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Second Language Experience Impacts First Language Irony Comprehension Among Bilingual Adults

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Recently, core components of irony processing (e.g., mental-state reasoning, executive control, and metalinguistic awareness) have been tentatively linked to bilingual experience. Thus, we investigated whether bilingual experience modulates irony comprehension during first language (L1) reading and also how bilingual adults comprehend irony in positive versus negative contexts (i.e., ironic compliments vs. criticisms, respectively). We deliver 3 main findings. First, bilinguals are faster at processing ironic criticisms than ironic compliments, and they find ironic criticisms more sensible than ironic compliments in their L1, much like past findings among monolinguals. Second, individual differences in bilingual experience modulate comprehension of ironic statements. Specifically, readers with high global second language (L2) proficiency find ironic statements more sensible than readers with low global L2 proficiency, regardless of the valence of the preceding context. Third, individual differences in global L2 proficiency further predict the speed of L1 irony comprehension: following a positive scenario, greater global L2 proficiency patterns with faster processing of irony compared to literal statements. Together, these data suggest that second language experience may be linked to irony processing in the first language. While the precise mechanism underlying this relationship remains open, potential sources may be rooted in flexible social cognition or executive functions.

Public Significance Statement
We assessed how bilingual adults read ironic versus literal statements in their first language, English. We found that markers of second language experience related to the ease of first language irony processing.

Keywords: irony, bilingualism, individual differences, mentalizing, pragmatics

Supplemental materials: http://dx.doi.org/10.1037/cep0000230.supp

Comprehending verbal irony entails a complex interaction of language and social impact (Katz, 2017). Verbal irony, including sarcasm, is commonly used in everyday communication, whereby a deliberately insincere statement takes on meaning contrary to what is being literally said or written (Kreuz & Glucksberg, 1989). Irony serves many social communicative functions. In positive contexts, irony may dampen a compliment (i.e., "ironic compliment"). In negative contexts, irony may mute a criticism (i.e., "ironic criticism"). For example, Dews, Kaplan, and Winner (1995) found that spoken ironic compliments were perceived as more insulting than literal compliments and ironic criticisms as less insulting than literal criticisms, highlighting the importance of context (see also Clark &

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The data are available at https://osf.io/dgvra/.

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Gerrig, 1984; Kreuz & Glucksberg, 1989; Sperber & Wilson, 1981). Indeed, ironic criticism was found more familiar to North American English users than ironic compliment (Gibbs, 2000).

Like most examinations in psycholinguistics, work on irony has assumed a default (or presumed) monolingual language user, without consideration of how cumulative knowledge and experience acquired through bilingualism might impact this process (Tiv, Kutlu, & Titone, in press). Indeed, different bilingual experiences may collectively alter the social–cognitive capacities that support the processing of verbal irony, such as mental state reasoning, executive control, and metalinguistic awareness. To fill this gap, we investigated how individual differences in bilingual second language (L2) experience affect verbal irony processing during first language (L1) reading.

The Parallel-Constraint Satisfaction Framework of irony comprehension (Katz, 2005) suggests that multiple cues from the context, the speaker, and the listener are concurrently synthesized before settling on the most likely intention behind an utterance. This framework uniquely centralizes individual differences in shaping the interpretation of the ambiguous utterance. Indeed, the role of these individual differences among monolinguals has been found, and they range from executive function and emotion processing (Olkoniemi, Ranta, & Kaakinen, 2016) to experience with ironic language (Ivanko, Pexman, & Olineck, 2004) and dissociating communicative intent from message content (Kaakinen, Olkoniemi, Kinnari, & Hyönä, 2014).

These individual differences may collectively covary with broad differences in language experience, such as knowing two or more languages. Recent work from our group demonstrates that global L2 proficiency positively predicted self-perceptions of general sarcasm use (Tiv, Rouillard, Vingron, Wiebe, & Titone, 2019), which is a more specific form of verbal irony (Lee & Katz, 1998). Similarly, Kim and Lantolf (2018) found that explicit L2 instruction of sarcasm nurtured greater awareness of sarcasm in the first language (L1). These suggest a potential link between bilingual experience and ironic language, such that greater dual-language use and proficiency shape one's overall perception of sarcasm use and permeate L1 processing. Thus, an open question is whether bilingual experience similarly impacts the online processing of written ironic statements in the L1.

The link between bilingualism and irony may be anchored in social cognition and pragmatic proficiency (Antoniou, in press). Among children and adults, bilingualism nurtures awareness that other people have mental states that differ from one's own (Goetz, 2003; Javor, 2017; Rubio-Fernández & Glucksberg, 2012). Consider how frequently bilinguals must attend to contextual cues that signal the language preference of their conversational partner. This increased sociolinguistic awareness may facilitate effective communication and guide an understanding of the speaker's intended meaning. Anticipating others' communicative intentions is at the heart of irony comprehension (Fan, Liberman, Keysar, & Kinzler, 2015) and relates to capacities in perspective taking, mentalizing, and Theory of Mind. To this end, a recent meta-analysis revealed that, despite controlling for publication bias, bilingualism cultivated Theory of Mind to a greater degree than monolingualism (Schroeder, 2018). Bilingual children also demonstrate less ingroup bias in friendship making (Byers-Heinlein, Behrend, Said, Girgis, & Poulin-Dubois, 2017) and exhibit less racial bias than monolingual children (Singh, Quinn, Qian, & Lee, 2020). Lastly, bilingual adults have outperformed monolinguals in tasks of pragmatic competence and metapragmatic awareness, such as estimating the social status of an interlocuter (Zand-Moghadam & Adeh, 2020). Together, these convergent data suggest that knowledge of two or more languages exercises social cognition generally, potentially supporting irony comprehension.

The link between bilingualism and irony may also be anchored in other aspects of cognition, such as executive control. Executive control is a set of cognitive processes that are needed to control thought and behaviour, subsuming working memory (WM), attentional monitoring, inhibitory control, and cognitive flexibility (e.g., Miyake & Friedman, 2012). Many propose that bilinguals benefit from enhanced executive control due to the recruitment of control mechanisms that resolve the coactivation of both target and nontarget language (Abutalebi & Green, 2016; Bialystok, 2001; Kroll, Bobb, Misra, & Guo, 2008), although this is a contentious issue (e.g., Nichols, Wild, Stojanoski, Battista, & Owen, 2020). The interplay between bilingualism and executive control is likely to be much more nuanced than originally asserted (Titone, Gullifer, Subramaniapillai, Rajah, & Baum, 2017), but what is clear is that some control mechanism is necessary for any reader to resolve competition between plausible literal and ironic meanings of an utterance (Katz, 2005; Pexman, 2008). Of these control mechanisms, working memory, WM (i.e., the capacity to engage multiple pieces of information in memory) has been found to support irony processing among monolinguals (Kaakinen et al., 2014; Olkoniemi et al., 2016).

For these reasons, we first assess how bilingual adults read scenarios involving ironic criticisms versus ironic compliments in their first language. We predict that all bilinguals will perform similarly to past findings from monolinguals (e.g., Antoniou, Veenstra, Kissine, & Katsos, 2019), such that ironic compliments will have longer reaction times (RTs) and lower sensibility ratings than ironic criticisms (Katz, 2005). Second, we investigate whether bilingual language experience, particularly global L2 proficiency and L2 age of acquisition (AoA), relate to irony processing. Here, we expect that more bilingual language experience (i.e., earlier L2 AoA or higher L2 proficiency) will predict faster and easier recognition of irony.

Method

Subjects

Forty-nine bilinguals (L1 English; 37 females, 11 males) aged 18–29 participated in this study. All participants had at least some university (bachelor's) education and reported knowing at least one language other than English (nine reported three languages, four reported four languages, and two reported five languages). The majority (82%) reported knowing French. Participants were recruited by advertisements around McGill University, received compensation of $10 per hour or course credit, and consented prior to starting the experiment. In Analysis 1, results from all participants were analysed. In Analysis 2, seven participants were excluded due to missing data ($n = 42$). All participants contributed to the sample from Tiv et al. (2019).

Procedure

First, a brief language history questionnaire was completed, which inquired about their second language(s), the L2 AoA, and self-report proficiency for each language (see Figure 1). Responses to the questionnaire were analysed using principal components analysis that identified two components, which mapped onto global L2 proficiency and L2 AoA. Next, participants completed the Sarcasm Self-Report Survey, which probed daily sarcasm use (Ivanko et al., 2004). Then, in a sarcasm generation task, participants freely generated as many ironic comments as possible following a negative and positive scenario, to encourage them into an ironic mind-set.[1] Afterward, a verbal WM task was administered, in which participants were instructed to read complex sentences and remember the letter that appeared after presentation of each sentence (Daneman & Carpenter, 1980).

Next, participants completed an irony comprehension task that consisted of 42 positive/negative English scenarios that concluded with a literal, ironic, or anomalous final statement (see Table 1). Participants were instructed to read the scenario for comprehension and press a button upon completion. After the button press, the four-word final statement appeared on the screen, one word at a time (words were presented on screen for 300 ms with a 200-ms interstimulus interval). After the final word of the statement was presented, a question mark appeared on the screen to probe whether the statement made sense based on the preceding context. Participants pressed a button to indicate "yes" or "no." The response and RT were recorded and analysed. The entire task was in English, which was the first language of all participants.

Following the irony comprehension task, participants completed a sentence recall task to ensure attention during the comprehension task. All participants performed better than chance (50%), and the lowest score was 65%. All computer tasks were completed using E-Prime Software (Psychology Software Tools, Inc., 2016) and included practice trials to ensure that participants understood the procedure.

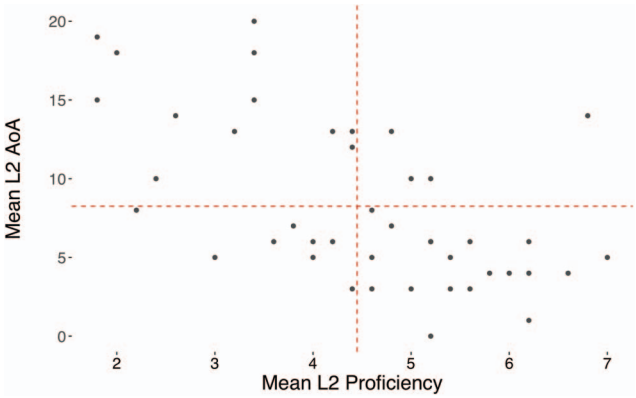

Figure 1. Distribution of individual differences in second language (L2) experience. Each point represents a single participant, and the dashed lines indicate average L2 age of acquisition (AoA; 8.3 years) and average self-reported L2 proficiency (4.5 on a scale of 1–7) across the sample (n = 42). Mean L2 proficiency was aggregated across self-report proficiency in reading, listening, speaking, and writing. Mean L2 AoA and mean L2 proficiency are correlated at −0.59. See the online article for the color version of this figure.

Results

All responses and RTs were analysed using mixed effect logistic/linear regression models in R, respectively, with scenario valence (positive and negative) and statement type (ironic, literal, anomalous) as deviation-coded (0.5, −0.5 or −0.33, 0, 0.33) fixed effects. In Analysis 1, we used maximal random effects for item and participant (Barr, 2013). In cases of convergence failures, we dropped the random effect contributing the least variance until convergence was reached. In Analysis 2, we added in the interactions with global L2 proficiency and L2 AoA while controlling for general sarcasm use (from the Sarcasm Self-Report Scale; Ivanko et al., 2004) and WM, which are known to impact comprehension of irony, as covariates. Here, we used random intercepts for item and participant given that our purpose in this analysis was to affirmatively test for individual difference interactions with our manipulated variables. The RT model failed to converge with these specifications, so the random intercept for item, which accounted for zero variance, was dropped to reach convergence.

Analysis 1

The logistic model assessing overall responses to statement type by scenario valence returned a significant interaction, $\chi^2(2) = 8.623$, $p = .01$. Pairwise comparisons of statement type detected the interaction between ironic and literal statements. As can be seen from Figure 2, irony was always considered less sensible than literal, but irony that followed a negative scenario (i.e., ironic criticism) was considered more sensible than irony following a positive scenario (i.e., ironic compliment), as expected. The marginal R^2 (i.e., contribution of fixed effects) of the model was 0.48.

An analysis of RTs to sensible ironic and literal items (i.e., judged "yes" on sensibility probe; sensible anomalous statements were excluded) also returned a significant interaction between statement type and scenario valence ($\beta = -0.308$, $SE = 0.092$, $t = -3.16$, $p < .01$). This effect, as illustrated in Figure 2, is such that following positive scenarios, ironic statement comprehension is slower than that for literal statement comprehension ($\beta = -0.347$, $SE = 0.0790$, $t = -4.395$, $p < .001$). Ironic and literal statements did not differ in their RTs following negative scenarios ($\beta = -0.010$, $SE = 0.072$, $t = -0.133$, $p = .894$). This further corroborates our hypothesis that ironic criticisms are easier to recognise than ironic compliments. The marginal R^2 of the model was 0.23.

Analysis 2

Next, we examined whether individual differences in L2 experience (global L2 proficiency, L2 AoA) modulated irony comprehension for the 42 participants who fully completed the language questionnaire. The logistic model examining responses to statement type by scenario valence as a function of bilingual experience rendered a significant interaction between statement type and global L2 proficiency, $\chi^2(2) = 9.819$, $p < .01$. Upon closer examination of statement type, we see that this interaction is

[1] Other work has specifically measured the extent to which this exercise is effective in altering irony reading patterns. They found that irony generation does not facilitate reading of irony (Giora, 2011).

Table 1
Example Irony Comprehension Stimuli

Variable	Positive scenario (e.g., You and your friend receive really tasty food at a supposedly two-star restaurant. Your friend says)	Negative scenario (e.g., You and your friend receive dry, bland food at a four-star restaurant. Your friend says)	Anomalous scenario (e.g., Although your new roommate claims to be a neat freak, you end up constantly tidying up after him. You tell a friend)
Positive statement	**LITERAL** "This food is amazing"	**IRONIC CRITICISM** "This food is amazing"	**ANOMALOUS** "This food is amazing"
Negative statement	**IRONIC COMPLIMENT** "This food is horrendous"	**LITERAL** "This food is horrendous"	**ANOMALOUS** "This food is horrendous"

significant for every pairwise comparison of the three statement types. The comparison of interest for our research questions is between ironic and literal statements. Here, the significant interaction ($\beta = 0.565$, $SE = 0.246$, $z = 2.299$, $p = .022$), suggests that as global L2 proficiency increases, the sensibility difference between literal and ironic statements closes, regardless of preceding scenario valence (i.e., no interaction with scenario valence; Figure 3). Adding individual differences increased the marginal R^2 of the model from 0.48 (Analysis 1) to 0.59.

An analysis of RTs to sensible ironic and literal items (i.e., judged "yes" on sensibility probe; sensible anomalous statements were excluded) returned a significant interaction between statement type by scenario valence by global L2 proficiency ($\beta = 0.124$, $SE = 0.0550$, $t = 2.251$, $p = .025$). When we assess the relationship between statement type and global L2 proficiency in each scenario valence separately, we detect the significant interaction only when the statement is made following a positive scenario ($\beta = 0.164$, $SE = 0.0438$, $t = 3.748$, $p < .001$). As illustrated in Figure 3, response times to ironic statements following positive scenarios are substantially faster among bilinguals with greater global L2 proficiency, consistent with our prediction. Adding individual differences doubled the marginal R^2 of the model to 0.51. Full model outputs from both analyses are available in the supplemental materials (https://osf.io/dgvra/).

Discussion

While irony processing has been extensively studied in monolinguals, the potential role of individual differences in bilingual language experience in irony processing remains unknown. In this investigation, we deliver three main findings. (a) Bilinguals are faster at processing ironic criticisms than ironic compliments, and they find ironic criticisms more sensible than ironic compliments in their L1, much like past findings among monolinguals (e.g., Katz, 2005). (b) Individual differences in bilingual experience modulate comprehension of ironic statements. Specifically, an increase in global L2 proficiency patterns with greater sensibility of ironic statements, regardless of the valence of the preceding context. (c) Individual differences in global L2 proficiency further predict the speed of L1 irony comprehension following a positive scenario. This difference in RT is striking: Bilinguals with low global L2 proficiency respond to ironic compliments within 2 s; however, bilinguals with high global L2 proficiency respond to these same items in less than 1 s.

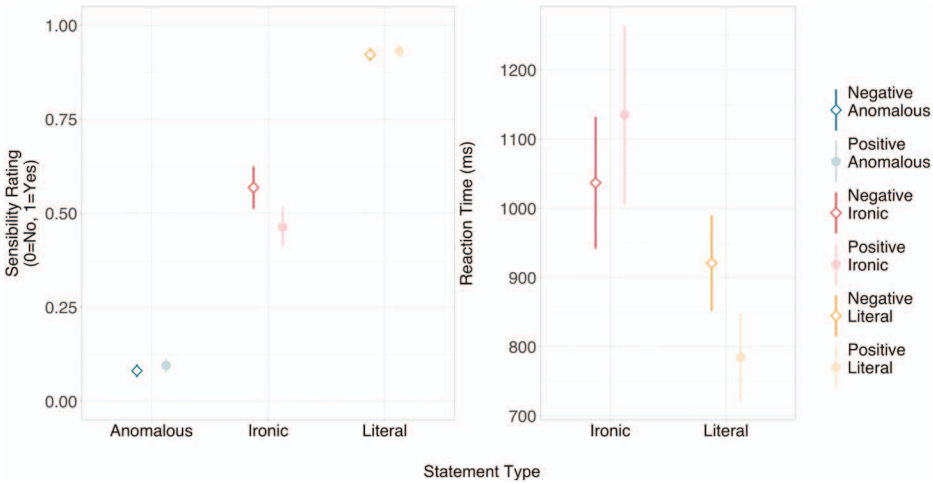

Figure 2. (Left) Mean response to sensibility prompt for each statement type and scenario valence. Zero indicates not sensible, and 1 indicates sensible (right). Mean reaction time to ironic and literal statements following positive and negative scenarios. Error bars represent ± 1 *SEM*. Open points represent statements made after negative scenarios, and closed points represent positive scenarios. See the online article for the color version of this figure.

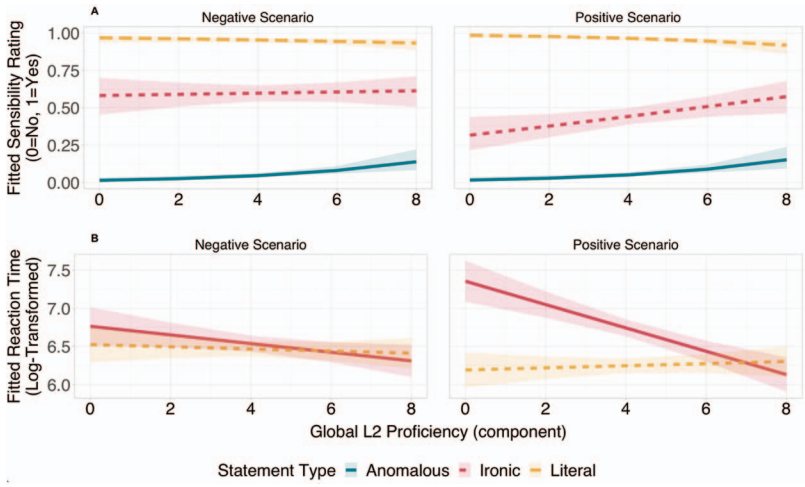

Figure 3. (A) Fitted sensibility judgments (zero indicates not sensible, and 1 indicates sensible) and (B) fitted reaction times (log-transformed) following negative and positive scenarios as a function of global second language (L2) proficiency. Shaded area represents ± 1 *SEM*. See the online article for the color version of this figure.

Thus, there is approximately a 1-s response time difference that is mediated by global L2 proficiency (statistically controlling for WM and general sarcasm use).

The results of our first analysis indicate that bilingual adults are sensitive to contextual differences in irony use, much like past findings from monolinguals. As predicted, sensibility judgments and RTs suggest that ironic language is harder to comprehend than literal language, particularly ironic compliments. Additionally, ironic statements were more sensible than anomalous statements, particularly ironic criticisms, suggesting that readers could distinguish irony from unrelated statements. This pattern of results broadly suggests that knowledge of a second language does not hinder complex language processing in the first language. Much like those who only know one language, bilinguals reading in their first language are attuned to sociocultural norms of typical irony usage, which may be driving their easier and faster recognition of ironic criticisms over ironic compliments when evaluating an utterance.

The results of our second, and more central, analysis indicate that individual differences in L2 experience relate to L1 online irony processing among bilingual adults. We found that global L2 proficiency predicted how sensible irony seemed, which may be attributed to various social and cognitive processes. Greater L2 proficiency may aid irony comprehension through accrued communicative skills, metalinguistic awareness, or more flexible social cognition (Schroeder, 2018), consistent with past findings that bilingual language brokers who have extensive informal translation experience (e.g., translating for their families in high-stakes situations) respond similarly across their two languages when rating plausibility of literal and figurative strings (López, Vaid, Tosun, & Rao, 2017). These more experienced bilinguals may view language and its functions through a more creative and less fixed lens (Vaid, López, & Martinez, 2015), likely exemplifying flexible, linguistic mastery and enhanced metalinguistic awareness (Peal & Lambert, 1962). In addition, bilingualism presents opportunities to experience novel social situations and interactions (Ikizer & Ramírez-Esparza, 2018), which may collectively alter one's expectations and attention to cues when using and understanding language. Thus, bilinguals may also generalise the intuitive understanding that different people may speak different languages to a broader understanding that different speakers may want to convey different intentions.

Whereas global L2 proficiency patterns with better irony comprehension in general, it predicts faster reading times for ironic compliments, which are considered more unfamiliar, and potentially more cognitively demanding, than ironic criticisms (Gibbs, 2000). This relationship may involve executive control, as others have found among monolinguals (Olkoniemi et al., 2016; Pexman, 2008). Bilinguals with greater L2 proficiency may require more control when switching between languages due to high thresholds of activation. Thus, more proficient bilinguals may be more experienced in regulating inhibitory control and can profit from this capacity under the most challenging ironic contexts (Gullifer et al., 2018). However, the link between bilingualism and irony comprehension was present despite statistically controlling for WM capacity, which may suggest that irony processing is exercised through other, potentially more social, aspects of bilingual experience such as cultural diversity or social and cognitive flexibility.

Lastly, there is additional evidence from a separate sample of bilinguals who completed an implicit version of the irony comprehension task that simply required reading of the statements and did not ask for an evaluation of their sensibility (see online supplemental materials). Among RTs, we only detected a main effect of statement type, such that ironic statements were read more slowly than literal statements. This finding echoes the results from Kreuz and Link (2002), who also did not find a difference in RT to ironic criticisms versus ironic compliments under implicit tasks among monolinguals. Moreover, we found that only L2 AoA modulated the relationship between statement type and scenario valence, such that bilinguals who acquired their L2 early in life quickly comprehended ironic criticisms and slowly comprehended ironic compliments, as compared to the anomalous statement in

each context. These results give further evidence in favour of the idea that greater experience with an L2, whether that be in number of years or relative proficiency, facilitates irony comprehension in the L1.

We conclude by acknowledging ongoing research that aims to capture the multidimensionality of bilingual experience. Due to this diversity, we conclude that a way forward is to continue unraveling how individual differences in bilingual experience, as outlined here, affect social and cognitive processes (Baum & Titone, 2014; Gullifer & Titone, 2019; Titone et al., 2017; Tiv et al., in press). Whether bilingualism confers general cognitive advantages remains an open question that the present study was not designed to answer. Instead, we bring to light an important relationship between individual differences in bilingual experience and irony processing, and we continue to probe its precise mechanisms in our ongoing work.

Résumé

Récemment, les composantes essentielles du traitement de l'ironie (par exemple, le raisonnement de l'état mental, le contrôle exécutif et la conscience métalinguistique) ont été provisoirement liées à l'expérience bilingue. Ainsi, nous avons cherché à savoir si l'expérience bilingue module la compréhension de l'ironie pendant la lecture de la première langue (L1) et aussi comment les adultes bilingues comprennent l'ironie dans des contextes positifs ou négatifs (c'est-à-dire les compliments ironiques ou les critiques, respectivement). Nous présentons trois principaux résultats. Premièrement, les bilingues sont plus rapides à traiter les critiques ironiques que les compliments ironiques, et ils trouvent les critiques ironiques plus sensées que les compliments ironiques dans leur L1, tout comme les résultats antérieurs chez les monolingues. Deuxièmement, les différences individuelles dans l'expérience bilingue modulent la compréhension des déclarations ironiques. Plus précisément, les lecteurs qui ont une grande maîtrise de la langue seconde (L2) trouvent les déclarations ironiques plus sensées que les lecteurs qui ont une faible maîtrise de la langue seconde, indépendamment de la valence du contexte précédent. Troisièmement, les différences individuelles dans la maîtrise de la L2 permettent de mieux prédire la vitesse de compréhension de l'ironie en L1 : après un scénario positif, des profils de maîtrise plus grande de la L2 concordent avec un traitement plus rapide de l'ironie par rapport aux déclarations littérales. Ensemble, ces données suggèrent que l'expérience dans la deuxième langue peut être liée au traitement de l'ironie dans la première langue. Bien que le mécanisme précis sous-jacent à cette relation demeure ouvert, les sources potentielles peuvent être enracinées dans la souplesse de la cognition sociale ou des fonctions exécutives.

Mots-clés : ironie, bilinguisme, différences individuelles, mentalisation, pragmatisme.

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