Journal of Psychology & Behavior Research
ISSN 2640-9895 (Print) ISSN 2640-9909 (Online)
Vol. 4, No. 2, 2022
www.scholink.org/ojs/index.php/jpbr

Original Paper

The Multi-Determined Nature of Online Verbal Irony Processing: A Review of Empirical Studies Employing Eye-Tracking and Event-Related Potentials

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Received: May 3, 2022 Accepted: May 11, 2022 Online Published: May 24, 2022

doi:10.22158/jpbr.v4n2p55 URL: http://dx.doi.org/10.22158/jpbr.v4n2p55

Abstract

Methodologies used in behavioral studies on the processing of figurative languages have been criticized for lack of sufficiently fine-grained recordings. Thus, recent literature on empirical studies on irony processing often talks about advantages of online-processing employing techniques with higher temporal resolution. This article reviews a series of selected Event-Related Brain Potentials (ERPs) and eye-tracking studies on the recognition and comprehension of verbal irony to provide an informed state of knowledge on this particular figurative language. First of all, we will introduce some common eye-tacking measures and ERP components recorded in these empirical studies; then we will enumerate factors involved in verbal irony processing from three differing but closely related dimensions. In this way, we expect to propose future research directions that could embrace more cognitive differences of individuals within the framework of theories about verbal irony comprehension.

Keywords

verbal irony, cognition, empirical studies, eye-tracking, ERPs

1. Introduction

Verbal irony (in contrast to other kinds of ironies like emoji-based irony) is a form of figurative language by which speakers can manage to convey their intended meanings that underlie, or for the most of the time, contradict what they actually say, (e.g., saying “He is bright!” about somebody who

says stupid thing). When employing verbal ironies, speakers simultaneously communicate some literal information and an opposite attitude toward literal information, and thus toward the referent, such as an event, a person, or an object (Cailles et al., 2019).

Therefore, the comprehension of irony is somewhat subtle and interesting, but crucial here is that most of the studies selected in this review often talk about ironic criticism, but not ironic praise or ironic compliment (we will return to this point later). As for the investigation of ironic criticism in early days, a battery of behavioral studies (e.g., Dews & Winner, 1999; Giora & Fein, 1999; Ivanko & Pexman, 2003) have been designed to test traditional theories about irony processing (i.e., standard pragmatic view, direct access view and graded salience hypothesis) but have yielded rather inconsistent results. More importantly, for previous behavioral researches, it seemed impossible to manifest the real time-course over which processing difficulties occurred, which was the primary interest of researches on verbal irony. Therefore, it is necessary to conduct other online methodologies, for instance, eye-tracking and event-related potentials (ERPs), so as to provide a more natural reading environment and more fine-grained recordings over time-course.

In studies concerning the recognition and processing of figurative languages (i.e., idiom, metaphor, irony, etc.), event-related potentials have been widely used which allow the investigation of specific components that are linked to different cognitive processes (e.g., semantic retrieval, semantic integration). In this way, ERP components provide information crucial for revealing the mental mechanism underlying figurative language processing. By comparison, however, though eye-tracking methodology merely yields reading times that are not linked to specific stages of processing, one advantage that eye-tracking is claimed to have over other on-line methods is that it more closely resembles normal reading outside of the laboratory. Compared to the rapid serial visual presentation technique used in the event-related potentials paradigm, in which a text is read one word or phrase at a time without the opportunity to view segments previously read, participants in eye-tracking studies view a text in its entirely and can reread words previously fixated. Therefore, these two on-line methods with high temporal revolution are claimed to have complementary advantages over each other in recording the time course of irony reading (or listening).

Before proceeding it is important to outline some mostly recorded reading time measures in eye-tracking studies and relevant components in ERP studies, so as to elucidate different functions of these indicators.

1.1 Eye-Tracking Recordings of Verbal Irony Processing

For eye-tracking recordings, though no measure of eye movement behavior has yet to be directly linked to a distinct phase of cognitive processing, and in this review, to localize and figure out any processing difficulty involved in verbal irony processing, researchers applied a broad distinction between early versus late measures of eye-movements. Some common early measures (e.g., first fixation duration and first-past time) would indicate that the meaning of irony is identified when being encountered for the

first time, whereas late measures (e.g., regression path time and total reading time) would suggest difficulties or reanalyses of the ironic meaning occurring before readers manage to integrate it into the overall context.

1.2 ERP Recordings of Verbal Irony Processing

For ERP recordings, quantitative differences have been found with reduced amplitudes and/or increased latencies of the ERP for literal sentences compared with matched control ones. We decided to focus on some mostly recorded components thought to reflect the different stages of processing from letter to word in verbal irony processing, e.g., LAN, N400, P600, and LPC (see Table 1). Additionally, out of different experiment designs or aims, some less recorded components like P200 (an indicator related to a myriad of factors like visual attention, word expectancy, short-term working memory, etc.) were also claimed to play a role in some certain cases, though we do not explain them in detail in Table 1.

Table 1. Summary of ERP Components Related to Irony Processing Reported in Selected Studies

ERP component	Cognitive processes related to verbal irony processing	Level of linguistic analysis	Studies that did not report (consistent) component
LAN	Reflecting an increased load on working memory for ironic materials	Lexicon	/
N400	Reflecting semantic difficulty on encountering the irony whose literal meaning does not match the context	Lexicon	E.g., Regel et al. (2011) Spotorno et al. (2013) Caffara et al. (2018) Caffara et al. (2019) Caillies et al. (2019)
P600	Reflecting pragmatic interpretation processes (e.g., integration of figurative meaning into context) that are associated with irony comprehension	Lexicon	E.g., Cornejo et al. (2007)
LPC	Reflecting ongoing processes for ironic materials (probably associated with the perception of humor and emotional connotation)	Lexicon	/

Note: Different from LAN and LPC, N400 and P600 were consistently demonstrated in studies examining other kinds of figurative languages, so here we only focus on studies that failed to report these two components.

1.3 Inconsistent N400 and Consistent P600 in Irony Processing

N400 and P600 are two components particularly relevant to pragmatic phenomena and figurative language comprehension. However, in the case of verbal irony comprehension, effects of P600 were constant across most of the researches whereas the observed effects of N400 did not hold across different studies (also see Table 1). In this sense, studies failing to report consistent N400 challenged standard pragmatic view (Grice, 1975), as well as the graded salience hypothesis graded salience hypothesis (Giora et al., 2007), since the volatility of N400 indicated that, in most cases, readers confronted little difficulties in identifying and integrating semantic information in the early stage of processing, that ironies were not treated as semantic anomalies. Also, the generally discovered P600 challenged the direct access model (Gibbs, 2002) by suggesting the disambiguation between two meanings did occur later.

For this observation, Regel et al. (2006) assumed the absence of N400 well corroborated the facilitative role of a context biasing towards ironic meaning. Nevertheless, even when setting a supportive context before Chinese ironic phrases, Yang et al. (2020) still reported effects of N400. Yang et al. (2020) explained that, as indicators of language processing, N400 and P600 did not distinguish from one another in a rather clear way in terms of their functional meaning, and sometimes, they might overlap each other, thus the unobserved N400 in some cases might be concentratedly reflected by P600 since both two components were conditional on semantic-pragmatic anomalies. This explanation also converged with findings by Kutas and Federmeier (2000) and Ericsson et al. (2008).

Generally speaking, ironic praise is more difficult to process than ironic criticism due to its lower frequency (Pexman & Zvaigzne, 2004), which is called “asymmetry of affect”. Thus, in a recent study by Caillies et al. (2019), it was discovered that the overall pattern of N400 was quite complex, and that N400 could be functionally modulated by the emotional connotation according to the type of irony (ironic criticism vs. ironic praise) as well as by prosody used by the speaker. Meanwhile, P600 effect remained a recurrent and consistent outcome of pragmatic phenomena in their research, reflecting the inference of the speaker’s intended meaning of ironic phrases. Therefore, Caillies et al. (2019) drew a conclusion that N400 and P600 were differentially sensitive to the negative or positive emotional connotations of the message. But considering the fact that researches included in this review mostly employed ironic criticism as the main ironic type of their materials, the explanation by Yang et al. (2020) would be more generally reasonable in some way.

In all, further studies employing more rigorous and elaborate designs are required to give a more reliable answer to this empirical question since N400 effects have been consistently demonstrated in studies examining other kinds of figurative languages.

2. Factors within Contexts

Studies involved in this review both suggested that, as well as ironic-favourable message in the context, some additional information, for example, emotion and use of humor could also contribute to the overall recognition and comprehension of irony (or sarcasm) comprehension.

First of all, in accordance with the direct access view, which proposed that contextual information and lexical processes interacted very early on, thus facilitating readings on ironic phrases to a great extent. In this manner, irony converges with other figurative languages in terms of benefiting from a supportive context biasing towards its non-literal meaning. For example, when communicative intentions were cued in preceding contexts, Regel and Gunter (2017) reported P200 followed by P600 pattern, providing evidence of the crucial role of contextual cues either in the early or in the late stage of irony processing. Similarly, Turcan and Filik (2017) reported that, rather than affecting the overall reading times on literal controls, echoing a previous contextual utterance modulated reading times on irony phrases. In a clear way, contextual echoic mention facilitated the processing of ironic criticism, as indicated by shorter total reading times. Of note, however, was the fact that reading times were overall higher in the spillover region for ironic phrases (we will turn to this point later).

Moreover, Filik et al. (2017) also provided insights into effects of characters' emotional responses in ironic text, with results indicating that, while readers might initially expect a character to be more hurt by ironic than literal criticism, they ultimately rationalized ironic criticism as being less hurtful but more amusing. That was the reason why reading times on ironic phrases were overall shorter than on literal phrases whereas opposite results were observed for spillover regions (Turcan & Filik, 2017). Either out of goodwill or out of spite, humorous use of language is an inevitable effect brought out within the context of irony, consequently, some ERP studies (e.g., Katz, Blasko, & Kazmerski, 2004) reported late P900 which were attributed to the probable processing of humor. Notably, this finding might parallel the discovery of LPC within 600-1000 ms time window regardless of irony familiarity (Regel et al., 2014), both reflecting the presence of ongoing cognitive processes for ironic materials: even though ironic criticism might be perceived as insulting, ironic comments are also used as a form of humor and can be funny. Not surprisingly, in a recent study by Pfeifer and Lai (2021), the function of irony was proved to be dependent upon the emotionality embedded in the context; for higher emotion contexts, larger LPC would be elicited which suggested ironies entailed more emotion processing in emotionally loaded situations. In other words, the extent to which irony could mitigate negativity of criticism might fluctuate with contextual emotions.

3. Factors within Ironic Phrases

Given that factors within the ironic phrase itself are not as various as those within idioms and metaphors, which fall into the same category of figurative expressions, therefore, the effect of familiarity during the comprehension of irony has long been the main focus of relevant studies since it settles the groundwork for resolving the acceptability of graded salience hypothesis (Giora et al., 2007). For example, Filik et al. (2014) conducted two experiments using eye-tracking and ERP respectively, and results suggested that, disruption to eye movements and an N400-like effect were observed for unfamiliar ironies only, supporting the predictions of the graded salience hypothesis. Moreover, in the second experiment, LPC was found for both familiar and unfamiliar ironic materials, compared to non-ironic controls, Filik et al. (2014) interpreted this LPC as reflecting ongoing conflict between the literal and ironic interpretations of ironic utterances regardless of how readers were familiar with them.

Surely, irony familiarity, the rather simple factor of irony, is insufficient for characterizing the full range and variety of irony processing. By using ironies, the attitude of speakers can also be manifested by their tone of voice or prosody (Caillies et al., 2019). Thus, some scholars began to lay eyes on the investigation of irony processing with a different modality, that is, to present participants with aural materials.

To examine whether or not a modality effect would manifest in aural and visual irony comprehension, Regel et al. (2011) presented participants with ironic phrases in auditory and visual forms respectively, LAN was found for both literal and ironic phrases when materials were presented auditorily, indicating the involvement of working memory in aural irony comprehension. However, for visual materials, only P600 was recorded for both phrases and no LAN was found, thus confirming the existence of modality effect with respect to working memory load in irony processing.

Later, prosodic aspects of speech (through attitudinal prosody or emotional prosody) were also proved to supplement or modify the meaning of the spoken ironic sentence by providing valuable clues to the speaker's attitude. Early on, Bryant and Fox Tree (2002) found that participants could correctly distinguish between spontaneously produced ironic versus non-ironic utterances based on prosody. Based on this, Caillies et al. (2019) implemented a research in which positive and negative remarks were presented aurally either with a sincere or an ironic prosody, and they found that N400 behaved in a more volatile way than P600, indicating N400 effect was more sensitive to the negativity of speaker’s message in different prosodies, as well as to the prosody uttered by speakers. Similarly, Caffarra et al. (2018) also merely reported consistent P600 distinctions concerning the impact of foreign accent on ironic praise and criticism, and native listeners considered foreign-accented expressions less ironic, especially for ironic praises, as indicated by greater reduction of P600 amplitude. Next year, in their follow-up ERP study investigating Spanish ironies (Caffarra et al., 2019), they found that, greater N400 effects were observed for ironic phrases only when the provided contexts were positive rather than negative, as well as when uttered by native speakers without foreign accent. Meanwhile, P600 effects

of irony were still constantly observed which suggested greater costs involved in interpreting both ironies. So, at variance with N400, P600 seemed to be independent either of experiment task or of experiment modality, which can be supplementary to our discussion over these two components in the first part.

Notably, as previously mentioned, ironies can be divided into two different types, namely, ironic praise and ironic criticism. With ironic criticism that is much easier to understand having received much attention, ironic praise has been rather neglected for its low frequency of use in our daily life (also referred to as "asymmetry of affect"). The recent ERP study by Cailles et al. (2019) seems to be the first to investigate the on-line neurocognitive processes behind "the asymmetry of affect" observed in irony understanding. So, further studies are required to shed more light on this rather underexplored field of irony research.

4. Factors Related to Individual Differences

In the previous discussion, it was concluded that supportive contextual information can facilitate the selection of an irony's figurative meaning. To be able to interpret a single sentence within the context of a longer piece of text, the reader or listener needs to retain context information in working memory. Results from the study (in Experiment 2) by Kaakinent (2014) suggested that working memory capacity contributed greatly to the way participants deduced the non-literal meaning of ironic expressions, with greater working memory capacity associated with a higher probability of initiating first-pass rereadings on ironies compared to literal matched controls. Thus, the facilitative effects of supportive context are only pronounced if the reader or listener possesses sufficient working memory capacity to retain it for later use, which parallels the discovery of LAN in the study by Regel et al. (2011), though the latter employed stimuli aurally rather than visually; otherwise, they would take compensatory strategies to predict the upcoming words in the sentence, which has been proved in elderly groups. By using a modified trailing mask paradigm, Olkoniemi et al. (2019) reported that, when reading texts containing sarcastic expressions, readers tended to adjust their reading behavior in that a mask prevented them from re-fixating the text content, that readers adopted compensatory strategies dependent on their spatial working memory capacity, though this effect did not hold across studies employing shorter contexts. Not surprisingly, effects brought out by taking different reading strategies can also be differing. When instructing participants to follow different interpretative strategies, Cornejo et al. (2007) confirmed that, holistic strategy or analytic strategy adopted by readers contributed unique variance to their amplitude of N400 amplitude, with greater reduction for the latter, manifesting stronger semantic contradiction encountered for readers adopting a holistic strategy.

Also, at variance with metaphor comprehension, the comprehension of verbal irony has been proved to entail more emotional components than it appeared to need. In one study by Olkoniemi and his colleagues (2016), it was reported that, in addition to shorter fixation times on critical regions for

participants with a better WMC, data on measures like first-past reading were clearly more sensitive to variables in characteristics of participants, indicating that cognitive-affective factors played a crucial role in sarcastic text processing. Again, we boldly extrapolate that this is associated with the very unique component in irony or sarcasm comprehension, that is, the "humor" expressed by the speaker. It can be easily understood that people blessed with different emotional characteristics are supposed to show different responses to this humorous information delivered by the speaker. In a follow-up eye-tracking study by Olkoniemi and his colleagues (2019), results showed that the ability to process emotional information (measured by Iowa Gambling Task) was related to the amount of processing effort invested in resolving sarcasm, in accordance with findings by Filik et al. (2018) which suggested that a reader's tendency to interpret certain phrases sarcastically could be influenced by factors of their personality, and specifically, their tendency to use malicious humor against others. Also, in an earlier ERP study by Regel et al. (2010), in which readers' performance on irony processing varied as a function of their pragmatic knowledge about the speaker's communicative style (with a greater or lower propensity to use ironic expressions), results suggested that an impact on initial phases of processing was found as early as 200 ms (P200), which indicated that readers' pragmatic information about two particular speakers had an early influence on the processing of the critical word embedded in an ironic expression. Moreover, these findings also corroborated the fact that readers' pragmatic knowledge affected later phases of processing in showing modulations of P600 in response to ironies of the respective speaker. Taken together, it follows that readers' different pragmatic knowledge about particular speaker char1acteristics (collected from subtle information in the context) appears to establish a relevant cue for potential sentence interpretations involved in both initial and late stages of verbal irony comprehension.

5. Summary and Discussion

In our review, the simultaneous recordings of ERPs and eye-tracking in different individuals may improve our knowledge of the multidimensional nature of irony comprehension. The review was organized in two main parts; in the first part, we introduced some common time measures and components recorded in eye-tracking and event-related potentials studies respectively, and in the second part, we teased apart factors involved in irony comprehension from three dimensions. For the first part, the unresolved question as to why in some cases N400 did not occur as consistently as P600 across different studies remains to be answered through more empirical studies. To avoid verbosity, we will not repeat it here since we have already discussed over this issue in detail in the first part. Furthermore, according to the suggestion by Olkoniemi and Kaakinen (2021), scan path analysis which was sensitive to effects of garden path sentences was supposed to be made in future eye-tracking researches, considering that irony was a property of a phrase, not of a single word. We take this suggestion as meaningful in that the level of linguistic analysis implemented in most of the selected

studies (especially those using ERPs, see Table 1) was always restricted to lexicon. Spillover regions could be as informative as critical ironic regions, as suggested by a newly published research on idiom comprehension (Kyriacou et al., 2021); even in presence of a supportive context that could elucidate the intended meaning, the disambiguation between literal and figurative meanings might still persist, and for many times, was delayed to following regions, rather than being resolved within the critical region. In this sense, it seems that eye-tracking advantages over ERPs in terms of recording irony processing at a sentence level or discourse level.

For the final part of summary, we are going to present some theoretical and empirical considerations originating from previous studies, and suggest some possible research directions for verbal irony (or sarcasm) processing in the future, at least in the view of the author.

Firstly, though a large number of studies using on-line approaches has been emerging to confirm different traditional models of irony processing, these models were not designed to take individual differences into account. These traditional models—standard pragmatic view (Grice, 1975), direct access view (Gibbs, 2002), and graded salience hypothesis (Giora et al., 2007)—were all focusing on factors within the context and irony phrase itself (e.g., the echoing of information in the context or the familiarity of the irony), with graded salience hypothesis being most widely accepted. Consequently, studies on individual differences in irony comprehension are not as comprehensive as those on other figurative languages (e.g., metaphor and idiom). For example, personality like anxiety, or propensity to be anxious, has been shown to play a possible role in idiom and metaphor comprehension (Cacciari et al., 2018; Sana & Park, 2021). This is an interesting discovery indicating the valence of figurative languages in accessing individual anxiety, and this valence may probably exist in ironies. Furthermore, though some other personalities (e.g., sensitivity to emotion clues, empathy ability) have already been examined in earlier off-line and behavior researches, nevertheless, little is known about whether or not those effects will still manifest during on-line processing. Finally, as noted by Katz et al. (2004), the comprehension of ironic statements might also be related to a bunch of social and cultural factors, a combination of effects like gender and occupation should be taken into consideration. All in all, the aspect of on-line irony processing that takes more individual variance into account remains rather underexplored.

So why it is meaningful to examine more individual differences in irony processing? Considering that individual differences (or variance within participants) may obscure the group data in studies concerning figurative languages, to exploit more potentialities of these factors as much as possible definitely deserves more attention in future researches. In this way, we aim to reduce the unreliability of data stemming from such variance within participants (and items), possibly by constructing linear mixed models for data analysis when taking participant and item as random factors (Baayen et al., 2008). What's more, given that irony differs from metaphor and idiom most significantly in terms of its greater use of humor and emotional information it evokes, which further aggravates its processing

workload, in turn, other individual differences mentioned above (e.g., empathy ability and gender difference) would probably interact in a more delicate way with humor use or emotion perception of irony. There is a promising future for researches on irony processing since some newly constructed models factoring in more readers-related variances are gaining momentum (e.g., Fabry, 2019). More empirical evidence providing new insights into these new models is expected to spring up since many researchers have been considering that the graded salience hypothesis is not the only the most comprehensive way to explain the mental mechanism underlying verbal irony comprehension.

Secondly, studies focusing on patients revealed that, for cognitively impaired patients, irony comprehension seemed more effortful due to their overall poorer executive functions. Nevertheless, further on-line processing studies are required to explore effects of healthy aging (i.e., aging in the absence of neurological disorders such as dementia) in irony processing since figurative expressions like idiom and metaphor have been proved to modulate the activation of frontal cerebral regions (e.g., Mashal et al., 2007; Zempleni et al., 2007) which were crucial for executive processes (West, 1996), for example, the ability to suppress irrelevant information. Moreover, since frontal cerebral areas are also first and greatly modulated by aging (West, 1996), effects of aging in irony processing are worth noting in future cognitive researches given that healthy aging is known to bring a myriad of changes in so-called fluid cognitive functions including inhibitory function (for a review, see Hasher & Zacks, 1988). Crucial here is the fact that, in contrast to idioms, ironies do not form a lexicalized unit, consequently, though the elderly performed as well as younger adults in online idiom processing due to their crystallized knowledge of idioms (Haeuser et al., 2021), they might fail to benefit from this in processing ironic phrases as much as in processing idiomatic units.

Finally, as previously discussed so many times, individually different efficiency in processing humor and emotional connotation does matter for irony comprehension, so we may anticipate more interdisciplinary researches concerning irony comprehension to emerge, with possible methodologies borrowed from sociology and child psychology. For example, peer relations in older children were claimed to depend on proficiency with banter, which in turn frequently involved verbal irony (Zajaczkowska & Abbot-Smith, 2020). Moreover, a study published recently (Tracy & Elizabeth, 2019) also confirmed that for young children, the ability to interpret ironies varied as a function of their socio-emotional functioning like loneliness and depression. In this way, we expect researchers in the future to further break through the shackles of disciplines, so as to produce more fruitful works on verbal irony processing.

References

Baayen, R., Davidson, D., & Bates, D. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *4*, 390-412.

Bryant, G. A., & Fox Tree, J. E. (2002). Recognizing verbal irony in spontaneous speech. *Metaphor and Symbol*, *17*(2), 99-119.

Cacciari, C., Corradini, P., & Ferlazzo, F. (2018). Cognitive and personality components underlying spoken idiom comprehension in context. An exploratory study. *Frontiers in Psychology*, *9*, 1-17.

Caffarra, S., Haeri, A. M., Michell, E., & Martin, C. D. (2019) When is irony influenced by communicative constraints? ERP evidence supporting interactive models. *European Journal of Neuroscience*, *50*(10), 3566-3577.

Caffarra, S., Motamed, H. A., Michell, E., & Martin, C. (2018). *Who makes you laugh? The role of foreign accent in irony comprehension*. Front. Psychol. Conference Abstract: XPRAG.it 2018-Second Experimental Pragmatics in Italy Conference.

Caillies, S., Gobin, P., Obert, A., Terrien, A., Coutté, A., Iakimova., & Besche-Richard, C. (2019). Asymmetry of affect in verbal irony understanding: What about the N400 and P600 components? *Jounal of Neurolinguistics*, *51*, 268-277.

Cornejo, C., Simonetti, F., Aldunate, N., Ibáñez, A., López, V., & Melloni, L. (2007). Electrophysiological evidence of different interpretative strategies in irony comprehension. *Journal of Psycholinguistic Research*, *36*, 411-430.

Dews, S., & Winner, E. (1999). Obligatory processing of literal and nonliteral meanings in verbal irony. *Journal of Pragmatics*, *31*, 1579-1599.

Ericsson, E., Olofsson, J. K., Nordin, S., Rudolfsson, T., & Sandstrom, G. (2008). Is the P600/SPS affected by the richness of semantic content? A linguistic ERP study in Swedish. *Scandinavian Journal of Psychology*, *49*(1), 1-9.

Fabry, R. E. (2019). *Getting it: A predictive processing approach to irony comprehension*. Advance online publication.

Filik, R., Brightman, E., Gathercole, C., & Leuthold, H. (2017). The emotional impact of verbal irony: Eye-tracking evidence for a two-stage process. *Journal of Memory and Language*, *93*, 193-202.

Filik, R., Howman, H., Ralph-Nearman, C., & Giora, R. (2018). The role of defaultness and personality factors in sarcasm interpretation: Evidence from eye-tracking during reading. *Metaphor and Symbol*, *33*, 148-162.

Gibbs, R. W. (2002). A new look at literal meaning in understanding what is said and implicated. *Journal of Pragmatics*, *34*, 457-486.

Giora, R., & Fein, O. (1999). Irony: Context and salience. *Metaphor and Symbol*, *14*, 241-257.

Giora, R., Fein, O., Laadan, D., Wolfson, J., Zeituny, M.,...,Shaham, R. (2007). Irony processing: Expectation versus salience-based inferences. *Metaphor and Symbol*, *22*, 119-146.

Grice, P. H. (1975). Logic and conversation. In P. Cole, & J. L. Morgan (Eds.), *Speech arts: Syntax and semantics* (pp. 41-58). New York, NY: Academic Press.

Haeuser, K. I., Baum, S., & Titone, D. (2021). Effects of aging and noncanonical form presentation on idiom processing: Evidence from eye-tracking. *Applied Psycholinguistics*, *42*, 101-127.

Hasher, L., & Zacks, R. (1988). Working memory, comprehension, and aging: A review and a new review. *Psychology of Learning and Motivation*, *22*, 193-225.

Ivanko, S. L., & Pexman, P. M. (2003). Context incongruity and irony processing. *Discourse Processes*, *35*, 241-279.

Kaakinen, J. K., Olkoniemi, H., Kinnari, T., & Hyona, J. (2014). Processing of written irony: An eye movement study. *Discourse Processes*, *51*(4), 287-311.

Katz, A. N., Blasko, D. G., & Kazmerski, V. A. (2004). Saying what you don't mean: Social influences on sarcastic language processing. *Current Directions in Psychological Science*, *13*, 186-189.

Kutas, M., & Federmeier, K. D. (2000). Electrophysiology reveals semantic memory use in language comprehension. *Trends in Cognitive Sciences*, *4*(12), 463-470.

Kyriacou, M., Conklin, K., & Thompson, D. (2021). When the idiom advantage comes up short: Eye-tracking canonical and modified idioms. *Frontiers in Psychology*, *12*, 1-16.

Mashal, N., Faust, M., Hendler, T., & Jung-Beeman, M. (2007). An fMRI investigation of the neural correlates underlying the processing of novel metaphoric expressions. *Brain and Language*, *100*(2), 115-126.

Olkoniemi, H., Johander, E., & Kaakinen, J. K. (2019). The role of look-backs in the processing of written sarcasm. *Memory & Cognition*, *47*, 87-105.

Olkoniemi, H., & Kaakinen, J. K. (2021) Processing of irony in text: A systematic review of eye-tracking studies. *Canadian Journal of Experimental Psychology*, *75*, 99-106.

Olkoniemi, H., Ranta, H., & Kaakinen, J. K. (2016). Individual differences in the processing of written sarcasm and metaphor: Evidence from eye movements. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*, 433-450.

Olkoniemi, H., Strömberg, V., & Kaakinen, J. K. (2019). The ability to recognise emotions predicts the time-course of sarcasm processing: Evidence from eye movements. *Quarterly Journal of Experimental Psychology*, *72*, 1212-1223.

Pexman, P. M., & Zvaigzne, M. T. (2004). Does irony go better with friends? *Metaphor & Symbol*, *19*(2), 143-163.

Pfeifer, V. A., & Lai, V. T. (2021). The comprehension of irony in high and low emotional contexts. *Canadian Journal of Experimental Psychology*, *75*(2), 120-125.

Regrl, S., Coulson, S., & Gunter, T. C. (2010). The communicative style of a speaker can affect language comprehension? ERP evidence from the comprehension of irony. *Brain Research*, *1311*(2010), 121-135.

Regel, S., Gunter, T. C., & Friederici, A. D. (2006). Processing of ironic and non-ironic sentences examined with ERPs. In *19th Annual CUNY Conference on Human Sentence Processing*.

Regel, S., Gunter, T. C., & Friederici, A. D. (2011) Isn't it ironic? An electrophysiological exploration of figurative language processing. *Journal of Cognitive Neuroscience*, *23*, 277-293.

Regel, S., & Gunter, T. C. (2017). Don't get me wrong: ERP Evidence from cueing communicative intentions. *Frontiers in Psychology*, *8*, 1-11.

Regel, S., Meyer, L., & Gunter, T. C. (2014). Distinguishing neurocognitive processes reflected by P600 effects: Evidence from ERPs and neural oscillations. *PLoS ONE*, *9*(5), e96840.

Sana, F., & Park, J. (2021). The interplay between inhibitory control and metaphor conventionality. *Memory & Cognition*, *49*(6), 1267-1284.

Spotorno, N., Cheylus, A., Van Der Henst, J.-B., & Noveck, I. A. (2013). What's behind a P600? Integration operations during irony processing. *PLoS ONE*, *8*, e66839.

Turcan, A., & Filik, R. (2017). Investigating sarcasm comprehension using eye-tracking during reading: What are the roles of literality, familiarity, and echoic mention? In A. Athanasiadou, & H. L. Colston (Eds.), *Irony in language use and communication* (pp. 255-276). Amsterdam, the Netherlands: John Benjamins.

Tracy, A., & Elizabeth, S. (2019). Shy children's understanding of irony: Better comprehension does not always mean better socioemotional functioning. *Infant and Child Development*, *28*, 1-21.

West, R. L. (1996). An application of prefrontal cortex function theory to cognitive aging. *Psychological Bulletin*, *120*(2), 272-292.

Yang, B., Bian, J., & Zhang H. (2020). ERP study on the cognitive processing mechanism of Chinese verbal irony. *Linguistic Sciences*, *19*(5), 449-462.

Zajaczkowska, M., & Abbot-Smith, K. (2020). "Sure I'll help-I've just been sitting around doing nothing at school all day": Cognitive flexibility and child irony interpretation. *Journal of Experimental Child Psychology*, *199*, 1-21.

Zempleni, M. Z., Haverkort, M., Renken, R., & Stowe, L. A. (2007). Evidence for bilateral involvement in idiom comprehension: An fMRI study. *Neuroimage*, *34*(3), 1280-1291.