***Examining the influence of perspective and prosody on expected emotional responses to irony: Evidence from event-related brain potentials***


## Abstract

Ironic language is typically more difficult to process and interpret than a literal equivalent, hence is assumed to serve several social and emotional functions not achieved by literal communication (such as politeness or introducing humour). Several factors may influence emotional responses to irony, such as the perspective from which the utterance is encountered (e.g., speaker vs. target) and the tone of voice (prosody) used. To examine these issues, we conducted two event-related brain potential (ERP) studies in which participants listened to scenarios describing emotional responses to either literal criticism or ironic criticism. Ironic criticism was delivered with either natural or ironic prosody. Scenarios either described an emotional response the speaker expected to elicit from the target (speaker perspective), or the target's actual emotional response (target perspective). Expected or actual emotional responses were described as either 'amused' (Experiment 1) or 'hurt' (Experiment 2). ERPs were calculated time-locked to the end of the ironic or literal statements, and to the audio presentation of the critical emotion words. Results showed a significant effect of perspective for *amused* conditions, reflected by a larger late posterior positivity for the target than speaker conditions, indicating amused responses are more expected from speaker than target perspective. This effect was not seen for *hurt* conditions, suggesting these are equally expected from target and speaker perspectives. The data also revealed a more negative-going ERP waveform specifically for ironic criticism delivered with ironic prosody, reflecting prosodic processing. This suggests prosody may be able to speed the identification of irony.



*Keywords:* irony, perspective, event-related potentials, prosody, emotion


*Public interest statement:* This study shows that when delivering criticism, people expect both speaker and target to find it hurtful, but only the speaker may intend it to be amusing. It also shows that ironic tone of voice may facilitate the identification of irony.

## Introduction

The basic nature of verbal irony is to say one thing with the intention of communicating the opposite of the surface form (Booth, 1974; Grice, 1975); for example, saying *You're so hilarious* with the intended meaning of *You're not even slightly funny*. However, if the irony is not correctly identified, a listener may take the literal surface form as the intended meaning. The potential ambiguity posed by irony is well established (Clark, 1996; Filik, Leuthold, Wallington, & Page, 2014; Filik & Moxey, 2010; Regel, Gunter, & Friederici, 2011), as is the frequency of irony in everyday speech (Gibbs, 2000; Hancock, 2004). Language users, therefore, are often faced with resolving this particular ambiguity, either relying on context or more explicit signals.

Irony has many functions that are argued to justify its use in spite of the ambiguity it poses. These can include politeness (Kumon-Nakamura, Glucksberg, & Brown, 1995) and forging in-group identity (Colston, 1997), though they mainly fall into the broad categories of *hurtfulness* (Gibbs, 1986; Jorgensen, 1996; Katz & Pexman, 1997; Kreuz, Long, & Church, 1991) and *humour* (Dews, Kaplan, & Winner, 1995; Dress, Kreuz, Link, & Caucci, 2008; Kreuz et al., 1991; Toplak & Katz, 2000). Interestingly, these are not necessarily mutually exclusive responses (Dress et al., 2008). A speaker can intend a comment as partially hurtful and partially amusing. Indeed, Filik, Brightman, Gathercole, and Leuthold (2017) found that ironic criticism can be initially interpreted as hurtful and later understood as humorous. These additional layers to irony increase the chances of discrepancies between speaker intent and listener interpretation.

Indeed, perspective has been highlighted as a significant factor when interpreting meaning. Bowes and Katz (2011) demonstrated that criticism (both literal and ironic) is judged as more impolite when framed from the perspective of the target as opposed to the speaker. Eye-tracking research (e.g., Filik et al., 2017) has also indicated that participants find it more

difficult to process ‘amused’ responses to criticism when described from the perspective of the target as compared to the speaker. This is perhaps explained by the observation by Toplak and Katz (2000) that intention is most closely linked to the speaker’s perspective and the emotional impact is closely linked to the target’s perspective. Based on this, Filik et al. (2017) suggest that when the target’s perspective is considered, the negative aspects are attended to more, while framing things from the speaker’s perspective prompts a deeper consideration of intent.

Perspective may also be a factor underlying a point of contention in the literature: whether irony strengthens or lessens the impact of a comment. Some research has suggested that irony increases the emotional response, typically to negative comments (Colston & Gibbs, 2007; Leggitt & Gibbs, 2000; Toplak & Katz, 2000), but also for positive comments (Filik, Hunter, & Leuthold, 2015). However, an opposite muting effect of irony, which is known as the Tinge Hypothesis (Dews & Winner, 1995), has also been widely reported (Dews et al., 1995; Filik et al., 2016; Harris & Pexman, 2003; Jorgensen, 1996; Thompson, Mackenzie, Leuthold, & Filik, 2016). Pexman and Olineck (2002) suggest that these different findings may relate to the particular perspectives that are used in different experimental materials, such as focusing on intent, or on ‘social impression’.

Clearly, then, the perspective from which irony is encountered or described can be expected to influence the anticipated emotional response. In order to further examine this issue, we conducted two event-related potential (ERP) studies in which participants listened to short, spoken scenarios. The reason for using spoken scenarios is that it affords the opportunity to additionally investigate the influence of tone of voice (prosody). The disambiguating effect of prosody has been shown by Mauchand, Vergis, and Pell (2020), at least for literal praise versus ironic criticism (as in *Your hair looks great!*), and observed in a more general manner by Bryant and Fox Tree (2002). The most common feature of an ironic tone is a slower speaking rate (Bryant, 2010), but other typical features can include more varied pitch and greater stress

(Kreuz & Roberts, 1995). However, beyond serving to disambiguate, it is currently unclear whether prosody contributes to the expected emotional response to irony.

## Current Study: Objectives and Hypotheses

The aims of this paper are (1) to study what role ironic prosody plays in the processing of ironic criticism and in contributing to the expected emotional response; (2) to reveal whether there is a difference in the expected emotional response to irony as a function of the perspective from which it is described; and (3) to examine whether the two major attributes of irony (humour and hurtfulness) are associated with particular perspectives. We address these by conducting two ERP studies in which we manipulate perspective and attitude. Specifically, participants will listen to scenarios in which criticism is delivered one of three ways: literally with natural prosody; ironically with natural prosody; or ironically with ironic prosody (we refer to these conditions as *literal-natural*, *ironic-natural*, and *ironic-ironic*, respectively; see Table 1 for example scenarios). Participants' electrical brain activity on encountering (1) literal-natural criticism vs. ironic-natural and ironic-ironic criticism, and (2) the emotional response (*amused* in Experiment 1, and *hurt* in Experiment 2) to the criticism that is either described as being experienced by the target, or intended by the speaker, will be analysed.

With regard to the processing of prosody, Regel (2009) reported a more negative-going ERP waveform over posterior electrodes for ironic than natural prosody at sentence onset, which was not influenced by the type of context (ironic versus literal). Hence, she took this enlarged ERP negativity to reflect the detection of prosody. By contrast, for ERPs time-locked to sentence offset, she observed an enlarged positivity (P600) to ironic versus literal utterances. Likewise, we predict that processing of prosodic information would be revealed by a more negative going ERP waveform for ironic-ironic as compared to both ironic-natural and literal-natural conditions. By contrast, if ERPs reflect the processing of irony, a larger positivity

should be triggered by ironic than literal criticism as in previous ERP studies (Filik et al., 2014; Regel, 2009; Regel et al., 2011), although this effect might also be modulated by prosody. That is, if irony mutes the response to criticism, one might predict a smaller LPP to ironic than literal criticism.

Regarding the processing of the target emotional response (e.g., words such as *amused* in Experiment 1, and *hurt* in Experiment 2), studies using non-constraining contexts or emotional contexts have typically shown a larger late posterior positivity (LPP) to emotional than non-emotional materials, reflecting the intensity of affective processing both when the affective content has to be judged (e.g., Delaney-Busch & Kuperberg, 2013; Kunkel, Filik, Mackenzie, & Leuthold, 2018) and when merely reading for comprehension (e.g. Kunkel, Filik, Mackenzie, & Leuthold, submitted). Specifically, we predict participants will find humour to be a better fit for the speaker's intent, and hurtfulness to be a better fit for the target's response. Given the relatively non-constraining nature of the current contexts, therefore, we expect an LPP effect.

That is, in Experiment 1, which examines 'amused' responses, we might predict a larger LPP for amused responses that are described as being experienced by the target, as opposed to being intended by the speaker. In contrast, in Experiment 2, which examines 'hurt' responses, we might expect the opposite, specifically, a larger LPP for hurt responses that are described as being intended by the speaker, as opposed to being experienced by the target. In addition, if irony mutes the emotional response to criticism, one might predict a smaller LPP to emotion words following ironic compared to literal criticism. In terms of effects of prosody, ironic prosody may help to emphasise the presence of irony generally, and hence elicit a greater consideration of the possible speaker intentions and target responses, however, it is not clear how this will impact expectation for specific emotional responses.

## Participants

Forty-one participants took part in Experiment 1, however, three were excluded due to poor data quality (e.g., excessive EEG activity during the baseline, extreme alpha activity, or drifts), one due to too few trials remaining following artifact correction (≤ 35%), and one due to a computer crash half-way through the experiment. The final set of 36 participants were aged between 16 and 44 (mean = 24.97; SD = 6.99; 15 female). A new set of 41 participants took part in Experiment 2; five were excluded due to poor data quality (as above). The final 36 participants were aged between 18 and 60 (mean = 22.36; SD = 6.88; 21 female). All participants were native speakers of British English with no learning difficulties. Participation was voluntary and paid at £18. Both studies were approved by the Ethics Committee of the School of Psychology, University of Nottingham.

## Stimuli

Two hundred and forty sets of materials were created in the form of short scenarios with six conditional variants, as in Table 1. Items were assigned to six counterbalanced lists and interspersed with a set of 240 filler materials. All were recorded by a native speaker of British English and cut to length using Audacity (Version 2.1.0) audio editing software. The materials all took the same form for the two experiments except that for those in Experiment 1, the final sentence described either the target having an amused response, or the speaker intending to elicit an amused response, whereas in Experiment 2, the final sentence in each case was replaced with one describing either the target having a hurt response, or the speaker intending to elicit a hurt response. For further details on stimuli and a full list of materials, see our supplementary materials.

**Table 1** Example material showing six conditional variants: 2 perspective (target vs. speaker) × 3 attitude (literal-natural vs. ironic-natural vs. ironic-ironic). The critical emotion word in Experiment 1 vs. 2 is shown in italics.

| | Audio | Condition |
|---|---|---|
| 1 | Mark had aimed to climb a mountain at the weekend but barely got past the car park. | |
| 2 | Lauren said to him, "You're so lazy". | literal; natural tone |
| | Lauren said to him, "You're so energetic". | ironic; natural tone |
| | Lauren said to him, "You're so energetic". | ironic; ironic tone |
| 3 | When Mark heard the comment, he was *amused/hurt*. | target perspective |
| | Lauren hoped Mark would hear the comment and be *amused/hurt*. | speaker perspective |

**Procedure**

Participants sat in a magnetically shielded and soundproof booth. Stimuli were presented using SR Research Experiment Builder, while EEG signals and sentence-specific triggers were recorded in BioSemi ActiView. Trials started with a fixation spot. While there was no visual component, this helped to minimise eye-movement artifacts. Next the three-sentence audio stimuli were played. The experiment had regular breaks built in to avoid fatigue. To ensure attention, comprehension questions were asked after 10% of trials and always following fillers to avoid drawing attention to any aspects of the experimental materials. All participants achieved an accuracy of at least 80%.

**Electrophysiological measures and ERP analysis**

In the following, we briefly describe data preprocessing, with full details being given in our supplementary materials. EEG activity was recorded continuously from 72 Ag-AgCl electrodes using a BioSemi Active-Two amplifier system. The sampling rate for the EEG and electrooculogram (EOG) recordings was 256 Hz. Off-line, all EEG channels were recalculated

to an average reference and high-pass filtered (0.1 Hz, 6 dB/oct). EEG signals were preprocessed as described in Dudschig, Mackenzie, Strozyk, Kaup, and Leuthold (2016; for details see supplementary materials).

For artifact-free trials, the signal at each electrode site was averaged separately for each experimental condition, time-locked (1) to the offset of the second sentence containing the literal/ironic criticism, and (2) to the onset of the critical word in the final sentence. Thus, the analysis epoch for the second sentence started 1,400 ms prior to its offset and lasted until 600 ms after it, whereas the epoch for the emotion word started 200 ms prior to its onset and lasted until 1,500 ms after it, resulting in total epoch durations of 2,000 and 1,700 ms, respectively. All resulting ERP waveforms were low-pass filtered (6 Hz, 6 dB/oct), and aligned to a 200-ms baseline either at the start of the analysis epoch of the second sentence or prior to the onset of the critical emotion word of the final sentence.

The ERPs triggered by the critical word in the final sentence were analysed as in a previous study from our lab concerned with emotional text comprehension during reading (Kunkel, Mackenzie, Filik, & Leuthold, submitted). That is, mean ERP amplitudes were determined for the two time ranges 300-600 ms and 600-1000 ms at electrodes close to the midline (CP1, CPz, CP2, P1, Pz, P2, POz) that were pooled to form one posterior region of interest (ROI). For this ROI, the resulting ERP amplitudes were also determined relative to the offset of the second utterance for the time range -300-0 ms and 0-300 ms. Since the disambiguating word started about 1000-500 ms before the offset of the second sentence, these two analysis intervals should allow us to reveal potential effects of irony and prosody triggered by this sentence.

## Data analysis

Statistical analyses were performed by means of Huynh-Feldt corrected mixed-design analyses of variance (ANOVA) for the analyses of the between-subjects factor *emotional response* (Experiment 1: amused vs. Experiment 2: hurt) and the within-subject factors *perspective* (speaker vs. target) and *attitude* (literal-natural vs. ironic-natural vs. ironic-ironic). For all statistical analyses, the significance level was set to alpha = .05. For follow-up tests, the significance level was Bonferroni-corrected.

## Results

### Utterance-related ERPs

Figure 1 displays grand average ERP waveforms time-locked to the offset of the utterance, showing an ERP positivity that was maximal around the offset of the utterance in both experiments.

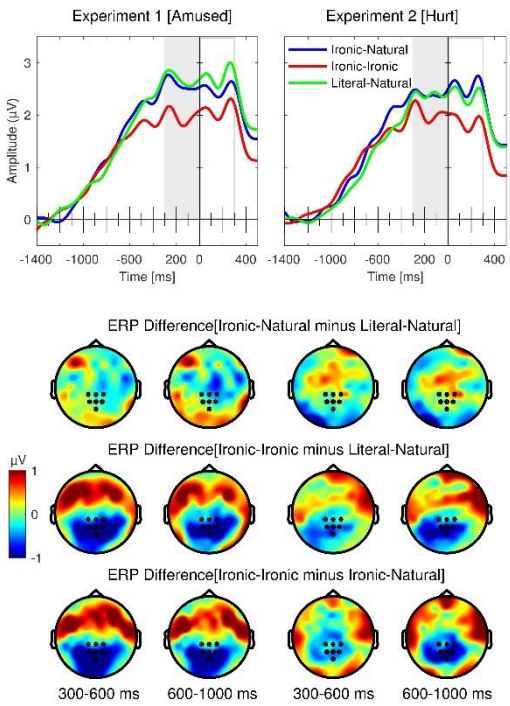


**Figure 1** Grand average ERP waveforms for literal-natural, ironic-natural, and ironic-ironic criticism separately for amused responses (Experiment 1: left panel) and hurt responses (Experiment 2: right panel). The respective topographic maps of ERP amplitudes in grand mean difference waveforms for the 300-600 ms and 600-1000 ms time intervals are depicted below.

**Time interval -300-0 ms**

Within this time window, only the main effect of attitude was significant, $F(2, 140) = 8.26$, $p < .001$, $\varepsilon = .97$, $\eta_p^2 = .11$. Further testing indicated a reliably more negative-going ERP amplitude for the ironic-ironic condition (2.01 µV) than for both the ironic-natural condition (2.53 µV), $F(1, 71) = 10.02$, $p = .002$, and the literal-natural condition (2.59 µV), $F(1, 71) = 11.91$, $p < .001$. There were no other significant effects, all $F$s ≤ 1.70, $p$s ≥ .17, $\eta_p^2 \leq .02$.

**Time interval 0-300 ms**

As in the earlier time interval, the ERP analysis revealed a main effect of attitude, $F(2, 140) = 10.57$, $p < .001$, $\varepsilon = 1.0$, $\eta_p^2 = .13$. Again, ERP amplitudes for the ironic-ironic condition (1.90 µV) were more negative-going than for both the ironic-natural condition (2.51 µV), $F(1, 71) = 16.09$, $p < .001$, and the literal-natural condition (2.55 µV), $F(1, 71) = 10.07$, $p < .001$. No other effects were significant, all $F$s ≤ 2.08, $p$s ≥ .15, $\eta_p^2 \leq .03$.

## Emotion word-related ERPs

Figure 2 displays grand average ERP waveforms time-locked to the critical emotion word in both experiments.

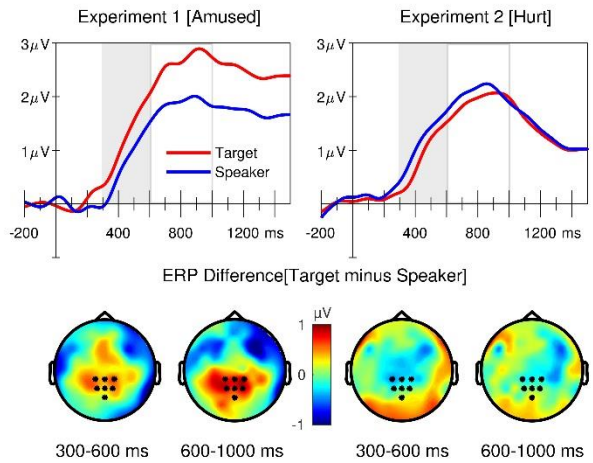


**Figure 2** Grand average ERP waveforms for target and speaker perspectives (averaged across attitude conditions) separately for amused responses (Experiment 1: left panel) and hurt responses (Experiment 2: right panel). The respective topographic maps of ERP amplitudes in grand mean difference waveforms for the 300-600 ms and 600-1000 ms time intervals are depicted below.

### Time interval 300-600 ms

As can be seen in Figure 2, within this time window, the ERP waveform for the posterior ROI was characterized by a developing positivity. The Emotional Response x Perspective interaction was significant, $F(1, 70) = 9.87$, $p = .002$, $\eta_p^2 = .12$. Separate tests indicated a more positive-going ERP amplitude for the target than the speaker condition (1.20 vs. 0.76 μV) with amused responses, $F(1, 35) = 11.26$, $p = .002$, whereas the reverse numerical effect with hurt responses (0.85 vs. 1.05 μV) was not significant, $F(1, 35) = 1.59$, $p = .22$. No other effects were significant, all $F$s $\leq 2.56$, $p$s $\geq .081$, $\eta_p^2 \leq .04$.

### Time interval 600-1000 ms

Posterior ERP amplitude within this time interval was more positive for the target than the speaker condition (2.25 vs. 1.92 μV), $F(1, 70) = 8.22$, $p = .005$, $\eta_p^2 = .11$. In addition, the Emotional Response x Perspective interaction was significant, $F(1, 70) = 7.75$, $p = .007$, $\eta_p^2 = .10$. Again, separate tests indicated a more positive-going ERP amplitude for the target than the speaker condition (2.53 vs. 1.90 μV) with amused responses, $F(1, 35) = 16.44$, $p < .001$, but not with hurt responses (1.96 vs. 1.95 μV), $F(1, 35) = 0.003$, $p = .95$. There were no other significant effects, all $F$s $\leq 1.40$, $p$s $\geq .25$, $\eta_p^2 \leq .02$.

## Discussion

This paper presented an ERP study examining the roles of perspective and prosody on the processing of (a) ironic and literal criticisms and (b) two types of emotional responses typically associated with irony: *humour* and *hurtfulness*. The data produced several interesting findings.

There was a notable effect of perspective, aligning with other work that highlights its importance (Bowes & Katz, 2011; Toplak & Katz, 2000). Perspective made a significant difference for *amused* conditions (Experiment 1), as reflected by the larger LPP for the target than speaker. This was sustained throughout the analysis epoch, which lasted from 300-1000

ms. We take this to indicate that an amused response was generally evaluated as affectively more salient from the perspective of the target than that of the speaker, in other words, because it was more unexpected from the target than the speaker. For *hurt* conditions (Experiment 2), this pattern was reversed, though only produced a statistical trend in the 300-600 ms but not the 600-1000 ms time interval. This zero-effect might indicate that hurtfulness is equally processed in both a speaker's intention and a target's response. This suggests criticism can be both perceived as hurtful and intended as hurtful, as one would expect; however, while an amused response to criticism is emotionally salient and unexpected from the target's perspective, it is seen as a legitimate possibility that criticism is *intended* as amusing by the speaker. Since intending to elicit an amused response to literal criticism is unlikely, we suggest this effect is driven in part by the ironic conditions, due to irony's association with the attributes of both humour and hurtfulness (Dress et al., 2008). A future study could examine this possibility.

Interestingly, the ERP response to hurt conditions also seems worthwhile to investigate further. Thus, There was a numerical trend for a more positive-going ERP waveform for the speaker than the target condition, but this appeared to be less sustained than the effect observed for amused conditions. This observation might relate to previous findings that a hurt response elicits a more complicated pattern of effects than an amused one. Specifically, an eye-tracking study conducted by Filik et al. (2017) using similar materials showed that whether or not a hurt response was anticipated by readers changed over time, whereas expectations for an amused response did not.

The data also revealed a more negative-going ERP waveform for ironic criticism delivered with ironic prosody as compared to the ironic-natural and literal-natural conditions, which pattern together. We take this to reflect processing of prosodic information, in line with Regel (2009). Furthermore, given how early the difference emerges, it seems likely that ironic

prosody contributes to faster detection of irony. Typically, prosody helps to disambiguate irony from its possible literal interpretation (Bryant & Fox Tree, 2002; Mauchand et al., 2020). However, our data suggest such disambiguation or greater attention does not impact the way participants process or predict speaker intent, nor the response of the target. That is, prosody may signal the presence of irony, but does not appear to impact further pragmatic processing.

In conclusion, we see that the perspective from which a statement is framed - speaker versus target - primarily impacts the processing of amused responses, but has a less clear effect on hurt responses. We also saw a clear response to ironic prosody, which is likely to lead to faster identification of the presence of irony. However, this did not alter responses to the subsequent emotional reactions or intentions. Given these first insights, it appears worthwhile for future studies to investigate the combined impact of irony, prosody, and perspective on online pragmatic processing using ERPs.

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