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Perspective-taking and frugal strategies: Evidence from sarcasm detection

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Abstract

Prior research suggests an egocentric bias in the ability to adopt a third-person perspective in sarcastic statements. However, it remains unclear whether (1) this bias is genuinely due to egocentric anchoring or to the cost of the activation of the sarcastic interpretation; (2) context-based, allocentric processing of sarcasm can be by-passed by cheaper strategies, such as prosody processing. To settle the first question, two sarcastic conditions were compared: one, 'egocentric', where the favored interpretation was sarcastic only from the participant's perspective, and another, 'allocentric', where the sarcastic interpretation was salient from both the addressee's and the participant's perspectives. To address the second question, performance in the egocentric and allocentric conditions were compared when salient prosodic cues were added. To show direct evidence for serial adjustment and to minimize the possibility of parallel processing of prosodic and contextual cues, we compare two experiments: In the first experiment, French-speaking participants had no time limit to respond, while time pressure was added in the second experiment. Results confirm that perspective-shifting is egocentrically anchored (i.e. slower reaction times and poorer accuracy for egocentric condition than allocentric one); furthermore, this egocentric bias is already evident in early stages of processing (within 3 s). We also show that perspectival assessment of contextual cues is not triggered in the presence of salient prosodic cues. Since perspective-taking is time consuming, using the non-contextual, prosodic cue is an efficient strategy to make an accurate judgment with the least processing effort.

Keywords: Sarcasm; Perspective-taking; Prosody; Egocentricism; Interpretation

1. Introduction

Daily conversations are peppered with innuendo, hints and irony, requiring listeners to reach beyond the literal meaning of the words. Sarcasm, understood as a critical form of irony,[1] is probably one of the clearest examples of language use that involves a discrepancy between the literal content of an utterance and the meaning the speaker actually intends to convey. For example, if a friend tells you how he just got his bag stolen and concludes by saying 'It's a lovely day!', you will probably notice the discrepancy between the conversational context and this last utterance, and, in all likelihood, perceive it as sarcastic. In addition to its importance for social dynamics, investigating sarcasm detection allows crucial insights into complex perspective-taking mechanisms. There is a consensus in the literature that in order to

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[1] Irony is, of course, a broader category than sarcasm, and encompasses features as jocularity, hyperbole, rhetorical questions, and understatements (Gibbs, 2000). In the current study, all ironical stimuli consisted in praise being intentionally used to blame the interlocutor.

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fully grasp sarcastic meanings one must master complex mental-state attribution skills (Akimoto et al., 2012; Bryant, 2012; Kissine, 2013). After all, both lies and sarcasm involve the production of a false statement; in order to detect sarcasm, the addressee thus needs to determine whether the speaker believes that he, the addressee, realizes that the message is blatantly false. In other words, sarcasm requires interpreters to adopt the speaker's perspective; from the addressee's own, egocentric perspective both lies and irony are indistinguishably false assertions.

What remains debatable is whether taking the other's perspective, or, in other words, shifting toward an allocentric perspective, is an automatic, effortless process or whether it is a cognitively costly mechanism, triggered only in special occasions, such as irony interpretation. As far as models of utterance interpretation go, both assumptions are found in the literature. Some authors posit that all pragmatic processing is necessarily grounded in the attribution of complex communicative intentions, so that (adult) processing of linguistic communication inherently involves adopting the speaker's perspective (e.g. Brown-Schmidt, 2009; Sperber and Wilson, 1995, 2002). Others, by contrast, conceive of pragmatics as a suite of distinct processes—some of which independent of perspective-shifting—that may be selectively activated depending on the interpretative task at hand (Kissine, 2013, 2016; Recanati, 2004). Such non-modular models are consistent with the idea that linguistic processing is subject to cognitive economy considerations (Ferreira and Patson, 2007), and by default relies on frugal, egocentric strategies (Shintel and Keysar, 2009), even though context may prompt more complex, allocentric processing.

Prior research suggests that the ability to infer the addressee's interpretation of ironic statements is egocentrically biased (Epley et al., 2004; Keysar, 1994; Nilsen et al., 2011). In these studies, participants were presented with privileged background information (e.g. *A thief has stolen Alice's handbag in the morning*) and had to judge whether the intended interpretation of a target statement (Alice says: 'It is a lovely day!') was sarcastic or not. In the 'literal' condition, the background information (e.g. *This morning, Alice received a nice handbag as a gift from her mother*) favored a literal, non-sarcastic interpretation. Assuming that literal is the default interpretation mode, in this condition, the message is literal both from the addressee's and the participant's perspective. In the 'sarcasm' condition, background context was inconsistent with the target statement, and thus favored a sarcastic interpretation of the message. However, this relevant background information was not available to the addressee, but only to the participant (who was in the position of a privileged eavesdropper, so to speak). In the sarcastic condition, then, while the intended meaning was literal, it interfered with the sarcastic reading, which was salient from the participant's perspective. Even though participants' performance is generally good in such tasks, they are also slower and more error prone when they do not have the same contextual background as the addressee, viz. in 'sarcastic' than in 'literal' conditions (Epley et al., 2004). These results suggest that it is cognitively costly to adopt somebody else's perspective, while inhibiting an egocentrically salient ironic reading. This interpretation can be framed within the broader *anchoring and adjustment heuristic* (Tversky and Kahneman, 1974), according to which people adopt others' perspectives by using their own point of view as an anchor and then adjusting away from it to account for their partner's epistemic state.

Two important questions, however, are still outstanding. First, on closer inspection, Epley et al.'s findings do not allow to firmly conclude that perspective-shifting is really egocentrically grounded. Second, it remains unknown whether context-based, allocentric processing of irony can be by-passed by cheaper strategies. These questions, to be addressed in the two studies presented below, are of great importance to cognitive theories of irony processing, but also to broader models of epistemic perspective-shifting.

The first issue is mostly methodological. While quite intuitive, the difference between 'sarcastic' and 'literal' conditions, reported by Epley and colleagues, may be explained away by the competition between two interpretations: literal and ironic. Most models of figurative language processing, such as, for instance, Gibbs's (1994) *Direct Access* or Giora's (2003) *Graded Salience*, predict a priority activation of ironic meanings when these are rendered particularly accessible and/or salient by the context. In the same vein, in Pexman's (2008) parallel constraint satisfaction model prosodic and contextual cues are processed in parallel; the interpretation that receives the highest activation—ironic or literal—is then selected. Accordingly, one may object that in both Epley et al.'s 'literal' and 'sarcastic' conditions participants started from the speaker's perspective, but that performance in the 'sarcastic' condition was influenced by the cost of parallel activation of ironic interpretation, triggered by the incongruence between the context and the target sentence.

A straightforward way to settle this question is to create two types of sarcastic conditions: one 'egocentric', where, as in Epley et al.'s paradigm, the favored interpretation is sarcastic from only the participant's, and not the addressee's, perspective, and another, 'allocentric', where the sarcastic interpretation is favored from both the addressee's and the participant's perspective. To begin with, since sarcastic interpretation is triggered by incongruent contextual cues, one should expect both allocentric and egocentric sarcastic conditions to be costlier to process than literal ones. More importantly, if perspective-taking is egocentrically anchored, participants should dispense with accessing the addressee's perspective in the sarcastic allocentric conditions, where the sarcastic reading is salient from both their own and the addressee's points of view. That is, one should expect egocentric sarcastic scenarios to be more difficult to process than allocentric ones, as the former involves inhibition of an egocentrically-consistent sarcastic interpretation. By contrast, if the difference between Epley et al.'s 'literal' and 'sarcastic' conditions were simply due to the cost of sarcastic interpretations,

one should expect comparable performance (i.e. reaction times and accuracy) in inferring the speaker's belief across egocentric and allocentric sarcastic conditions.

The second, perhaps more important issue left unresolved in the literature is whether perspective-taking—and, more generally, complex, context-based interpretation—is automatic or whether it can be by-passed when alternative cues are available. In that respect, sarcasm detection is a perfect testing ground. Of course, sarcasm can be conveyed solely through contextual cues, as in written form. In such cases, there is little alternative for detecting sarcasm than reasoning about the communicative intentions underlying the incongruence between the message and the background. In many other situations, however, facial expressions, body language and tone of voice may guide interpreters more intuitively toward sarcasm detection (e.g. Attardo et al., 2003; Rankin et al., 2009). Focusing on acoustic cues, hearers seem also to be able to discriminate between sarcastic and non-sarcastic interpretations by relying only on prosody (Bryant and Fox Tree, 2005). In addition, while incongruence between context and literal content is the primary cue for sarcasm, prosody seems to be a powerful trigger for sarcastic interpretation when context is ambiguous (Voyer et al., 2016). What is not known, however, is whether in the latter case prosody serves as an *alternative and primary* cue or whether it merely orients participants toward a certain assessment of contextual information, thus serving as a guide toward mandatory perspective-shifting. In other words, the question is whether sarcastic prosody merely facilitates and complements a more complex context-based processing or whether, in mature interpreters, it may lead to a sarcastic interpretation by-passing mental-state attribution. Within post-Gricean pragmatic models, such as Sperber and Wilson's (1995, 2002) Relevance theory, utterance interpretation is necessarily rooted in complex mental-state attribution, and prosody is merely an optional cue toward ironic interpretation (see Wilson and Sperber, 2012, chapter 6). By contrast, according to the model put forward by Kissine (2016), interpretation outputs of a given pragmatic type (e.g. literal, indirect or sarcastic) are not necessarily coupled to a single kind of pragmatic strategies; rather, metacognitive assessment of the interpretative goal contributes to the selection of the adequate processing route. This model predicts that when a cheap strategy is available to reach the task at hand—for instance, detecting the presence of sarcasm—it should be favored over more complex interpretative strategies.

The bulk of available literature on the interplay between contextual and prosodic cues asks participants to gauge statements according to their own perspective. Any behavioral evidence gathered in such paradigms—be it reaction time or error rate—does not allow one to decide whether the prosodic ironic cues merely facilitate or altogether replace perspective-shifting. However, useful information on this issue may be gained from paradigms such as Epley's et al. (2004), where participants have to place themselves in the addressee's shoes. What needs to be determined is whether participants still actively assess contextual cues from the addressee's perspective in a situation where salient prosodic cues for irony are available. If ironic prosody is a sufficiently salient signal to override any context-based process, one should expect participants to rapidly judge the target sentence as ironic irrespective of the contextual information available to the addressee. That is, participants should display a similar proportion of correct responses and similar response latencies for sarcastic allocentric and egocentric messages uttered with a sarcastic tone. If, by contrast, ironic prosody simply boosts a non-optional perspective-taking process, absence of sufficient contextual information from the addressee's perspective and presence of ironic prosody should constitute incongruent cues, thus slowing down reaction times and yielding less consistent judgments on the target statement.

2. Study 1

2.1. Materials and method

2.1.1. Participants

In order to calculate the minimum sample size needed, ideally we should have used power analyses based on effect sizes calculated from Epley's et al. study (2004). However, since standard deviations and eta square are not reported in this paper, we used a similar sample size as in Epley's et al. study (minimum 70 participants). Eighty-one undergraduate students (65 females) took part in the study. Inclusion criteria were: native French speaker and self-reported normal hearing. Since sleep loss has been shown to slow perspective-taking processes (Deliens et al., 2015), participants with a total time spent in bed (TIB) < 6 h the night preceding the experiment (reported in the St. Mary's Hospital Sleep Questionnaire; Ellis et al., 1981) were also excluded from the statistical analyses. Five subjects were excluded from further analyses: one participant reported hearing problems and four spent less than 6 h in their bed the night before the testing. The age of the 76 remaining participants (62 females) ranged between 17 and 37 (m = 19.64; sd = 2.54). The study received ethical clearance from the ethical committee of the Faculty of Psychology and Education Sciences at the Université libre de Bruxelles.

2.1.2. Material

The task was adapted from Deliens et al. (2015). Participants were instructed to read the description of an event in the life of the fictional character Anaïs Reton on a computer screen and to press a key when they finished reading the story.

This description constituted the message *context*. The text was then removed from the screen and an intentionally ambiguous voicemail message left by Anaïs on a friend's phone was delivered through the computer speakers. This utterance constituted the *target statement*. Oral messages were directly followed by the question 'Will X (first name of Anaïs's friend) perceive this message as sarcastic?' displayed in the middle of the screen. Participants had to decide, as fast as possible, whether the target sentence would be interpreted by the addressee as sincere or as sarcastic, by pressing the corresponding key (Yes [key 'K']/No [key 'L']). Some of the contexts and their associated target sentences were inspired from the studies conducted by Epley et al. (2004), Kreuz et al. (1999) and Pexman and Zvaigzne (2004); see Annex for the full list.

Five categories of scenarios, each composed of five scenarios, were used. Three categories of scenarios were associated with a target sentence uttered with a neutral tone of voice: literal (L), sarcastic egocentric (SE), and sarcastic allocentric (SA). The two other categories included sarcastic egocentric or allocentric messages but uttered with a sarcastic prosody (SEP and SAP, respectively). See Table 1 for an example of each category.

In the literal scenarios (L), the literal content of the target sentence was the meaning the speaker actually intended to convey. The message was sincere from both the participant's and the addressee's perspectives. The sarcastic egocentric scenarios (SE) contained a discrepancy between the literal meaning of the target sentence and the most salient meaning. From the participant's point of view, this scenario was compatible with a sarcastic interpretation of the target utterance; however, the scenario was designed in such a way that the addressee of the voice message was not in possession of sufficient contextual information to interpret the target as sarcastic. In other words, the message could be seen as sarcastic from the participant's, third-person perspective, but not from the addressee's perspective. Since the question the

Table 1
Example of context, target sentence and tone of voice pairings for each category of scenarios.

Written context	Target sentence	Tone of voice	Category of scenarios
Anaïs asks a friend, Anne, which restaurant she would recommend going to with her parents, who are in town and whom she wants to take to a nice place. Anne just had a nice dinner at the weekend and recommends the perfect place right away. ''I think they will love that new Italian restaurant, Veneza, Anne says, I ate there last week and it was wonderful. Tell me what you think about it if you decide to go''. Anaïs takes her parents there. The food is delicious and the service is perfect. Later that night, when Anne gets back home, she finds a message on her answering machine, saying:	Good evening Anne, as for restaurants, you certainly have very fine taste, thank you for your recommendation.	Neutral	Literal (L)
Anaïs is on her way to her first ballroom dance class when she runs into Helen, an old friend from school. When she tells her she is going to a ballroom dance class, she enthusiastically answers: ''I was just thinking about taking that class but I can't make it tonight, I have a meeting with my supervisor. Can you call me when you get back and tell me how it was?'' During the lesson, the instructor only teaches one repetitive and boring step. At the end of the class, he refuses to let Anaïs stay and practice for a little longer. When Helen comes back from her meeting, she finds a message on her answering machine, saying:	Helen, the class is great and the instructor is particularly motivating, it was really worth it.	Neutral	Sarcastic egocentric (SE)
Anaïs has always been a good student. When her friend, David, sees her on her way to her final exam, he tells her once again: ''Don't worry, you always know the material from A to Z. You will nail the final exam''. Actually, as never before, Anaïs has a black out and can't even understand most of the questions. When David goes back home in the afternoon, he finds a message saying:	Hey David, you are right, there was no reason to be anxious, the exam went smoothly.	Sarcastic	Sarcastic egocentric with sarcastic prosody (SEP)
Anaïs is going on vacation to Barcelona. Her friend Clemence would like to visit the city soon too and asks Anaïs to tell her what she thinks of her hotel. Therefore Anaïs, once there, sends Clemence a post card saying: ''Dear Clemence, you will love Barcelona as long as you do not stay at the hotel we are in: it is dodgy, ugly and dirty! That aside, it is all sun and parties!'' A few days later, Anaïs is back from her holidays and wants to call her friend to tell her about her trip. As she reaches the voice mail, she leaves a message:	Hi Clemence, I'm back! I need to tell you about our hotel: a small and charming place, and impeccably clean.	Neutral	Sarcastic allocentric (SA)
Anaïs goes to a conference with her co-worker Harry. After ten minutes, they exchange bored looks, and after twenty minutes, Harry is nodding off. He finally decides to leave the room before the end of the conference. Anaïs stays, hoping the debate following the presentation will be more interesting: ''Maybe if he stopped just reading his text, he would look smarter'', she tells Harry. When she gets back home, Anaïs calls Harry to tell him about the end of the conference. She reaches voice mail. When Harry checks his messages a bit later, he finds the following one:	Hi, it's Anaïs. It is too bad you left so quickly earlier, the debate was of the same sort, this lecturer really is a genius!	Sarcastic	Sarcastic allocentric with sarcastic prosody (SAP)

participants had to answer concerned the addressee's interpretation of the target utterance, the correct answer in the SE condition required the inhibition of the contextually salient sarcastic interpretation.

Sarcastic egocentric scenarios uttered with a sarcastic prosody (SEP) were identical to SE scenarios, except that the target sentence was uttered with a distinctive sarcastic prosody. We reasoned that since prosody may lead to sarcasm detection in the absence of further cues (Bryant and Fox Tree, 2002), the prosodic cue may fill in context knowledge gaps and lead the addressee to infer that the speaker means something different from what s/he said. Therefore, we classified the 'sarcastic' judgment as being the correct response in the SEP condition.

The sarcastic allocentric scenarios (SA) also contained a discrepancy between the literal meaning of the target sentence and the meaning the speaker actually intended to convey. However, this time the addressee of the voice message had access to sufficient contextual information for interpreting the target utterance as sarcastic. That is, in SA the message was sarcastic from both the participant's and the addressee's perspectives.

Finally, the sarcastic allocentric scenarios uttered with a sarcastic tone (SAP) were identical to SA scenarios, except for the fact that the target statement was uttered with a distinctive sarcastic prosody. That is, in SAP the addressee had both contextual information and prosodic cues at his disposal in order to disambiguate the speaker's communicative intent. To sum up, to correctly judge a target sentence as sarcastic from the addressee's perspective, participants could rely on the prosodic cue for SEP scenarios, contextual information for the SA scenarios, and on both cues for the SAP scenarios. The correct response for L and SE scenarios was 'not sarcastic' and could be reached only by assessing the contextual information available to the addressee.

Utterance lengthening and speaker modulation of the fundamental frequency seem to be inherent acoustic properties of sarcastic prosody in both English and French (González-Fuente et al., 2016; Lœvenbruck et al., 2013; Rockwell, 2000). In the few studies that addressed irony in French, ironic prosody seems associated with higher fundamental frequency (González-Fuente et al., 2016; Lœvenbruck et al., 2013); in English, some studies found lower fundamental frequency (Rockwell, 2000), while the others contend exactly the opposite (Anolli et al., 2000; Bryant and Fox Tree, 2005; Cheang and Pell, 2008). In order to verify that target sentences associated with an ironic prosody were objectively different from neutral sentences, we used Praat (version 6.0.08; Boersma and Weenink, 2015) to measure the following acoustic characteristics of all target utterances: fundamental frequency (in Hz, measured every 3 ms), intensity (in dB, measured every 11 ms) and syllable duration (in ms). A linear regression using the lm function of the lmer package (version 1.1-12; Bates et al., 2015) in R (version 3.2.2; R Development Core Team, 2015), with prosody (sarcastic vs. neutral) as a factor, revealed that target statements with sarcastic prosody had a lower mean fundamental frequency ($\beta = -21.98$, SE = 3.99, $p < 0.001$) and a longer mean syllable duration ($\beta = 57.44$, SE = 6.96, $p < 0.001$). These acoustic characteristics are consistent with those reported by Rockwell (2000) for English ironic prosody. For French, Lœvenbruck et al. (2013) reported slower delivery rate but higher fundamental frequency.

To ensure that target utterances were perceived as accurately reflecting the intended prosody (sarcastic or sincere), 25 participants, not involved in the experiment, listened to the target sentences. The statements were presented without their surrounding context and participants judged the tone of voice as sincere or sarcastic by pressing the correct key on the keyboard. The target utterances used in the SAP and SEP scenarios were scored as sarcastic with an agreement rate above 84% and 96% among the raters, respectively; the target utterances used in the L, SE and SA scenarios were judged as not sarcastic with an agreement rate above 84%, 88% and 76% among the raters, respectively.

The 25 scenarios were presented in random order, with no more than four stories of the same category in a row. All participants saw the stimuli in the same order. A program written in Matlab 6.1 (Mathworks Inc., Natick, MA) recorded accuracy and reaction times (RTs).

2.1.3. Procedure

On arrival at the lab, participants were led to an individual cubicle. After completing the demographic questionnaire, they were administered the St. Mary's Hospital Sleep Questionnaire (Ellis et al., 1981). They then performed the Sarcasm Detection Task wearing headphones. Prior to the test phase, subjects were given a definition and an example of sarcasm, and were trained on a first scenario.

2.1.4. Data analyses

Statistical analyses were conducted on proportions of correct responses and RTs for correct responses in R version 3.2.2 (R Development Core Team, 2015). Correct responses were analyzed using binomial mixed-effects models with a logit link function using the glmer function of the lme4 package (version 1.1-12; Bates et al., 2015); response times were analyzed using linear mixed-effects models fit by maximum likelihood (ML) using the lmer function of the lme4 package. Post hoc comparisons of least square-means, with Tukey adjustment for multiple comparisons and Satterthwaite method for estimating degrees of freedom, were performed using the lsmeans function of the lsmeans package (version 2.23-5; Lenth, 2016).

2.2. Results

Proportion of correct responses. We constructed a binomial mixed model with response, correct vs. incorrect, as the predicted variable and 'scenario' as the predictor variable. The model also included by-subject intercepts as a random factor (the null model with by-subject random slopes failed to converge). Likelihood ratio tests of the model containing the fixed effect 'scenario' against a similar model in random effects structure but without the fixed factor showed a significant effect of scenario ($\chi^2(4) = 281.28$, $p < 0.001$).

The main effect of scenario on correct responses is displayed in Fig. 1. Starting with items without prosody, post hoc pair-wise comparisons revealed that participants were less accurate in SA ($\beta = 0.57$; 95% CI = [0.35; 0.78]) and SE scenarios ($\beta = 0.27$; 95% CI = [0.06; 0.47]) than in L ones ($\beta = 2.43$; 95% CI = [2.06; 2.8]; for SA $z = 8.63$; $p < 0.0001$; for SE $z = 10.7$, $p < 0.0001$). In fact, performance was almost at chance level in SE scenarios ($t(75) = 1.74$; $p = 0.087$; 95% CI = [49.03; 64.13]), but not in SA scenarios ($t(75) = 4.09$; $p < 0.001$; 95% CI = [57.02; 70.35]). However, the rate of correct responses in SA scenarios was not significantly higher than that in SE ones ($z = 2.01$; $p = 0.26$). When the target sentence was uttered with a distinctive sarcastic prosody, accuracy rates rose dramatically, viz. in SAP ($\beta = 2.5$; 95% CI = [2.12; 2.9]) relative to SA ($z = 8.76$, $p < 0.001$) and in SEP ($\beta = 2.33$; 95% CI = [1.98; 2.69]) relative to SE ($z = 9.91$, $p < 0.001$). Finally, L scenarios did not differ from SAP and SEP, and SEP and SAP did not differ from each other (all ps > 0.9).

Response times in correct responses. We built a linear mixed model with reaction time in correct responses as the predicted variable and 'scenario' as the predictor variable. The model included by-subject random intercepts (the null model with by-subject slopes failed to converge). Likelihood ratio tests of the model containing the fixed effect 'scenario' against a similar model in random effects structure but without the fixed factor revealed a significant effect of scenario ($\chi^2(4) = 51.39$, $p < 0.001$).

The effect of scenario on reaction time is displayed in Fig. 2. Starting, again, with items without prosody, post hoc comparisons revealed significantly faster reaction times (in ms) in L ($\beta = 1643$; 95% CI = [1346; 1940]) relative to SA ($\beta = 2405$; 95% CI = [2077; 2733]; $t(1433) = -4.72$; $p < 0.0001$). Reaction times in SE scenarios ($\beta = 2036$; 95% CI = [1695; 2377]) were not significantly slower neither from L ($t(1439) = -2.33$, $p = 0.13$) nor from SA ($t(1451) = 2.01$, $p = 0.26$). These latter results, however, are difficult to interpret given the low proportion of accurate responses in SE scenarios. Turning to items with a distinctive sarcastic prosody, reaction times in SAP scenarios ($\beta = 1521$; 95% CI = [1124; 1818]) were significantly faster than those in SA ($t(1433) = -5.48$, $p < 0.0001$), and reactions times in SEP scenarios ($\beta = 1367$; 95% CI [1069; 1665]) were significantly faster than in SE scenarios ($t(1440) = -3.96$, $p = 0.0007$). By contrast, SAP, SEP and L did not differ in terms of reaction times (all ps < 0.3).

Note that, in our material, the correct response for all items with a distinctive prosody was 'sarcastic'. It is thus possible that during the course of the experiment participants simply ended up blindly associating the 'sarcastic' response with SEP and SAP items. Such a habituation bias for SAP and SEP scenario should give rise to an effect of the order of appearance of the item—in the first or the second half of the experiment—on accuracy and/or reaction times. Adding the fixed factor 'order' to the mixed model on accuracy used above, revealed a significant effect of order ($\chi^2(1) = 48.48$, $p < 0.001$); however, the interaction between order and scenario did not reach significance ($\chi^2(4) = 5.51$; $p = 0.24$). Similarly, adding the fixed factor 'order' to the linear mixed regression model on reaction times, showed a significant effect of order ($\chi^2(1) = 50$, $p < 0.001$). Again, however, there was no significant interaction between order and scenario ($\chi^2(4) = 1.37$, $p = 0.85$).

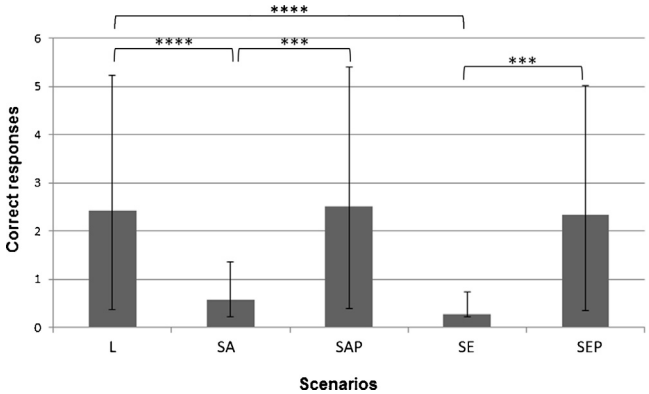

Fig. 1. Estimated means for correct responses by scenario in Study 1. (Literal scenarios (L), sarcastic allocentric scenarios with sarcastic prosody (SAP), sarcastic egocentric scenarios with sarcastic prosody (SEP), sarcastic allocentric (SA) and sarcastic egocentric (SE) scenarios.) Error bars indicate 95% confidence intervals. ****$p < .0001$, ***$p < 0.001$.

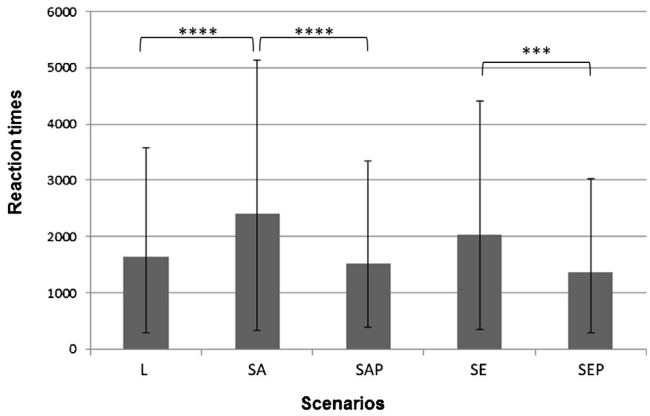

Fig. 2. Predicted reaction times (ms) for correct responses by scenario type in Study 1. (Literal scenarios (L), sarcastic allocentric scenarios with sarcastic prosody (SAP), sarcastic egocentric scenarios with sarcastic prosody (SEP), sarcastic allocentric (SA) and sarcastic egocentric (SE) scenarios.) Error bars indicate 95% confidence intervals. ****$p < .0001$, ***$p < 0.001$.

2.3. Discussion

The first clear result is that detecting sarcasm requires cognitive effort, as participants were less accurate and slower to respond in sarcastic allocentric (SA) scenarios compared to literal (L) scenarios. Recall that in both scenarios the addressee's and the participant's perspectives coincided, indicating that the effect is clearly due to a cost inherent in processing contextual cues for sarcasm. We also replicated the difference in accuracy between literal (L) and sarcastic egocentric (SE) scenarios found by Epley et al. (2004). Recall from the Introduction that, as such, this difference might have been due to the necessity to shift from one's own to the addressee's perspective or to the greater cognitive load inherent in the contextually salient sarcastic interpretation. Since the context activates sarcastic interpretation in both sarcastic allocentric (SA) and egocentric (SE) scenarios, if perspective-taking is egocentrically anchored, the former should involve additional cost of shifting away from one's own to the addressee's point of view. That is, according to the *anchoring and adjustment heuristic* model, participants should have been faster and less error prone in sarcastic allocentric (SA) scenarios, where their anchor point was closer to the addressee's perspective, than in sarcastic egocentric (SE) scenarios, where it was not. However, results showed that accuracy rate and processing speed did not differ relative to the listener's knowledge state. While accuracy tended to be lower in sarcastic egocentric (SE) scenarios than in sarcastic allocentric (SA) scenarios, this difference did not reach significance; neither did we observe a difference in reaction time between correct responses in sarcastic egocentric (SE) and allocentric (SA) scenarios. These results are compatible with a model that posits a by-default allocentric perspective-taking, which would kick off without being mediated by one's own point of view. On such an interpretation, in all three literal (L), sarcastic allocentric (SA) and egocentric (SE) scenarios participants would automatically adopt the addressee's perspective, but discrepancy between the context and the target statement would entail supplementary processing load in the latter two conditions.

However, an alternative take on these data would be that while allocentric perspective-shifting is highly automatic, it is not default. That is, while participants do start from their own perspective, they are capable to rapidly shift away from it when needed. Note that in Study 1, sarcastic egocentric (SE) scenarios elicited very poor performance even though participants had no time limit to perform a single task, which thus allowed them to allocate all of their cognitive resources to it. A handful of studies have shown a significant blunting in perspective-taking performance when individuals perform concurrently a task tapping onto executive processes (German and Hehman, 2006; Lin et al., 2010; Newton and de Villiers, 2007). In the same vein, in Epley et al. (2004: Experiment 2) time pressure led to poorer accuracy and slower reaction times in sarcastic egocentric (SE) scenarios compared to literal (L) ones. Therefore, if perspective-shifting is indeed egocentrically biased, one should expect a higher proportion of egocentrically biased responses, viz. the difference between sarcastic egocentric (SE) and allocentric (SA) scenarios to increase, when participants are put under time pressure to respond.

Our second goal was to examine the interplay between contextual and prosodic cues in sarcasm detection. The presence of sarcastic prosody clearly facilitates sarcasm detection, as sarcastic allocentric scenarios with prosody (SAP) and literal (L) scenarios were indistinguishable both in response accuracy and reaction times. As mentioned in the Introduction, a question that remained unanswered so far is whether participants still necessarily process perspectival, contextual information to interpret sarcasm, when prosodic cues are also available. In sarcastic egocentric scenarios with prosody (SEP), adopting the addressee's perspective favors the incorrect, 'literal' response, while the prosodic cues the

opposite sarcastic reading. In sarcastic allocentric scenarios with prosody (SAP), by contrast, prosodic cues are consistent with the context made available to the addressee. Therefore, if participants engage in perspective-shifting even in the presence of salient prosodic cues, in sarcastic egocentric scenarios with prosody (SEP) interference between the addressee's perspective and prosody should have surfaced as lower accuracy and/or slower reaction times relative to sarcastic allocentric scenarios with prosody (SAP). Yet, both accuracy and reaction times in sarcastic egocentric scenarios with prosody (SEP) did not differ from sarcastic allocentric scenarios with prosody (SAP), or, for that matter, literal (L) scenarios. In addition, the absence of interaction between the order of appearance and the scenario in accuracy and reaction times rules out that once participants detected that only sarcastic items had a distinctive prosody, they do not seek to assess the sarcastic character of the target scenario in sarcastic allocentric and egocentric scenarios with prosody (SAP and SEP), automatically selecting the 'sarcastic' response.

On the face of it, results of Study 1 strongly suggest that sarcasm may be detected without engaging in complex perspective-taking when salient, non-contextual cues are provided. However, we cannot entirely rule out a build-up of prosodic and contextual cues. It may be the case that participants automatically engage in perspective-shifting, but that this process is quickly canceled or superseded by a parallel processing of prosody. Here too, increasing time pressure provides a straightforward test: within a reduced time window, any earlier incongruent allocentric perspective-shifting should be made evident through a decreased advantage of prosody in sarcastic egocentric scenarios with prosody (SEP).

3. Study 2

In this Study we test two hypotheses: first, that perspective-shifting is always egocentrically anchored, and, second, that perspectival assessment of contextual cues is optional and is not triggered in the presence of salient prosodic cues. Both hypotheses can be tested using the same paradigm as in Study 1, but limiting the time available (to a maximum of 3 s) to judge the target statement as sarcastic or not.

3.1. Materials and method

3.1.1. Participants

Seventy-six undergraduate students, none of whom took part in Study 1, participated for monetary reward in Study 2. Inclusion criteria were similar to Study 1. Six subjects were removed from the statistical analyses because of hearing problems ($n = 2$), a sleep duration shorter than 6 h the night before the testing ($n = 2$) and two additional participants were removed because they did not fully complete the demographic and sleep questionnaires. The age of the seventy remaining participants (49 females) ranged between 17 and 32 ($m = 21.77$; $sd = 2.51$).

3.1.2. Procedure

The task and the scenarios used were similar to Study 1 except that participants were informed that they had 3 s at most to respond, as in Epley et al.'s paradigm (2004). After reading the contextual background, participants listened to the target statement. At the end of the target statement, a sound was heard and the following question appeared on the screen 'Will X (first name of Anaïs's friend) perceive this message as sarcastic?'. Participants had to decide, as fast as possible, whether the target sentence would be interpreted by the addressee as sincere or as sarcastic, by pressing the corresponding key. If participants did not respond within 3 s, a second sound was heard followed by the next trial.

3.2. Results

Out of the 1750 target trials, 42 trials did not include a response within 3 s and were thus left out of analyses (2.4% of the data).

Proportion of correct responses. A binomial mixed model was run with response, correct vs. incorrect as the predicted variable and 'senario' as the predictor and by-subject intercept as random factor (the null model with by-subject slope failed to converge). This analysis indicated a significant effect of Type ($\chi^2(4) = 269.13$, $p < 0.001$). Fig. 3 displays the proportion of correct responses predicted by the Scenario type. As in Study 1, accuracy was significantly higher in L scenarios ($\beta = 1.53$; 95% CI [1.25; 1.8]) than in SA scenarios ($\beta = 0.76$; 95% CI [0.53; 1]; $z = 4.25$, $p = 0.0002$) and in SE scenarios ($\beta = -0.14$; 95% CI [−0.36; 0.08]; $z = 9.47$, $p < 0.0001$). Unlike Study 1, however, accuracy in SA items was significantly higher than in the SE ones ($z = 5.7$, $p < 0.0001$). A one-sample *t*-test against 50% confirmed that participants responded at a chance level in SE scenarios ($t(69) = -0.87$; $p = 0.39$; 95% CI [39.67; 54.47]), but not in SA scenarios ($t(69) = 6.11$; $p < 0.001$; 95% CI [62.12; 73.88]).

Turning to items with a distinctive sarcastic prosody, SAP scenarios ($\beta = 2.22$; 95% CI [1.86; 2.58]) led to a significantly higher accuracy than SA scenarios ($z = 6.84$, $p < 0.0001$), and SEP to a significantly higher accuracy than SE scenarios

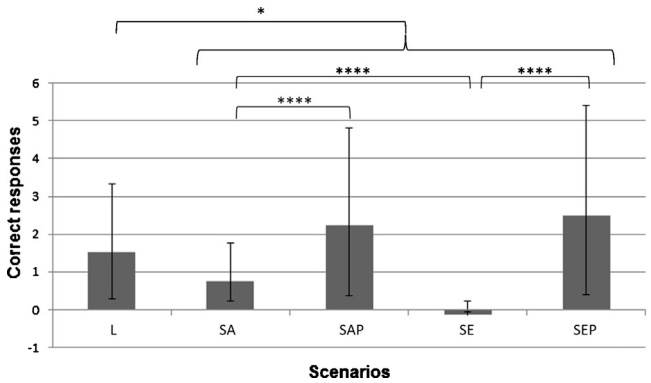

Fig. 3. Estimated means for correct responses by scenario in Study 1. (Literal scenarios (L), sarcastic allocentric scenarios with sarcastic prosody (SAP), sarcastic egocentric scenarios with sarcastic prosody (SEP), sarcastic allocentric (SA) and sarcastic egocentric (SE) scenarios.) Error bars indicate 95% confidence intervals. ****$p < .0001$, *$p < 0.05$.

($z = 11.54$; $p < 0.0001$). Interestingly, relative to L scenarios, accuracy was higher in SAP ($z = 3.02$; $p = 0.02$) and SEP ($z = 3.97$, $p = 0.0007$). Finally, SAP and SEP scenarios did not differ from each other in terms of accuracy ($p = 0.83$).

Response time on correct responses. It is important to urge caution on the interpretation of reaction times in paradigms where participants have a limited time window to respond, and many independent factors may conspire to increase variation. That said, information from reaction times can nevertheless be useful as one of our hypotheses is the absence of early interference of incongruent perspective-taking in SEP conditions.

We built a linear mixed model on correct responses with reaction time as the predicted variable and 'scenario' as the predictor variable. The model included by-subject random intercepts (the null model with by-subject slopes failed to converge). Likelihood ratio tests of the model containing the fixed effect 'scenario' against a similar model in random effects structure but without the fixed effect 'scenario' revealed again a significant effect of scenario ($\chi^2(4) = 31.86$, $p < 0.001$).

Fig. 4 displays reaction times predicted by scenario Type. Post hoc comparisons revealed that response time for correct items was not different in SAP ($\beta = 738$; 95% CI [652; 824]) and SEP scenarios ($\beta = 683$; 95% CI [598; 769]; $p = 0.63$). By contrast, participants were slower in L scenarios ($\beta = 883$; 95% CI [796; 971]) than in SAP ($t(1256) = 3.597$, $p = 0.0031$) and SEP ($t(1256) = 4.98$, $p < 0.0001$). Response times were also slower in SA scenarios ($\beta = 919$; 95% CI [796; 971]) than in SAP ($t(1257) = 4.254$; $p = 0.0002$) and SEP scenarios ($t(1259) = 5.55$, $p < 0.0001$). Finally, reaction times for correct responses in SE scenarios ($\beta = 806$; 95% CI [703; 908]) were not different from SA, L and SAP (ps > 0.2) scenarios and marginally slower relative to SEP scenarios ($t(1271) = 2.52$, $p = 0.09$). However, given that participants responded at chance in SE scenarios, these latter comparisons are difficult to interpret.

Again, since the correct response for all items with a distinctive prosody was 'sarcastic', it is possible that during the course of the experiment participants simply ended up blindly associating the 'sarcastic' response with SEP and SAP

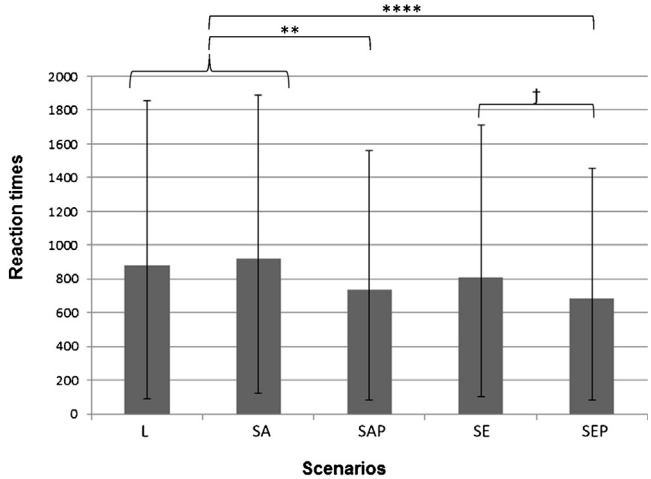

Fig. 4. Predicted reaction times (ms) for correct responses by scenario type in Study 2. (Literal scenarios (L), sarcastic allocentric scenarios with sarcastic prosody (SAP), sarcastic egocentric scenarios with sarcastic prosody (SEP), sarcastic allocentric (SA) and sarcastic egocentric (SE) scenarios.) Error bars indicate 95% confidence intervals. ****$p < .0001$, **$p < 0.01$, †$p < 0.1$.

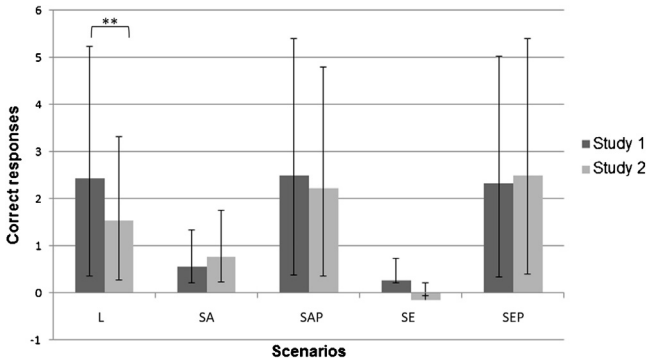

Fig. 5. Estimated means of correct responses by scenario type per study. (Literal scenarios (L), sarcastic allocentric scenarios with sarcastic prosody (SAP), sarcastic egocentric scenarios with sarcastic prosody (SEP), sarcastic allocentric (SA) and sarcastic egocentric (SE) scenarios.) $^{**}p < 0.01$.

items. As above, we reasoned that such a habituation bias for SAP and SEP scenarios should have given rise to an effect of the order of appearance of the items—in the first or the second half of the experiment—on accuracy and/or reaction times. Enriching the mixed binomial model used to test the effect of scenario showed a significant effect of order ($\chi^2(1) = 19.532$, $p < 0.001$), as well as a significant interaction between order and scenario ($\chi^2(4) = 15.86$, $p = 0.0032$). Expectedly, overall accuracy was lower in the first half ($\beta = 1.15$; 95% CI [0.95; 1.35]) than in the second ($\beta = 1.8$; 95% CI [1.52; 2.09]; $z = -3.77$, $p = 0.0002$). Post hoc analyses revealed no difference in accuracy between the two halves of the experiment for L, SA and SEP items (all ps > 0.98). Accuracy for SAP scenarios tended to be lower in the first half ($\beta = 1.9$; 95% CI [1.52; 2.28]) than in the second half of the experiment ($\beta = 3.6$; CI [2.56; 4.75]; $z = -.2.75$, $p = 0.15$). The only significant difference in accuracy concerned SE scenarios, for which performance was lower in the first half ($\beta = -0.735$; 95% CI [−1.08; −0.39]) than in the second half ($\beta = 0.32$; 95% CI [0.03; 0.61]; $z = -4.46$, $p = 0.0002$). Enriching the linear mixed regression model used to test the effect of scenario on reaction times revealed a significant effect of order ($\chi^2(1) = 52.07$, $p < 0.001$), but no significant interaction between order and scenario ($\chi^2(4) = 6.94$, $p = 0.14$).

Comparisons between egocentric biases in Studies 1 and 2: In order to get a clearer idea of the effect of time pressure on the egocentric bias, we compared performance between our two studies. We first merged the data from both studies and built a binomial mixed model with scenario as predictor of accuracy and by-subject intercepts as a random effect. Next, we enriched this model with the predictor 'study' (1 or 2). Likelihood ratio tests indicated a significant effect of study ($\chi^2(1) = 5.81$, $p = 0.016$). Post hoc analyses indicated that accuracy in Study 1 ($\beta = 1.59$; 95% CI [1.46; 1.74]) was significantly higher than in Study 2 ($\beta = 1.37$; 95% CI [1.24; 1.51]; $z = 2.43$, $p = 0.015$). The interaction of scenario with study also proved significant relative to a model with study and scenarios as predictors ($\chi^2(4) = 5.81$, $p = 0.01$). Fig. 5 compares the effect of scenario on accuracy in the two studies.

Post hoc comparisons revealed that accuracy was higher in the first Study for L scenarios ($z = 3.84$, $p = 0.0048$), and is numerically higher for SE scenarios ($z = 2.64$, $p = 0.2$), even though this difference failed to reach statistical significance. No difference in accuracy emerged between studies for SA, SAP and SEP scenarios (all ps > 0.97).

3.3. Discussion

The first hypothesis put to test in Study 2 was that the egocentric anchoring of perspective-shifting should cause an egocentric bias evident in early stages of processing (within 3 s). If time pressure hinders the ability to adjust our own perspective to the point of view of the other, its negative impact on accuracy should be mostly observed in sarcastic egocentric (SE) scenarios in comparison to sarcastic allocentric (SA) scenarios, since the former requires more adjustment than the later. As expected, whereas sarcastic allocentric (SA) and egocentric (SE) scenarios did not differ in unhurried participants (Study 1), accuracy rate in hurried participants (Study 2) was significantly higher in sarcastic allocentric (SA) scenarios than in sarcastic egocentric (SE) scenarios. This result strongly suggests that participants start from their own perspective and, provided sufficient processing time, shift toward the addressee's perspective. Unlike in Study 1, where participants had sufficient time for shifting away toward the addressee's perspective, in Study 2 participants were under pressure to respond before this shift could take place. This result supports the *anchoring and adjustment heuristic* model: under time pressure, the serial adjustment process from one's own perspective to the other's perspective has no sufficient time to succeed, leading to responses closer to the egocentric anchor.

Second, when incongruence with context was the only basis for sarcasm judgment, participants were more accurate in appraising the addressee's interpretation of literal (L) scenarios relative to sarcastic egocentric (SE) and allocentric (SA) scenarios. This result is consistent with our first study and supports the idea that context-based sarcasm detection is a cognitively costly process. In fact, assessing contextual (in)congruence of the target sentence takes time even when the interpretation is literal, as revealed by significantly lower performance in literal (L) scenarios in hurried participants (Study 2) relative to participants with no time limit to respond (Study 1). Consistently, in the presence of prosodic cues, accuracy in both sarcastic scenarios was enhanced in such a way that not only were participants more accurate in assessing sarcastic allocentric (SAP) and egocentric (SEP) scenarios, but also literal (L) ones. This latter result supports our initial hypothesis that in the presence of salient sarcastic prosody participants disregard contextual cues.

The absence of a difference between sarcastic allocentric and egocentric scenarios both delivered with sarcastic prosody (SAP & SEP) replicates our first study and provides further support to the idea that hurried participants focus on prosodic cues to accurately appraise the addressee's interpretation of a statement, so that they can bypass the cognitively costly perspective-taking process.

Reaction time analyses lend some further credence to this interpretation. If participants exclusively rely on prosodic cues, whenever these were available, reaction times to process sarcastic allocentric scenarios associated with sarcastic prosodic cues (SAP) should be identical to participant's reaction times in sarcastic egocentric scenarios uttered with a sarcastic prosody (SEP). By contrast, if contextual information is processed in parallel with prosodic cues, participants should be faster in sarcastic allocentric scenarios with a sarcastic prosody (SAP) which benefit from two congruent cues (contextual and prosodic cues) than in sarcastic egocentric scenarios with a sarcastic prosody (SEP) where prosodic cues are incongruent with contextual information. Consistent with our first study, results indicated that both categories of sarcastic scenarios uttered with a sarcastic prosody (SAP/SEP) didn't differ from each other and are faster than literal (L) and sarcastic allocentric (SA) scenarios. This finding supports again the hypothesis that, when prosodic cues are available, participants use them to ground their judgment without processing contextual information. The absence of difference in accuracy and reaction times in sarcastic allocentric and egocentric scenarios with a sarcastic prosody (SAP and SEP) between Studies 1 and 2 also confirms that prosodic cues are relied upon at the expense of contextual ones from the very beginning of the processing, rather than being treated in parallel.

Finally, just as in Study 1, the advantage of prosody cannot be ascribed to a habituation effect, as no systematic difference emerged in accuracy for sarcastic allocentric and egocentric scenarios with a sarcastic prosody (SAP and SEP) between the first and the second half of the experiment, and no interaction was found between order of appearance and reaction times.

4. General discussion

Together, our two studies contribute to provide firm support to the *anchoring and adjustment heuristics* in language processing. Results of our second study, where participants were placed under time pressure to respond, unambiguously reveal that utterance processing involved in gauging someone else's sarcasm understanding starts from one's own egocentric perspective. The effect of egocentric bias is less visible in the unhurried participants of Study 1, suggesting that, albeit costly, allocentric perspective-shift may still be efficiently triggered by contextual cues. Consistently with this idea, Deliens et al. (2015) recently investigated the impact of sleep deprivation on the ability to adopt another perspective with a paradigm very similar to the one used here. Interestingly, while a 24-hour sleep deprivation appeared to cause an overall slowdown, sleep-deprived participants did not make more egocentric errors in the egocentric scenarios than non-sleep-deprived controls. This means that participants do engage in a cognitively-taxing perspective-taking process in order to detect sarcasm, even in a situation where their cognitive abilities are depleted due to acute sleep deprivation.

This is not to say, however, that allocentric perspective-taking is automatic. Another important result of this paper is that participants do not shift away from their own perspective when alternative, cheaper strategies are available. Our studies demonstrated that in the condition where participants could rely on sarcastic prosody to detect sarcasm, their performance was not taxed by an incongruent allocentric perspective. This result cannot be explained away by an early parallel processing of prosody and perspective-taking, as the absence of interference of the allocentric point of view was even more evident in the hurried participants of Study 2.

In addition to allow insights into mechanisms of epistemic perspective-taking, the sarcasm detection task we used provides interesting evidence on the hierarchy of pragmatic processing. Contrary to the Direct Access (Gibbs, 1994) and Graded Salience (Giora, 2003) models, which predict a priority activation of ironic meanings when these are rendered particularly salient by the context, our study evidenced that processing sarcastic statements requires more time than processing literal statements. By contrast, when participants are under time pressure and salient prosodic cues are available, sarcastic statements are faster processed than literal ones, and this for both allocentric and egocentric scenarios. These results show that when people have to gauge someone else's sarcasm understanding in the presence

of both contextual and prosodic cues, they use the latter to ground their judgment without fully processing contextual information. Since assessing message (in)congruence with the background context is time consuming, focusing on a salient sarcastic marker such as prosody is an efficient strategy to make an accurate judgment with the least processing effort. This finding is inconsistent with the core of Relevance theory, which holds that utterance interpretation is necessarily grounded in complex mental-state attribution (Wilson and Sperber, 2012, chapter 6). It also contradicts the parallel constraint satisfaction account (Pexman, 2008) which suggests that prosodic and contextual cues are processed in parallel. By contrast, our results support a conception of pragmatics according to which communicators may resort to different types of cognitive processing—some of them not necessarily involving complex mental-state attribution or perspective-shifting—in order to reach the level of interpretation that is independently motivated by the context (Kissine, 2016). Under such a view, pragmatic competence involves a metacognitive component, responsible for rapid identification of the interpretative goal and the selection of the most parsimonious path to reach it. In our study, the participants' task was to detect sarcasm, and they appeared to exclusively rely on cheaper, prosodic cues, whenever these were available.

It is worth emphasizing that we are not claiming that fully-blown sarcasm detection does not require advanced processing of context. To begin with, in most situations it is not sufficient to detect that the speaker is sarcastic; one also needs to understand more precisely the intended meaning—and this, more complex, interpretative challenge is likely to require advanced assessing of context. There is also robust evidence, both from typical and atypical development, that the capacity to accurately understand sarcasm requires complex perspective-shifting, Theory of mind-based abilities (see, for instance, Kissine, 2013 for a review). What our results do show is that even though such mechanisms are available, adult hearers may sometimes rely on other signals for sarcasm without necessarily going through a complex assessment of background context.

Conflict of interest

The authors have declared that no competing interests exist.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.pragma.2017.08.002.

References

Akimoto, Y., Miyazawa, S., Muramoto, T., 2012. Comprehension processes of verbal irony: the effects of salience, egocentric context, and allocentric theory of mind. Metaphor Symbol 27 (3), 217–242.

Anolli, L., Ciceri, R., Infantino, M.G., 2000. Irony as a game of implicitness: acoustic profiles of ironic communication. J. Psycholinguist. Res. 29 (3), 275–311.

Attardo, S., Eisterhold, J., Hay, J., Poggi, I., 2003. Multimodal markers of irony and sarcasm. Humor 16 (2), 243–260.

Bates, D., Maechler, M., Bolker, B., Walker, S., 2015. Fitting linear mixed-effects models using lme4. J. Stat. Softw. 67 (1), 1–48. http://dx.doi.org/10.18637/jss.v067.i01

Boersma, P., Weenink, D., 2015. Praat: Doing Phonetics by Computer [Computer Program] (Version version 6.0.08).

Brown-Schmidt, S., 2009. Partner-specific interpretation of maintained referential precedents during interactive dialog. J. Mem. Lang. 61, 171–190.

Bryant, G.A., 2012. Is verbal irony special? Lang. Linguist. Compass 6 (11), 673–685.

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

Bryant, G.A., Fox Tree, J.E., 2005. Is there an ironic tone of voice? Lang. Speech 48 (Pt 3), 257–277.

Cheang, H.S., Pell, M.D., 2008. The sound of sarcasm. Speech Commun. 50 (5), 366–381.

Deliens, G., Stercq, F., Mary, A., Slama, H., Cleeremans, A., Peigneux, P., Kissine, M., 2015. Impact of acute sleep deprivation on sarcasm detection. PLOS ONE 10, e0140527. http://dx.doi.org/10.1371/journal.pone.0140527

Ellis, B.W., Johns, M.W., Lancaster, R., Raptopoulos, P., Angelopoulos, N., Priest, R.G., 1981. The St. Mary's Hospital sleep questionnaire: a study of reliability. Sleep 4 (1), 93–97.

Epley, N., Keysar, B., Van Boven, L., Gilovich, T., 2004. Perspective taking as egocentric anchoring and adjustment. J. Pers. Soc. Psychol. 87 (3), 327–339. http://dx.doi.org/10.1037/0022-3514.87.3.327

Ferreira, F., Patson, N.D., 2007. The 'Good Enough' approach to language comprehension. Lang. Linguist. Compass 1 (1–2), 71–83.

German, T.P., Hehman, J.A., 2006. Representational and executive selection resources in 'Theory of mind': evidence from compromised belief-desire reasoning in old age. Cognition 101 (1), 129–152. http://dx.doi.org/10.1016/j.cognition.2005.05.007
Gibbs, R.W., 1994. The Poetics of Mind. Figurative Thought, Language, and Understanding. Cambridge University Press, Cambridge.
Gibbs, R.W., 2000. Irony in talk among friends. Metaphor Symbol 15 (1–2), 5–27.
Giora, R., 2003. On our Mind. Salience, Context, and Figurative Language. Oxford University Press, Oxford.
González-Fuente, S., Prieto, P., Noveck, I., 2016. A fine-grained analysis of the acoustic cues involved in verbal irony recognition in French. Speech Prosody 2016, 902–906.
Keysar, B., 1994. The illusory transparency of intention: linguistic perspective taking in text. Cogn. Psychol. 26 (2), 165–208. http://dx.doi.org/10.1006/cogp.1994.1006
Kissine, M., 2013. From Utterances to Speech Acts. Cambridge University Press, Cambridge.
Kissine, M., 2016. Pragmatics as metacognitive control. Front. Psychol. 6. http://dx.doi.org/10.3389/fpsyg.2015.02057
Kreuz, R.J., Kassler, M.A., Coppenrath, L., Allen, B.M., 1999. Tag questions and common ground effects in the perception of verbal irony. J. Pragmat. 31 (12), 1685–1700.
Lenth, R., 2016. Least-squares means: the R package lsmeans. J. Stat. Softw. 69 (1), 1–33. http://dx.doi.org/10.18637/jss.v069.i01
Lin, S., Keysar, B., Epley, N., 2010. Reflexively mindblind: using Theory of mind to interpret behavior requires effortful attention. J. Exp. Soc. Psychol. 46 (3), 551–556.
Lœvenbruck, H., Jannet, M.A.B., D'Imperio, M., Spini, M., Champagne-Lavau, M., 2013. Prosodic Cues of Sarcastic Speech in French: Slower, Higher, Wider. Paper presented at the 14th Annual Conference of the International Speech Communication Association (Interspeech 2013).
Newton, A.M., de Villiers, J.G., 2007. Thinking while talking: adults fail nonverbal false-belief reasoning. Psychol. Sci. 18 (7), 574–579.
Nilsen, E.S., Glenwright, M., Huyder, V., 2011. Children and adults understand that verbal irony interpretation depends on listener knowledge. J. Cogn. Dev. 12 (3), 374–409.
Pexman, P.M., 2008. It's fascinating research the cognition of verbal irony. Curr. Direct. Psychol. Sci. 17 (4), 286–290.
Pexman, P.M., Zvaigzne, M.T., 2004. Does irony go better with friends? Metaphor Symbol 19 (2), 143–163.
R Development Core Team, 2015. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria Retrieved from: http://www.R-project.org/
Rankin, K.P., Salazar, A., Gorno-Tempini, M.L., Sollberger, M., Wilson, S.M., Pavlic, D., Miller, B.L., 2009. Detecting sarcasm from paralinguistic cues: anatomic and cognitive correlates in neurodegenerative disease. Neuroimage 47 (4), 2005–2015. http://dx.doi.org/10.1016/j.neuroimage.2009.05.077
Recanati, F., 2004. Literal Meaning. Cambridge University Press, Cambridge.
Rockwell, P., 2000. Lower, slower, louder: vocal cues of sarcasm. J. Psycholinguist. Res. 29 (5), 483–495.
Shintel, H., Keysar, B., 2009. Less is more: a minimalist account of joint action in communication. Topics Cogn. Sci. 1, 260–273.
Sperber, D., Wilson, D., 1995. Relevance: Communication and Cognition, second ed. Blackwell, Oxford.
Sperber, D., Wilson, D., 2002. Pragmatics, modularity and mind-reading. Mind Lang. 17, 3–23.
Tversky, A., Kahneman, D., 1974. Judgment under uncertainty: heuristics and biases. Science 185 (4157), 1124–1131.
Voyer, D., Thibodeau, S.H., Delong, B.J., 2016. Context, contrast, and tone of voice in auditory sarcasm perception. J. Psycholinguist. Res. 45 (1), 29–53. http://dx.doi.org/10.1007/s10936-014-9323-5
Wilson, D., Sperber, D., 2012. Meaning and Relevance. Cambridge University Press, Cambridge.

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