive component compared to literal statements (Katz, Blasko, & Kazmerski, 2004; Spotorno, Cheylus, Van Der Henst, & Noveck, 2013), an indication that sarcasm evokes more intense processing of a sentence than literal messages. However, when the reader or listener knows that the person who uttered a sarcastic statement is actually a very sarcastic person (based on previous utterances from that same person), this immediately changes how sarcastic statements are processed: When readers know that a person is likely to use sarcasm, sarcastic sentences are perceived just as literal messages, and receive no additional processing (Regel et al., 2010).

These psycholinguistic studies show that social context can directly influence language perception, such that even initial linguistic perception includes processing of the social situation and the speaker's goals. This suggests the possibility that social context could also directly change the processing of verbal insults, and that a focus on the neurocognitive processes involved in language perception could reveal these effects. Indeed, a recent review by Van Berkum (2015) reviews a growing body of literature that shows that the perception of words and sentences also takes into account the emotional intentions of a speaker, the emotional situation, and the emotional relevance of the utterance. To test whether the presence of onlookers and the expectation of laughter immediately changes the emotional processing of an insulting utterance, we will therefore focus on two ERP components that have previously been shown to be sensitive to the emotional processing of language, the Late Positive Potential (LPP) and the N400.

The LPP, a positive component within the ERP with a maximum amplitude between 300 and 1000 ms after stimulus presentation, is directly linked to the emotional processing of a stimulus. Larger LPP amplitudes have been observed for photographs of emotional scenes (Keil et al., 2002; Palomba, Angrilli, & Mini, 1997; Schupp et al., 2003) and emotional faces (Krolak-Salmon, Fischer, Vighetto, & Mauguiere, 2001; Schupp et al., 2004; Vanderploeg, Brown, & Marsh, 1987). Particularly relevant for the current study is the research that shows that words and sentences can evoke LPPs as well. There is abundant evidence that words with an emotional load evoke an LPP (Herbert, Junghofer, & Kissler, 2008; Herbert, Kissler, Junghofer, Peyk, & Rockstroh, 2006; Kanske & Kotz, 2007; Naumann, Bartussek, Diedrich, & Laufer, 1992). Moreover, statements that are of personal emotional relevance, such as statements that violate ones moral conviction, evoke an LPP compared to statements that agree with ones morals (Van Berkum, Holleman, Nieuwland, Otten, & Murre, 2009). Furthermore, negative stimuli seem to evoke larger LPP than positive stimuli (Ito, Larsen, Smith, & Cacioppo, 1998; Smith, Cacioppo, Larsen, & Chartrand, 2003). Therefore, it seems likely that insults will result in increased amplitude of the LPP, since insults have clear emotional valence.

The N400, a negative brain potential with a maximum amplitude around 400 ms after the onset of the stimulus, is modulated by the lexical-semantic fit of a word: N400 amplitude is larger for incongruent and unexpected words (Kutas & Federmeier, 2011; Kutas & Hillyard, 1980, 1984). Wabnitz and colleagues (Wabnitz, Martens, & Neuner, 2012) showed that N400 amplitude is also larger for personal insults. This suggests that insults presented in a neutral social context are perceived as irregular and out of the ordinary, which is reflected by the increase in N400 amplitude.

In the current study, we tested whether these neural markers related to emotional processing of language (the LPP and the N400) are indeed relevant for the processing of insults, and whether these neurocognitive processes are directly changed when the insult is accompanied by a laughing crowd of onlookers. We recorded the electrical activity of the brain while participants read insulting sentences that were either presented in isolation, without any additional social context (No Laughter Condition), or in the presence of a laughing crowd (Laughter Condition). This crowd was represented by an outline of a group of people depicted on the computer screen, presented together

with the words of the sentence, and the sound of multiple people laughing that followed the presentation of the sentence.

The presence of the picture and sounds create additional differences between the above conditions that are not the focus of our investigation: in the Laughter Condition, words were presented with additional visual stimuli and, since each sentence ended with laughter, sentences in the Laughter Condition could also potentially be more complicated to process, and more open-ended, as participants might anticipate and prepare for the laughter while they are reading the sentence. To control for potential effects on the ERP of these factors, participants also read *compliments* with and without a laughing crowd. The laughter that accompanies compliments has a (standard) positive connotation, signaling shared joy, and positive affect (Scott et al., 2014) without the negative consequences for the listener. The low-level visual and auditory demands, as well as the high-level anticipatory demands, however, are the same. As a whole, this design can therefore clarify what the effects are of the social implications of the laughing crowd on the processing of insults, relative to compliments.

Based on previous research we expected that insults (“*You often make an ass out of yourself in your interaction with others*”) would evoke increased N400 and LPP amplitudes compared to compliments (“*The things that you do are always successful because of your determination*”) for the critically insulting (“*ass*”) and complimenting (“*successful*”) word in each sentence. Moreover, we hypothesized that the presence of a laughing crowd would *immediately* increase the negative load of the insult (cf., Mann et al., submitted). As such, the presence of a laughing crowd should make insults stand out more and lead to increased semantic analysis of the insult. If this is indeed the case, the N400 effect (insult—compliment) should be larger in the Laughter Condition compared to the No Laughter Condition. In a similar vein, in the presence of a laughing crowd, insults should become much more emotionally relevant and thus should receive more emotional processing. This will result in a larger LPP effect in the Laughter Condition compared to the No Laughter Condition.

Methods

Participants

Forty-six participants (eight men, mean age 21.7 years, range 18–37), recruited from the University of Amsterdam participant-pool, took part in this 2-hour experiment for payment (20 euro) or study credit. The study was approved by the Ethical Review Board of the Department of Psychology at the University of Amsterdam. All participants read and signed an informed consent before taking part in the experiment.

Stimuli

We constructed 60 insulting sentences (“*You often behave as a tyrant towards your friends.*”) and 60 complimenting sentences (“*You are always so incredibly nice to everyone.*”). Insulting sentences contained relatively few personally directed curse words since these words in Dutch are most often related to genitals (De Raad, Van Oudenhoven, & Hofstede, 2005), and are therefore gender-specific. Instead both insults and compliments mainly focused on describing the readers' personality, interaction with others, or the way others responded to them, in a positive or negative way. Sentence length was comparable for the two types of sentences (M_{insult} = 9.6, SD_{insult} = 2.5; $M_{compliment}$ = 9.3, $SD_{compliment}$ = 2.6). The critical word was determined as the first explicitly insulting (i.e., “*tyrant*” in the example) or complimenting (i.e., “*nice*” in the example) word in the sentence. The critical word was never sentence-final. Insulting and complimenting critical words did not differ in sentence position (M_{insult} = 6.0 words, SD_{insult} = 1.8; $M_{compliment}$ = 6.1, $SD_{compliment}$ = 2.4) or word length (M_{insult} = 8.1, SD_{insult} = 3.0; $M_{compliment}$ = 7.9, $SD_{compliment}$ = 2.8). Overall, the complimenting critical words occurred somewhat more frequent in Dutch language, as derived from the CELEX database (Baayen, Piepenbroek, & Gulikers, 1995), compared to insulting critical words (M_{insult} = 37.7 occurrences per 1 million, SD_{insult} = 103.8; $M_{compliment}$ = 45.8, $SD_{compliment}$ = 51.8). For the complete list of the sentences in Dutch see Supplementary Materials.

Procedure

This experiment had a 2 by 2 within subjects design: Sentence Message (2 levels: insult, compliment) * Social Context (2 levels: laughing crowd, no crowd). The 60 insults and 60 compliments were randomly divided in two lists each consisting of 30 sentences. One of the lists of compliments was presented with a laughing crowd present, while the other list was presented without onlookers. This was the same for the lists of insults. Pairing of lists with a laughing crowd was randomized over subjects.

The insults and compliments were presented word for word. To make the visual presentation more natural, words were presented using a Variable Serial Visual Presentation (VSVP) procedure (Otten, Nieuwland, &

Van Berkum, 2007a), in which the presentation time of each non-critical word varied with its length. Non-critical word duration consisted of a standard offset of 187 ms plus an additional 27 ms per letter (with an upper bound of 10 letters for each word). The presentation of clause-final words preceding a comma was prolonged with an additional 200 ms. In addition, presentation time for sentence-final words was extended with an extra 500 ms. The critical word and the word that followed the critical word were presented with a fixed duration of 346 ms.

In the Laughter Condition, each word of the sentence was presented together with the outline of a crowd (see Figure 1, left panel). The presence of the crowd was necessary to introduce a clear source (i.e., a broader social context) for the laughter that was presented at the end of each sentence, and to serve as a constant reminder that this sentence was presented with the laughing crowd. Pretests of the materials showed that laughter at the end of each sentence without the presence of the crowd was perceived as confusing, while laughter that started during presentation of the sentence (at the end of the critical word) was highly distracting and unnatural.
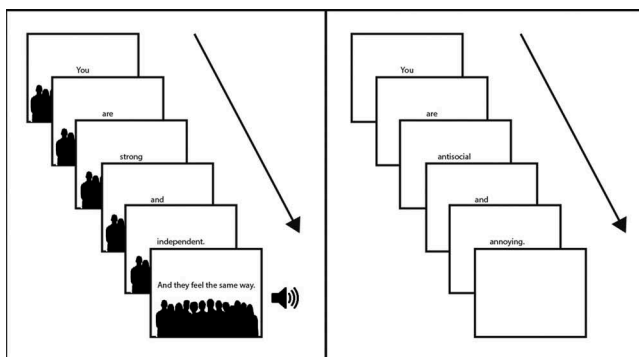
Following the final word of the insult or compliment, subjects saw the sentence "And they feel the same. *[En dat vinden zij ook.]*", which was presented as a whole sentence on the screen for 2 seconds, accompanied by a 2-second sound clip of a group of people laughing. Each group of laughing people actually consisted of four individual sound clips of laughter that were played simultaneously. For each trial, four clips were selected randomly from 14 clips, each consisting of 2 seconds of laughter. The sound clips were collected by Sauter & Scott (2007).

In the No Laughter Condition, the words of each sentence were presented on an otherwise empty screen, and each sentence was followed by a 2 second interval in which no visual or auditory input was presented (see Figure 1, right panel).

It is important to note that the critical insulting or complimenting word itself was not presented at the same time as the laughter. Instead, the laughter (if laughter was present) followed at the end of the sentence. Therefore, it was crucial for the success of the laughter manipulation that participants were aware whether laughter would follow or not while they were reading the sentence. To make sure that this was the case, we included the outline of the crowd alongside each word of the sentence in the Laughter Condition. In addition, the stimuli were presented in a blocked fashion, such that each participant saw one block of 30 insults without laughter, one block of 30 insults with laughter, one block of 30 compliments without laughter, and one block of 30 compliments with laughter. Participants were informed beforehand that all the stimuli in a block would be of the same type, so that they knew what to expect within that block. The sequence of the four blocks was randomized over subjects. Because of the blocked design and pre-block information about the type of sentences they would read, participants were aware while they were reading each sentences whether the insult was public or private, and whether laughter would follow or not, a fact that was made extra salient by presenting the outline of a crowd below each word in the laughter condition but not in the no-laughter condition. This design optimizes the potential integration of the social context within language processing.

Participants were instructed to avoid blinks and eye-movement when the sentences were presented on screen. Instead they were encouraged to blink on designated intervals, during a 2-s "blink break" which appeared after every sentence. This screen showed the Dutch word for "blink" ("*knipperen*"). After 10 sentences, subjects could take a break, with a maximum duration of 30 seconds. After each block, participants had the opportunity to drink something and relax a bit before they continued with the next block.

Electrophysiological recording

EEG was recorded with a Biosemi active-electrode system (Biosemi Inc., Amsterdam, The Netherlands) which included 32 + 2 electrodes (Fp1, Fp2, AF3, AF4, F7, F3, Fz, F4, F8, FC5, FC1, FC2, FC6, T7, C3, Cz, C4, T8, CP5, CP1, CP2, CP6, P7, P3, Pz, P4, P8, PO3, PO4, O1, Oz and O2; CMS and DRL). Blinks and eye-movements were registered by placing two electrodes under and next to the left eye. Two additional electrodes were placed

Figure 1. Provides an illustration of the sequence of presentation of an item in the Laughter Condition (compliment, left panel) and in the No Laughter Condition (insult, right panel).

on the left and right mastoid to allow for offline re-referencing of the EEG signal. The signal was amplified by a BioSemi ActiveTwo amplifier (−3 dB at ~102 Hz low-pass, fully DC coupled) with a sample rate of 512 Hz.

The EEG signals were re-referenced off-line to the average of right and left mastoids, and an offline high pass filter of 0.1 Hz was applied (no additional filtering was applied to the data in the process of analysis). Blinks and eye movements were removed from the data using a procedure based on Independent Component Analysis (ICA) as described by Jung et al. (Jung et al., 2000, 2000). After that the data were segmented in epochs lasting from 250 ms before stimulus onset until 1500 ms after the onset of the critical word. After baseline-correcting the signals by subtracting mean amplitude in the 150 ms preceding word onset, segments in which the signal exceeded ±100 µV were eliminated. For each participant the remaining artifact-free trials were averaged separately for the four conditions (insults with laughter, insults without laughter, compliments with laughter, and compliments without laughter). Based on our predictions and visual inspection of the ERPs, mean amplitude in the N400 region (300–400 ms after word onset) and in the LPP region (600–1200 ms) was exported for each participant and each condition.

Data analyses

Repeated Measures Analyses of Variance (ANOVA) were performed for the N400 and LPP time window. To assess not only the effects of Sentence Message and Social Context but also the possible interaction with electrode position the ERPs recorded in these time windows were evaluated in an ANOVA crossing Sentence Message (Compliments vs. Insults), Social Context (No Laughter vs. Laughter), Hemisphere (left/right), and Anteriority (anterior/posterior). This analysis thus involved four quadrants: (1) left-anterior, comprising FP1, AF3, F7, F3, FC1, FC5; (2) right-anterior, comprising FP2, AF4, F8, F4, FC2,FC6; (3) left-posterior, comprising C3, T7, Cp1, Cp5, P3 and P7, Po3, O1; (4) right-posterior, comprising C4, T8, Cp2, Cp6, P4 and P8, Po4, O2. Effects on the midline electrodes (Fz, Cz, Pz, and Oz) were assessed in a separate ANOVA crossing the factors Context, Consistency, and Electrode position. F tests with more than one degree of freedom in the numerator were adjusted by means of the Greenhouse-Geisser or Huynh-Feldt correction where appropriate. Uncorrected degrees of freedom and corrected P-values are reported.

Results

N400

Compared to compliments, insults evoke a larger negative inflection between 300 and 400 ms after word onset. Even though the scalp distribution of the effect is more anterior than the canonical N400 effect, the timing and polarity of the effect suggest that this negativity is in fact related to differences in N400 amplitude (see also below). Contrary to our predictions, this N400 effect was only present in the absence of the laughing crowd (Figure 2, left panel). In the presence of a laughing crowd there was no N400 difference in ERPs evoked by insults and compliments (Figure 2, right panel).

Sentence Message and Social Context did not have main effects on the ERP between 300 and 400 ms after word onset ($F(1,45) = .73$, $p = .40$, partial $\eta^2 = .02$ and $F(1,45) = .26$, $p = .62$, partial $\eta^2 < .01$). There was a significant interaction between Sentence Message and Social Context ($F(1,45) = 4.31$, $p = .04$, partial $\eta^2 = .09$), with insults evoking a larger negativity between 300 and 400 ms compared to compliments in the absence of a laughing crowd ($t(45) = 2.36$, $p = .02$, Cohen's $d = .70$) but not when the laughing crowd was present ($t(45) = .64$, $p = .52$, Cohen's $d = .16$). The presence of the laughing crowd affected insult processing (as indicated by a marginally significant difference $t(45) = 1.74$, $p = .09$, Cohen's $d = .52$) but not compliment processing ($t(45) = .95$, $p = .34$, Cohen's $d = .28$). This interaction between Sentence Message and Social Context was most pronounced over the right hemisphere, as indicated by an three-way interaction between Sentence Message, Social Context and Hemisphere ($F(1,45) = 5.32$, $p = .03$, partial $\eta^2 = .11$). The pattern of results for midline electrodes is the same, with an absence of main effects for Sentence Message ($F(1,40) = .18$, $p = .67$, partial $\eta^2 < .01$) and Social Context ($F(1,40) = 1.12$, $p = .30$, partial $\eta^2 = .03$), but a presence of an interaction between the two factors ($F(1,40) = 5.44$, $p = .03$, partial $\eta^2 = .12$).

LPP

Compared to compliments, insults evoke a larger positivity starting approximately 600 ms after word onset. When the sentences were presented without laughter, this effect was limited to the early half of the LPP time window (Figure 2, left panel). In the presence of a laughing crowd, insults elicited a larger and longer-lasting LPP relative to compliments, covering the entire

Laughing Crowd Absent   **Laughing Crowd Present**
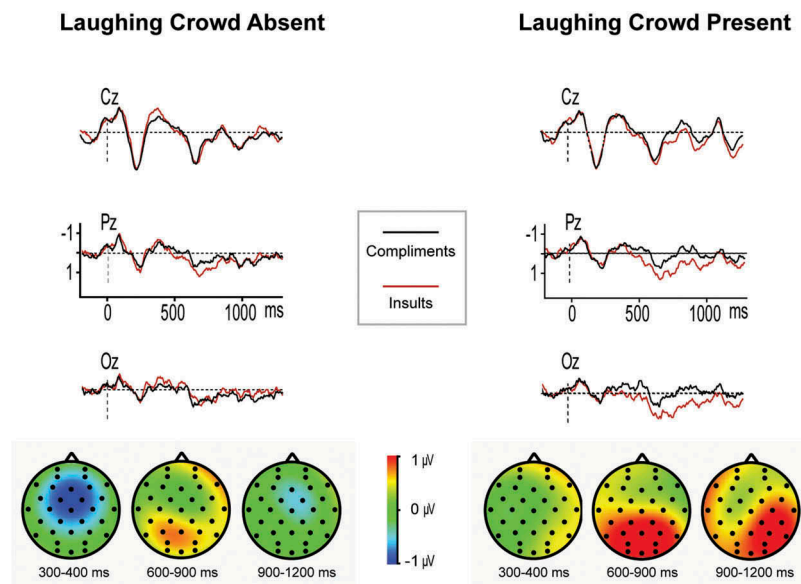
Figure 2. Shows the ERPs evoked by compliments (black lines) and insults (red lines) in the absence of a laughing crowd (No Laughter Condition, left side) and in the presence of a laughing crowd (Laughter Condition, right side). Scalp distributions of the ERP effects for each analysis window are presented for each of the two conditions at the bottom of the figure.

LPP time window (Figure 2, right panel). To be able to detect differences over time between the presence and absence of a laughing crowd on the effects of Sentence Message, we split the analysis for the late positivity into two time windows: One early time window covering 600–900 ms after word onset, and one late time window covering 900–1200 ms after word onset.

600–900 ms
Sentence Message had a significant main effect on the ERP between 600 and 900 ms ($F(1,45) = 7.90$, $p < .01$, partial $\eta^2 = .15$), with insults evoking a more positive ERP than compliments. This effect of Sentence Message was only present on posterior electrodes (Sentence Message * AntPost; $F(1,45) = 13.50$, $p = .001$, partial $\eta^2 = .23$). There was no main effect of Social Context in this time window ($F(1,45) = 1.00$, $p = .32$, partial $\eta^2 = .02$). There was also no significant interaction between Sentence Message and Social Context ($F(1,45) = .49$, $p = .50$, partial $\eta^2 = .01$), indicating that in this time window the ERPs to insults were more positive compared to compliments independent of the presence or absence of a laughing crowd. For the central electrodes the pattern of results is the same, with only a main effect of Sentence Message on early LPP amplitude ($F(1,40) = 5.74$, $p = .02$, partial $\eta^2 = .13$)

900–1200 ms
In the late LPP window, Sentence Message and Social Context did not have main effects on the ERP (respectively $F(1,45) = 2.33$, $p = .13$, partial $\eta^2 = .05$; and $F(1,45) = .96$,

$p = .33$, partial $\eta^2 = .02$). There was, however, a significant interaction between Sentence Message and Social Context ($F(1,45) = 4.96$, $p = .03$, partial $\eta^2 = .10$), with insults evoking a larger positivity than compliments in the presence of a laughing crowd ($t(45) = 2.38$, $p = .03$, Cohen's $d = .71$) but not when the laughing crowd was absent ($t(45) = .35$, $p = .73$, Cohen's $d = .10$). The presence of the laughing crowd affected insult processing ($t(45) = 2.47$, $p = .02$, Cohen's $d = .74$) but not compliment processing ($t(45) = 1.53$, $p = .13$, Cohen's $d = .46$). Again the effect of Sentence Message interacted with scalp location (Sentence Message * AntPost; $F(1,45) = 5.25$, $p = .03$, partial $\eta^2 = .11$), showing that there was only a difference in ERP amplitude between insults and compliments on posterior electrodes. For the central electrodes the pattern of results is the same, with a significant interaction between Sentence Message and Social Context ($F(1,40) = 7.12$, $p = .01$, partial $\eta^2 = .15$).

Discussion

The results of this experiment show that insults are processed differently from compliments from as early as 300 ms after the first insulting word has been read. Moreover, the social context in which an insult is delivered directly changes the way the brain processes insults.

Neural correlates of insult perception

Insults in the No Laughter Condition, where insulting and complimenting sentences were presented without any

social context, evoked a larger negativity between 300 and 400 ms, followed by a short-lived late positivity compared to compliments. The late positivity could reflect an increase in LPP, and suggests that insults evoke stronger emotional processing compared to compliments, even when presented without laughing onlookers, in line with findings from another recent ERP study on insult processing (Struiksma, De Mulder, Spotorno, Basnakova, & Van Berkum, 2014).

The increased negative potential occurred within the N400 time window, suggesting that differences in emotional processing between insults and compliments also modulated the N400. However, the scalp distribution is more anterior than that of the canonical N400. One reason for this relatively unusual scalp distribution could be the fact that the effect of insult is measured relative to compliments. Explicitly positive words are known to evoke increased N400 amplitude themselves (Holt, Lynn, & Kuperberg, 2009; Wabnitz et al., 2012). The observed anterior distribution of the difference in activation between insults and compliments suggests that both insults and compliments evoke an increase in N400 amplitude, but that insults evoke a more widespread N400 than compliments (See Holt et al., 2009 for a similarly distributed difference in N400 activation between negative and positive words). This enlarged N400 for insults indicates that insults stand out (Kutas & Federmeier, 2011; Kutas & Hillyard, 1980) and lead to increased semantic analysis (Van Berkum, 2009) compared to compliments when these insults and compliments are presented in a neutral context.

Although we suggest here that the difference in N400 amplitude reflects a difference in emotional processing between insults and compliments, it could in principle also reflect a difference in lexical frequency between target words from insulting and complimenting sentences (with complimenting targets having a slightly higher frequency than the insulting targets). Another factor that could influence N400 amplitude is the emotional intensity of the target words: It is possible that the insulting target words have (on average) a more extreme valence than the complimenting target words. Although we cannot rule out these possibilities within the current experimental setup, the fact that the N400 is modified by the presence of a laughing crowd of onlookers (as discussed below) suggests that this activation relies on the processing of the emotional message of the sentences, not on relatively superficial lexical processing of the individual target words.

The effect of laughing others on insult perception

In line with the hypothesis that social context immediately changes the emotional load of insults, we found a critical modulation of the N400 and LPP effects when insults and compliments were presented with laughter: When the sentences were accompanied by (a symbolic representation of) a laughing crowd, there was no difference in N400 amplitude between insults and compliments. The difference between insults and compliments in LPP amplitude, however, was larger and longer lasting than in the No Laughter Condition.

The increased LPP effect indicates that, when the presence of a laughing crowd is suggested, insults evoke much stronger emotional processing. This finding is highly relevant for research that focusses on negative interpersonal interactions such as bullying, or interpersonal and intergroup conflict. Our results stress the immediate and direct relevance of context in these negative interpersonal interactions: While the insulted is still busy reading the unfolding insult, the extra sting of publicity is already encoded and integrated in the brain. For example, our results suggest that for example a child that is being bullied by a classmate in a full classroom will directly encode the additional emotional toll of the public humiliation of the bullying statements. This direct and immediate effect of laughter and publicity on insult perception is likely to make it more difficult to regulate the subsequent emotional imbalance (Ochsner & Gross, 2008) for the bullied child. As such, the direct integration of publicity and laughter with insult perception could have both short- and long-term effects on emotional well-being. The current experiment could also explain why cyberbullying has such far-reaching effects on its victims (Kowalski, Giumetti, Schroeder, & Lattanner, 2014; Sticca & Perren, 2013; Tokunaga, 2010). Even though cyberbullying often takes place without any direct witnesses, the Internet has a long memory and an almost unlimited potential for others to witness the humiliation of the bullied person at a later point in time. The current study shows that the knowledge of future mocking is enough to make an insult sting more. It thus also suggests that the potential future publicity of cyberbullying might make it harder to handle the emotional impact of these already very negative interactions. On a more uplifting note, our results also speak to potential positive effects of context. If an insult can be made worse by being presented publicly, then it is perhaps also possible that a negative interaction can be immediately improved by a positive social context, such as the presence of supportive friends, or knowledge about the insulter ("She does not mean it.").

The absence of a difference in N400 amplitude between insults and compliments when a laughing crowd is present is somewhat surprising. One possibility is that the presence of a laughing crowd induced a

qualitative shift in processing style, lowering attention for lexical-semantic processing of insults, while more resources are attributed to emotional processing of the insult. This possibly indicates a shift from a local, lexical-semantic style of processing when insults are less personally relevant, and thus less personally negative, to a more global level of emotional processing when insults are made more personally relevant, and thus more personally negative, by the social context. One emotion that could play an important role here is humiliation. As described in the introduction, a recent study by Mann et al. (submitted) shows that insults are specifically perceived to be more humiliating when received in front of a laughing crowd. Publicity, combined with public endorsement of a personally negative experience, is an important factor in interpreting a situation as humiliating (Besser & Zeigler-Hill, 2010; Elison & Harter, 2007; Hartling & Luchetta, 1999; Klein, 1991). Previous work on the neurophysiology of humiliation (Otten & Jonas, 2014) shows that humiliation mobilizes more neural processing power. This could explain why the (potentially) more humiliating public insults leave less room for other cognitive processes such as semantic analysis and integration.

Another possible explanation for the pattern of results observed in the Laughter Condition could be that the larger LPP evoked by insults in the presence of a laughing crowd is not only longer-lasting (as our results significantly show) but also starts earlier. Such an early onset of the positive LPP component would cancel out the negative N400 component, resulting in a net absence of N400 or LPP differences for the time window in which the two components overlap (see for example Van Berkum et al. (2009) for a similar overlap of N400 and LPP time windows). This pattern of overlapping components is already somewhat visible in the No Laughter condition, where the N400 effect is slightly shorter-lived than standard, suggesting that for the later part of the N400 time window, the N400 effects is obscured by the presence of an LPP effect (and vice versa). If it is indeed the case that an early onset LPP simply obscures the presence of an N400 effect, then the interpretation of the consequences of the presence of a laughing crowd should be modified: The presence of a laughing crowd leads to earlier, stronger and longer-lasting emotional processing of insults, while lexical-semantic attention to insults (over compliments) stays comparable to a neutral social context.

The results clearly show that the laughter manipulation has an effect on the processing of insults (compared to compliments). This effect of social context can rely on several aspects relevant to the experimental manipulation. It could be directly related to the anticipation of the laughter itself or to the fact that the insults in the laughter condition were public, while the insults in the no laughter condition were private, and it might also result from a combination of these two aspects. The current design does not allow a distinction between these factors. Future research that includes the presence of a non-laughing crowd in addition to a laughing crowd could shed light on which factor (laughter or publicity, or a combination of both) drives the social context effects on insult perception.

It is important to note that the differential effects of laughter on insult and compliment processing are not the result of the processing of the auditory signal related to the laughter itself. For a small subset of sentences (20% of the total set) where the critical insulting or complimenting word appears one word before the end of the sentence (target words were never sentence final), the onset of the auditory laughter signal is 925 ms after the onset of the critical word. However, exploration of the ERP signal timelocked to the onset of the laughter itself shows that the results for the target word's 925–1200 ms time window (see Supplemental materials) cannot be explained by activation related to auditory processing of the laughter sound. Therefore, the differences between laughter and no-laughter condition is a result of the integration of anticipated laughter and/or publicity with the processing of the sentence, not of the auditory signal of laughter itself.

One interesting implication of this study is that the insulted people proactively take into account the social context of their insults. In our experiment, the "crowd" did not start laughing until after each sentence had finished. However, the effects of the presence of the laughing crowd were already visible very shortly after the presentation of the critical insult/compliment, which always took place several words before the end of the sentence. This means that the laughter had its effect long before any actual laughter had been detected by the participant. It thus seems that the participants anticipated the social context and the presence of the laughing onlookers. This was possible because, as a result of the blocked design, people knew that they would be laughed at or not. This finding is in line with results that show that simply imagining the sound of laughter is enough to generate the neural signature of the processing of actual laughter (Lima et al., 2015). Moreover, this finding suggests that people not just passively process the incoming sensory signal, but instead actively anticipate and predict what input they will receive. This shows that predictions in language processing are not limited to lexical-semantic predictions (Lau, Holcomb, & Kuperberg, 2013; Mani &

Huettig, 2012; Otten, Nieuwland, & Van Berkum, 2007b; Szewczyk & Schriefers, 2013; Van Petten & Luka, 2012) but also include predictions about the specific social context in which the linguistic utterance should be interpreted. This finding generates interesting new ways to think about how people understand and interpret language. It indicates that, to derive the meaning of an utterance people not just take into account the lexical-semantic content of the utterance, but also the present and anticipated state of the social context.

Throughout the paper, complimenting sentences have been considered as a baseline to which to compare the insults. We reasoned that, unlike insults, compliments do not convey a different meaning and emotional impact when presented with an approvingly laughing crowd. However, one could argue that the presence of a laughing crowd can change a compliment, from a well-intentioned positive statement to a somewhat mean sarcastic comment. That would mean that the differences that we observed between insults and compliments in the presence of a laughing crowd are not solely due to the differential processing of the insults, but (partially) to the compliments. However, previous work on sarcasm and irony processing (Katz et al., 2004; Regel et al., 2010; Spotorno et al., 2013) shows that sarcastic statements actually *increase* the amplitude of the late positivity in the ERP. As such, if adding laughter to a compliment would indeed alter its meaning from positive to sarcastic, this would mean an increase in amplitude of the late positivity for compliments with Laughter, compared to No Laughter. Our data, however, show no significant difference in LPP amplitude for compliments in the Laughter and No Laughter Condition. It is therefore not very likely that the difference in LPP amplitude between insults and compliments is driven by a sarcasm-induced increase in the late positive component evoked by compliments.

Overall, the current experiment shows that insults elicit more lexical-semantic and emotional processing compared to compliments. The ERPs evoked by insults and compliments diverge as soon as 300 ms after the first insulting information is encountered, showing that insult-specific neurocognitive processing emerges almost immediately. Moreover, the social context in the form of a laughing crowd can directly influence how the brain processes insults. In the presence of a laughing crowd, the LPP effect of the ERP, related to emotional processing, is larger than when no laughing crowd is present, while the N400 effect, related to lexical-semantic processing, is no longer present. The presence of a laughing crowd thus leads to stronger and more elongated emotional processing. In short, it seems that public insults are no laughing matter, at least not for the insulted.

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