



## Neural evidence that utterance-processing entails mentalizing: The case of irony

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### ABSTRACT

It is now well established that communicators interpret others' mental states through what has been called "Theory of Mind" (ToM). From a linguistic-pragmatics perspective, this *mentalizing* ability is considered critical because it is assumed that the linguistic code in all utterances underdetermines the speaker's meaning, leaving a vital role for ToM to fill the gap. From a neuroscience perspective, understanding others' intentions has been shown to activate a neural ToM network that includes the right and left temporal parietal junction (rTPJ, lTPJ), the medial prefrontal cortex (MPFC) and the precuneus (PC). Surprisingly, however, there are no studies – to our knowledge – that aim to uncover a direct, on-line link between language processing and ToM through neuroimaging. This is why we focus on verbal irony, an obviously pragmatic phenomenon that compels a listener to detect the speaker's (dissociated, mocking) attitude (Wilson, 2009). In the present fMRI investigation, we compare participants' comprehension of 18 target sentences as contexts make them either ironic or literal. Consider an opera singer who tells her interlocutor: "Tonight we gave a superb performance!" when the performance in question was clearly awful (making the statement ironic) or very good (making the statement literal). We demonstrate that the ToM network becomes active *while* a participant is understanding verbal irony. Moreover, we demonstrate – through Psychophysiological Interactions (PPI) analyses – that ToM activity is directly linked with language comprehension processes. The paradigm, its predictions, and the reported results contrast dramatically with those from seven prior fMRI studies on irony.

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### Introduction

Much work in the cognitive sciences has documented our species' ability to interpret other agents' intentions. This mentalizing ability, often called "Theory of Mind" (ToM) (Premack and Woodruff, 1978), concerns recognizing belief states or attitudes, beliefs about beliefs (second-order ToM) as well as recognizing that one's prior beliefs could be wrong (among other things). In fact, the earliest experimental research on ToM is based on adaptations of the False Belief paradigm taken from developmental psychology in which a participant is required to predict the behavior of a character who has a false belief about the location of a hidden object (Wimmer and Perner, 1983). A central marker of ToM maturity is the ability to recognize that a protagonist's belief-state ought to prompt her to search for the object where she last saw it and not where it actually is (i.e., Sally ought to look for a marble in a basket where she left it even though it had been moved to a box).

Neuroimaging investigations have played an important role in substantiating that Theory of Mind is involved in false beliefs and, more generally, in inference-making about other agents. Through a variety of tasks, there is now general agreement that one can point to a neural ToM network that includes the right temporal-parietal junction (rTPJ), the left

temporal-parietal junction (lTPJ), the medial prefrontal cortex (MPFC) and the precuneus (PC) (for reviews, see Mitchell, 2009; Saxe et al., 2004; Van Overwalle and Baetens, 2009; also see Frith and Frith, 2006 who would add the temporal poles as well). According to Saxe (2006), the right TPJ and the MPFC are especially central to ToM processing. The former is thought to be selectively recruited for reasoning about, and the interpretation of, the content of mental states (how the state of affairs is represented, i.e. what the person believes to be true of it). The latter (especially the dorsal part of the MPFC) is considered to be implicated in the representation of triadic relations, which can be viewed as *You, Me and a state of affairs* and which allows one to correctly interpret situations where two people are talking, thinking or working on a shared third "object".

Neurologically speaking, there are three ways in which research has investigated links between language and ToM. One is through studies that investigate the extent to which the two co-develop during the life span by determining whether a deficit in one affects the other (e.g., Malle, 2002). A second way is to investigate the link between pragmatic deficits and Autism Spectrum Disorders. Those on the Autism Spectrum are thought to be less capable at accomplishing linguistic tasks that depend on ToM (see Happé, 1993; for a review see Tager-Flusberg, 2000; though see Chevallier and Wilson, 2010; Chevallier et al., 2011; Chevallier et al., 2012). Finally, others have considered the connection between ToM-related regions and the – intended and unintended – communication of attitudes. For example, Frith and

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Frith (2006) reviewed several studies that show how ToM areas are activated when a participant is essentially asked to make inferences about others. For example, the Friths cite a study from Mitchell et al. (2006) in which the authors asked participants to predict attitudes of two individuals, one of whom was described as liberal and the other as conservative (e.g., “would he enjoy having a roommate from a different country”). Those sharing the same outlook prompt a pattern of results that differ from those who do not share the same leanings. This kind of work has ultimately been concerned with the segregation of activity associated with mentalizing and specifically with respect to the MPFC, one of the main regions of ToM activity.

The present work also aims to establish a neural relationship between ToM and language but more specifically by investigating how ToM is engaged *while* participants process utterances. No prior work – as far as we can tell – has aimed to establish such a link experimentally through neuroimaging (though see Saxe, 2009, for some speculations about such a potential link). Given the existing literature on ToM, it would be eminently sensible to assume that one would find neurological evidence linking linguistic triggers and ToM processing. After all, an utterance is typically a starting point for understanding an agent's intention and ToM is crucial for filling the gaps between *what is said* and *what is meant* (Sperber and Wilson, 1995; Carston, 2002). We attempt to establish this link by investigating verbal irony, which is a figure of speech that most obviously underlines how one need exploit ToM in utterance comprehension.

In what follows, we describe properties of irony as well as explain why its processing would make for an ideal linguistic-pragmatic object for investigating the ToM network. We briefly review the existing neuroimaging literature on irony and show how there is little support so far for the notion that irony provokes activity in a ToM network. We argue that this negative result is due largely to the methods and materials in the prior experiments. We then briefly summarize how the cognitive neuroscience literature currently views irony processing before turning to our experiment, which aims to establish that ironic utterances specifically prompt ToM activity.

### Processing irony

Ironic utterances provide prima facie evidence that a listener is required to, not only go beyond the literal meaning of an utterance but to, convey the speaker's attitude. That is, irony prompts a listener to understand the speaker's mental state about the proposition expressed. It is not surprising then that theorists generally highlight how irony comes with some form of attitude ascription (Clark and Gerrig, 1984; Grice, 1989; Wilson, 2009). Grice, for one, suggested that irony involves the expression of a “hostile or derogatory judgment or a feeling such as indignation or contempt” (Grice, 1989: 53). For Wilson (2006), the dissociativeness of irony is central to the echoic-mention theory (D. Wilson and Sperber, 1992) of irony, as she explains in the example of Mary who, after a difficult meeting, says “That went well”:

Mary might use “That went well” to communicate that it was ridiculous of her to think that the meeting would go well, stupid of her friends to assure her that it would go well, naïve of her to believe their assurances, and so on. Mary *echoes* a thought or utterance with a similar content to the one expressed in her utterance, in order to express a critical or mocking attitude to it.

It is clear – intuitively and theoretically – that the understanding of irony requires that one access a speaker's intention as she expresses a dissociative attitude.

There are currently seven studies that employ functional neuroimaging techniques to investigate irony processing on healthy participants (Eviatar and Just, 2006; Rapp et al., 2010; Shibata et al., 2010; Uchiyama et al., 2006, 2011; Wakusawa et al., 2007; Wang et al., 2006; see Table 1

for a description and summary of the prior neuroimaging studies). Remarkably, no single study reports extensive activity in the ToM network in the way that neural ToM tasks do (cf. Saxe and Powell, 2006). Instead, one finds either a) no overlap with ToM regions or b) only partial overlap.

As an example of the first sort, consider one recent study (Uchiyama et al., 2011). The authors developed vignettes that had ironic comments as endings, e.g. see the one in (2a) below, and they also worked out slightly different contexts that would render such comments more literal, e.g. see the one as in (2b):

- (2a) The woman was not a good cook and was taking up to an hour just preparing the ingredients. Her mother-in-law, who was watching how she was doing, said to her: “You're very skillful.”  
 (2b) The woman was a good cook and was preparing dinner efficiently. Her mother-in-law, who was watching how she was doing, said to her: “You're very skillful.”

Utterances such as those at the end of (2a) activated participants' subcortical and limbic regions when compared to the non-ironic versions of utterances such as those in (2b). These regions have no overlap with those considered to be part of the ToM network.

As an example of the second sort, consider Eviatar and Just (2006) who compared participants' reading of metaphorical, ironic and literal utterances when they were presented as the final passage of 4-sentence-long vignettes. They found limited extra activation in the regions near the Right TPJ (coordinates  $x = 51$   $y = -26$   $z = 5$ ) in the *Ironic* condition, but not much else (also see Wang et al., 2006). In short, findings from prior studies do not reveal extensive overlap with the ToM system.

In the absence of ToM activity in these studies, one is of course prevented from claiming that ToM is involved in irony processing, let alone language. It is our view, however, that the prior investigations have not reported extensive ToM activity because the methods and materials were not ideal for discovering it. Below, we summarize three general features of the prior fMRI these studies and consider how they have arguably prevented the literature from determining that verbal irony prompts neurological ToM activity.

First, the vignettes and their presentation have not been optimal for the two following reasons. One is that the vignettes and their target utterances are almost invariably short, ranging from two to at most four sentences (Eviatar and Just, 2006; Rapp et al., 2010; Shibata et al., 2010; Uchiyama et al., 2006, 2011; Wakusawa et al., 2007; Wang et al., 2006). Arguably, such brevity gives a participant a limited amount of time to appreciate the background of a story

**Table 1**

A summary of neuroimaging studies to date on irony and the extent to which they implicate ToM activity as based on generally accepted description of the neural ToM.

Study	Theory of Mind network				Comments
	rTPJ	ITPJ	MPFC	PC	
Eviatar and Just (2006)	None reported	None reported	Yes reported	None reported	MPFC activation in all conditions
Wang et al. (2006)	None reported	None reported	Yes reported	None reported	
Uchiyama et al. (2006)	None reported	None reported	Yes reported	None reported	No contrast: <i>Irony &gt; Literal</i>
Wakusawa et al. (2007)	None reported	None reported	Yes reported	None reported	
Rapp et al. (2010)	None reported	None reported	Yes reported	None reported	
Shibata et al. (2010)	None reported	None reported	Yes reported	Yes reported	
Uchiyama et al. (2011)	None reported	None reported	Yes reported	None reported	No contrast: <i>Irony &gt; Literal</i>

and its eventual irony (as in 2a above). These stimuli were no doubt developed in order to fit into the parameters of a typical fMRI session. However, judging from prior psycholinguistic investigations, an ironic statement in a laboratory setting requires contextual development and typically more background. For example, Gibbs (1986) presented stories that were up to seven sentences long and even recent EEG experiments (whose experimental conditions require 30 trials or more) include longer vignettes (see Regel et al., 2011). The differences across the neurological and behavioral literatures do not end there, of course. The other drawback of the neuroimaging studies is that the uptake of the vignettes is typically outside the participant's control (a vignette is presented as a block or else at a speed predetermined by the experiment). This is unlike the tasks in the behavioral literature, which are usually self-paced. Such features risk taking away from the naturalness of reading texts by constraining a participant's ability to make inferences on-line.

Second, ironic items in the neuroimaging studies predominate the stimuli in two ways. One way is that ironic items are practically telegraphed in the context of these experiments. That is, it appears that ironic utterances in existing neuroimaging studies are systematically cued by negative events while literal uses of similar utterances are not. The upshot is that any effort to mentalize, the very activity that is being investigated, risks becoming short-circuited over the course of an experimental session. The other way is that ironic materials are highly prominent in most of these fMRI investigations. Whereas frequency estimates indicate that irony represents 8% of conversational turns in talk among friends (Gibbs, 2000) and that readers of contemporary American literature can encounter, on average, an irony every four pages (Kreuz et al., 1996), the proportion of ironies over the course of a typical fMRI study is much higher. For example, ironic targets represent 1/3 of the stimuli in the studies of Eviatar and Just (2006) and Shibata et al. (2010). To some extent, these issues can be dealt with extra filler items but rarely are.

Third, the studies do not systematically take advantage of the fact that studies on irony come with an ideal control in which minor modifications to the context can allow one to use the very same sentence as an ironic remark or as a non-ironic, literal one. In two studies (e.g., Shibata et al., 2010; Wakusawa et al., 2007), ironic versus literal stories are not designed from common contexts. In three other studies (Eviatar and Just, 2006; Uchiyama et al., 2006; Wang et al., 2006), as Rapp et al. (2010) point out, *Ironic* and *Literal* conditions are not directly compared. For example, Uchiyama et al.'s (2006) *sarcasm-detection* measure was determined by contrasting, on the one hand, the sarcastic and the non-sarcastic remarks together and, on the other, a control sentence that was "unconnected." This does not allow one to isolate the activity linked exclusively to the sarcastic remark.

It is not surprising then that current neurological accounts of irony do not emphasize ToM processing. Instead, the literature underlines more general processes about figurative language that coincidentally involve the Right Hemisphere (RH). For example, Gernsbacher and Robertson (2004) attribute "narrative construction" to the RH while Long and Baynes (2002) use investigations of impairments to claim that the RH is involved in "discourse representation" (for a different perspective, cf. Bambini et al., 2011; Rapp et al., 2007). Although the comprehension of irony seems to be especially affected by lesions in the right hemisphere (e.g., Brownell et al., 1992; Shamay-Tsoory et al., 2005), the precise role that the RH plays in these impairments remains largely descriptive.<sup>1</sup> Of course, if one were to find extensive ToM activity, it would not be inconsistent with accounts that emphasize the right hemisphere's role in figurative language generally; after

all, proposed ToM networks include the crucial rTPJ. Our ToM account would provide some precision to claims about RH activation.

In the current investigation, our main question is the following: To what extent does irony comprehension recruit the bilateral ToM network? According to our hypothesis, when a target utterance is part of an *Ironic* condition as opposed to a *Literal* one, one ought to find evidence that covers the entire ToM network (the rTPJ, the lTPJ, the MPFC and the PC). Negative evidence, of course, would imply that the prior studies were on the right track or that perhaps ToM is secondary or even irrelevant to irony processing.

In an effort to find connections between ToM regions and language processing we anticipate using another investigatory technique, the psycho-physiological interactions analysis (PPI) which is designed to determine whether the functional connectivity of an a priori determined region interacts with other brain areas as a function of an experimental condition (Friston et al., 1997). In the current study, we aim to investigate the relationship between ToM areas and the left IFG, which is implicated (non-controversially) in language comprehension (e.g., see Hagoort, 2005). More specifically, if activity of ToM regions and language regions co-vary as a function of the *Ironic* v. *Literal* conditions, then it would imply that ToM activity is directly linked to language use.

To summarize, our study is designed to investigate the interaction between language processing and the ToM network and by using irony as a test bed. We designed the protocol in the most rigorous and ecological way possible given the experimental constraints imposed by fMRI methodology. We prepared our study so that we could address each of the criticisms raised about the prior studies and while using techniques that could determine the extent to which ToM is implicated in language through irony.

## Materials and methods

### Participants

Twenty healthy participants, who were students from the University of Lyon, participated in the study (12 females and 8 males). All participants (whose mean age was 22) were native French speakers, were right-handed and reported to have normal vision and no history of mental illness. Our protocol was accepted by the local ethics committee and each participant passed a medical visit and gave informed consent prior to the experiment.

### Materials

Twenty story-frameworks were created (in French) that led to a target sentence that could be interpreted either as ironic or as literal as a function of a minor modification made to the prior context. In the *Ironic* condition, a target sentence (e.g., "Tonight, we gave a superb performance.") was preceded by a negative context (e.g., a terrible performance) whereas in the *Literal* condition the target sentence was preceded by a positive context (e.g., an impressive performance). Otherwise, the introductory sentences and the wrap-up sentences of any given framework was the same for both conditions. Each story included the following six features.

First, all stories were seven lines long, each having a maximum length of 91 characters (spaces included) in order to fit into one line on a screen. Second, the stories described an everyday situation and an exchange between two characters who know each other casually (i.e., we avoided situations that presumed close relationships among interlocutors). Third, the first three sentences introduced the two characters and the situation. Fourth, the fourth and fifth sentences described the development of the situation that can be either positive (in the literal version) or negative (in the ironic version). These were the only two lines that could potentially change with respect to condition. Changes were designed to be as minimal as

<sup>1</sup> One current debate pits at least two positions against each other. One is that RH patients have deficits in making counterfactual inferences, which are often necessary for understanding speakers. The other is that RH patients have specific difficulties in making inferences about a speaker's mental states (see McDonald, 1999 for a review).

possible while keeping the stories sensible. Fifth, the sixth line was designed to be the target sentence. The length of all target sentences was between 10 and 12 syllables whose number of words ranged from 6 to 10, with a mean of 7.4. Crucially, the target sentence (line 6) is exactly the same in both *Ironic* and *Literal* conditions. Finally, the seventh line was an ordinary wrap-up conclusion of the story that makes sense for both the *Ironic* and *Literal* conditions.

As we indicated, we aimed to block a link between negative contexts and ironic remarks through what we refer to as *decoy* stories. The structure of the six decoys was the same as the ironic stories (7 sentences in which a negative event occurs), except that the target sentence was banal. For example, the decoy story in Table 2 describes how one character drops a mirror, which leads the other character to remark “We have made a big mistake.” Like in the *Ironic* and *Literal* conditions, the target sentence in the decoy stories is between 10 and 12 syllables.

Each participant read 10 ironic stories, 8 literal stories and 6 decoys. For each participant, the 18 critical (non-decoy) stimuli were extracted randomly from a pool of 20 frameworks that could each be the basis of either an ironic or literal target sentence. The 6 decoys remained the same for each participant. There were also a further 36 filler items (which also consisted of 7-line long stories about everyday situations as well; these were part of another experiment on text comprehension).

These stories were drawn from a corpus that has been developed and tested repeatedly as part of a cognitive study of irony. To verify that the specific stimuli used here were perceived as intended, a rating study was conducted on the 46 stories (2 from each of the frameworks plus the six decoys) with 26 participants (13 women) whose ages ranged from 19 to 35 (with a mean of 27) and who did not participate in the imaging study. Whereas the 40 *Ironic* and *Literal* stories were pseudorandomized and balanced across two lists, the 6 decoys were included for each participant. Participants were asked to read each story and rate the extent to which the target sentence was ironic on a scale from 1 (not at all ironic) to 5 (very ironic). Ironic target sentences were rated as highly ironic (mean of 4.5),

while literal sentences and the banal lines from the decoy stories were rated as low on the ironic scale (1.2 and 1.4, respectively). Repeated measure ANOVAs showed significant differences between (i) the *Ironic* and *Literal* conditions and (ii) the *Ironic* condition and *Decoys* (both at  $p < .001$ , corrected for multiple comparisons using the Tukey method). The comparison between the *Literal* condition and the *Decoys* was not significant ( $p = .1$ ).

A yes/no comprehension question followed each item (regardless of whether it was a critical or filler item). The question was about some detail in the story that made no reference to the target sentence whose goal was to ensure that the participants were paying attention to the stories. For half of the questions the correct answer was “yes” and for the other half the correct answer was “no” (see Table 2 for an example of all conditions and questions and the Appendix for further examples).

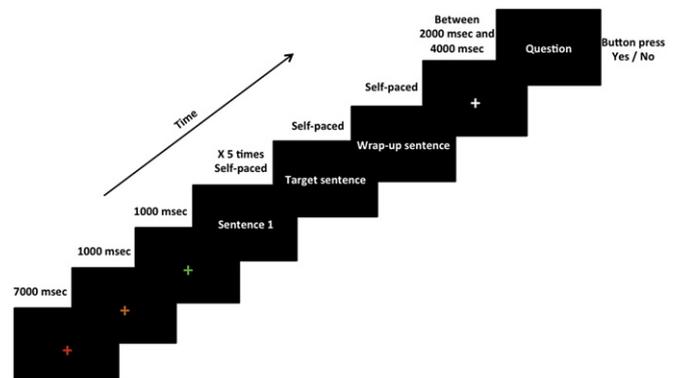
### Procedure

Stimuli were prepared with Presentation 11.0 software (Neurobehavioral Systems, [www.neurobs.com](http://www.neurobs.com)) and projected onto a translucent screen with a Canon Xeed SX50 projector. The screen was viewed through a mirror. Participants performed the experiment in four runs of 15 stories each. The maximum duration of each run was of 12 min. Each trial started with the presentation of a visual fixation mark (a central cross) in the center of the screen. The fixation mark was red for 7 s, orange for 1 s and then green for 1 s (see Fig. 1). The participant read the stories line by line (i.e., sentence by sentence) in a self-paced manner (i.e., each sentence remained on the screen until the participant pressed a key). The interval between the disappearance of a sentence and the presentation of the next one was 500 ms. After the last sentence (line 7) disappeared, the central cross (this time in white) reappeared for 500 ms. The question was then presented and the participants pressed one of two buttons on a keypad (yes/no response). Variable periods of visual fixations (between 2000 and 4000 ms) were added at the end of each trial to introduce jittering. The presentation order of the stories was pseudo-randomized. This means that the number of ironic and literal stories, decoys and fillers was balanced among the sessions. Two ironic stories, 2 literal stories and 2 decoys were presented in runs 1 and 3; three ironic stories, 2 literal stories and 1 decoy were presented in runs 2 and 4. Each stimulus was displayed in a left-justified manner at the center of the rear projection screen. Participants were instructed to read at a normal rate and to respond as accurately as possible to the questions. The experimental session began with 3 training trials, which do not include ironies. All told, a typical session lasted a little less than an hour (including breaks).

**Table 2**

An example from the *Ironic* condition, its *Literal* control as well as a decoy (translated from French).

Condition	Example
Ironic	Cynthia and Léa sing together in the same opera. On the night of the premiere they meet at the theatre. The show begins exactly on time. During their performance both ladies sing off key. After the show, Cynthia says to Léa: “Tonight we gave a superb performance.” As they take off their make-up they continue to discuss the show. Question: Do you think that the performance was in the morning?
Literal	Cynthia and Léa sing together in the same opera. On the night of the premiere they meet at the theatre. The show begins exactly on time. Both ladies sing beautifully and receive a rapturous round of applause. After the show, Cynthia says to Léa: “Tonight we gave a superb performance.” As they take off their make-up they continue to discuss the show. Question: Do you think that the performance was in the morning?
Decoy	Mateo is relocating and has to move a very fragile and heavy mirror. He asks Paul for help. Paul makes himself available immediately. As soon as Paul lifts the mirror it breaks into a thousand pieces. Mateo says to Paul: “We have made a big mistake.” A few days later, Mateo celebrates his move with his friends. Question: In your opinion, do Mateo and Damien move the mirror without problems?



**Fig. 1.** Experimental procedure.

## Imaging procedures

Images were collected using the 1.5 T MRI system (Siemens Sonata Maestro Class; Siemens, Erlangen, Germany) of the CERMEP Imagerie du vivant in Lyon. The fMRI blood oxygenation level dependent (BOLD) signal was measured using a T2\*-weighted echo-planar sequence (repetition time [TR]=2500 ms, flip angle=90°, echo time [TE]=60 ms). Twenty-six axial slices (4.40-mm thickness, field of view=23 cm, 64 64 matrix) were acquired per volume. Following functional image acquisition, a high-resolution T1-weighted anatomical image (TR=1880 ms, TE=3.93 ms, FOV=256 mm, flip angle=158, 176×256×256 matrix, slice thickness=1 mm) was collected for each participant.

## Analysis

### Behavioral data

The answers to the questions were analyzed in order to ensure that participants were paying attention to the stories. Each participant answered the comprehension questions correctly at rates that were higher than those predicted by chance (which is a 70% hit rate). The mean rate of correct responses overall was 91.5% (the lowest being 85%). Therefore, all participants were included in the analyses. Statistical analyses were made on the reading times for the target sentences (line 6), which were log transformed. Reading times that were 2.5 standard deviations above or below the mean were considered outliers. Given these constraints, we rejected approximately 4.5% of the data from the behavioral and fMRI analyses.

### fMRI data

fMRI data were analyzed using SPM8 software (Wellcome Department of Cognitive Neurology, London, UK, [www.fil.ion.ucl.ac.uk](http://www.fil.ion.ucl.ac.uk)). Each run contained 124 functional volumes after rejecting the first four scans to eliminate nonequilibrium effects of magnetization. Functional images were corrected for slice acquisition delays and were spatially realigned to the first image of the first session on a voxel-by-voxel basis so as to correct for head movements. The realigned functional images and the anatomical scans for each participant were then normalized into a standard stereotaxic space by using the Montreal Neurological Institute (MNI) template. The functional images were spatially smoothed with an isotropic Gaussian filter (8-mm full width at half maximum). The event-related statistical analysis was performed according to the general linear model (Josephs et al., 1997) using the standard hemodynamic response function provided by SPM8. Events were time-locked to the appearance of the target sentence (sixth line of the stories). The other sentences of the story were modeled together. The time series data were high-pass filtered (1/128 Hz) and serial correlations were corrected by an autoregressive AR (1) model. Each activation event was categorized according to the experimental variables. Random effects analyses were applied to individual contrasts to account for between-participants variance and to generalize to the population as a whole. The activations reported survived a voxel-level threshold of  $p < .001$ , uncorrected for multiple comparisons, and a cluster-level threshold of  $p < .05$ , corrected for multiple comparisons using the FDR method. The SPM8 coordinates were converted from MNI coordinate space into Talairach space ([www.mrc-cbu.cam.ac.uk/Imaging/Common/mnispace.shtml](http://www.mrc-cbu.cam.ac.uk/Imaging/Common/mnispace.shtml)) and localized using the Talairach atlas (Talairach and Tournoux, 1988).

Four regions of interest (ROIs) were defined based on two meta-analyses of the ToM network (Van Overwalle 2009; Van Overwalle and Baetens, 2009). More specifically, four sets of coordinates were taken from Fig. 2 of Van Overwalle and Baetens (2009), in which the authors report the coordinates that are prototypically considered to be part of the ToM network according to the meta-analysis from Van Overwalle (2009). The ROIs were spheres of 6 mm radius centered in:  $x = 50$   $y = -55$   $z = 25$  (rTPJ),  $x = -50$

$y = -55$   $z = 25$  (lTPJ),  $x = 0$   $y = -60$   $z = 40$  (PC) and  $x = 0$   $y = 50$   $z = 20$  (MPFC). Mean percent signal change (PSC) was extracted for each participant and condition using the SPM toolbox Marsbar (<http://marsbar.sourceforge.net/>). Specifically, mean activity in these regions was defined as the average amount of fMRI activity from 2.5 s to 7.5 s following the target sentence as measured with a Finite Impulse Response (FIR) model.

### Psychophysiological interaction (PPI) analysis

A PPI analysis was applied to isolate brain areas (targets) showing activity that can be explained in terms of an interaction between the influence of a distal area (seed) and an experimental parameter (Friston et al., 1997). The goal was to investigate the influence that a priori ToM-related seed regions could exert over other target brain areas in relation to the contrast between the *Ironic* and the *Literal* conditions (i.e., a measure of effective connectivity). For a PPI analysis to be optimal, however, it is important to ensure that the activity in the seed region is not correlated with the contrast of interest. In our case, none of the seed regions that would be used in the PPI analyses should be activated in the *Ironic* > *Literal* contrast. Because we observed greater activity for *Ironic* than *Literal* stories in all of the ROIs defined above (see Results), these regions could not be used in the PPI analyses as seeds. To define seed regions that are still in the relevant ROI's (but potentially inactive with respect to the *Ironic* > *Literal* contrasts), a two-step procedure was adopted. First, for each ToM region, we obtained alternative coordinates by averaging (by hand) the peak coordinates reported in Table 1, section 11 in Van Overwalle and Baetens (2009). The resulting average coordinates were  $x = 0$   $y = 55$   $z = 6$  (ventral part of the MPFC),  $x = -51$   $y = -60$   $z = 26$  (left TPJ),  $x = 54$   $y = -49$   $z = 22$  (right TPJ) and  $x = -1$   $y = -56$   $z = 33$  (PC). Second, we tested whether a significant difference between *Ironic* and *Literal* stories was observed at each of these peaks and only performed PPI analyses with the regions that were not associated with differential activity. Although none of these peaks were present in the whole-brain contrast of *Ironic* vs. *Literal* stories, simple t-tests revealed that *Ironic* stories were associated with more activity than *Literal* stories in both the left and right TPJ (left TPJ:  $t(19) = 2.30$ ,  $p = .04$ ; right TPJ:  $t(19) = 2.45$ ,  $p = .024$ ). However, no difference was observed in the MPFC ( $t(19) = 1.18$ ,  $p = .25$ ) and PC ( $t(19) = 1.79$ ,  $p = .09$ ). Therefore, we only conducted PPI analyses with the MPFC and PC as seed regions. Note that the lack of difference between *Ironic* and *Literal* stories in these particular regions highlights the fact that the regions identified in Overwalle first meta-analysis of ToM are rather large and may not be homogeneously more active during *Ironic* than during *Literal* stories.

The above approach amounted to extracting the first eigenvariate time series from 6 mm radius spheres located in the ventral part of the MPFC (center of mass:  $x = 0$   $y = 55$   $z = 6$ ) and the PC (center of mass:  $x = -1$   $y = -56$   $z = 33$ ). Each regional time series served as the first regressor in a distinct PPI analysis (i.e., the “physiological” part of the PPI). Next, we created a second regressor indicating whether each story was *Ironic* or *Literal* (the “psychological” parts of the PPI). Lastly, we created a third regressor reflecting the interaction between the physiological and psychological factors (i.e., the “interaction” parts of the PPI). To compute this interaction term, we first deconvolved the BOLD signal in the seed region by using a Bayesian estimation algorithm (Gitelman et al., 2003). We then multiplied the story type and deconvolved seed activity regressors to produce the interaction term. This interaction term was then convolved with a standard HRF. The effect of the interaction term was investigated for each participant and entered into a standard random effect group analysis at the second level (PPI maps were thresholded at an uncorrected voxel-level threshold of  $p < .005$ , and at a cluster level threshold of  $p < .05$  corrected for multiple comparisons using the FDR method). We then determined which of the regions identified in the PPI maps overlapped with the clusters found in the activity

analysis for the same contrast by applying a mask that includes all the regions that were activated in the whole brain analysis for the contrast *Ironic*>*Literal* on to the results of the PPI analysis.

## Results

### Reading times: *Irony* vs. *Literal*

A repeated measures ANOVA performed on the reading times of the target line (line 6) showed that participants took more time reading the target sentences in the *Ironic* condition (2373 ms) when compared to those in the *Literal* condition (2119 ms),  $F_1(1,19) = 14.43$   $p < .01$ ;  $F_2(1,17) = 6.6$   $p < .05$ , where  $F_1$  refers to an analysis by participants and  $F_2$  by stories. This is in keeping with the reading time measures in ongoing, behavioral self-paced reading studies in our laboratory.

### fMRI: *Irony* vs *Literal*

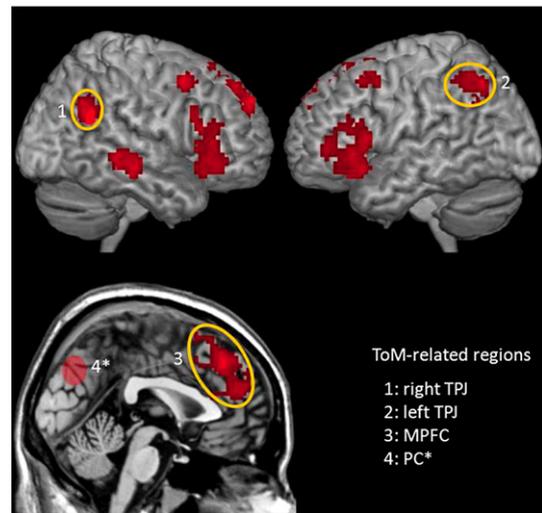
The *Ironic*>*Literal* contrast showed greater activity in both the posterior and ventral parts of the MPFC (from the most dorsal Brodmann area 6 to the more ventral 9), the bilateral IFG (especially in its triangular and orbitalis parts; Brodmann areas: 45, 46, 47), the left insula, the bilateral TPJ (Brodmann areas: 40), the right DLPFC (Brodmann areas: 8) and the right middle temporal gyrus (Brodmann area: 21). See Table 3 for a summary and Fig. 2 for brain images. Middle and posterior cingulate cortex and bilateral PC were also more activated in the *Ironic* than in the *Literal* condition, but only at a voxel-level threshold of  $p < .005$  (uncorrected for multiple comparisons) and a cluster-level threshold of  $p < .05$  (corrected for multiple comparisons). The *Literal*>*Ironic* contrast did not show any significant activations.

We also analyzed the contrasts (on the sixth line) of *Ironic* vs. *Decoy* stories and *Literal* vs. *Decoy* stories. These contrasts were not associated with any activated brain regions. Decoy stories, however, were only included in the design to block a link between negative contexts and ironic remarks and were not intended to be analyzed in fMRI contrasts. Their sole purpose was to keep participants from anticipating an ironic response (to maintain novelty with respect to ironic remarks). Moreover, their lengths and meanings were not designed to be comparable in any way with the *Ironic* and *Literal* stories. This is why only 6 decoy stories were included in the design of the experiment to start with. The lack of difference between the experimental stories and the decoys might thus be due to insufficient

**Table 3**

Brain areas activated in the contrast *Ironic* condition>*Literal* condition. Notes. L, left; R, right; ~ BA, approximate Brodmann's area; cluster-wise FDR (false discovery rate) corrected  $p < .05$  and voxel-wise uncorrected  $p < .001$ .

Anatomical locations	~BA	No. of voxels in clusters	Talairach coordinates			z score		
			x	y	z			
RL medial prefrontal cortex	6/8/9	541	6	56	29	5.18		
			-6	39	40	5.11		
			3	49	12	4.63		
L inferior frontal gyrus	45/ 46/ 47	303	-42	25	-3	4.34		
			40	101	-54	-62	48	4.70
			40	101	-56	-58	34	3.28
L inferior parietal lobule	40	101	-54	-62	48	4.70		
L temporal parietal junction	40	101	-56	-58	34	3.28		
L insula	47	25	-36	16	-13	4.93		
R dorsolateral prefrontal cortex	8	61	42	13	44	4.62		
R middle temporal gyrus	21	113	62	-22	-8	4.46		
R temporal parietal junction	40	126	62	-55	29	4.41		
R inferior frontal gyrus	45/ 46/ 47	196	59	-22	16	4.25		



**Fig. 2.** Contrast: *Ironic* condition>*Literal* condition. Cluster-wise FDR corrected  $p < .05$  and voxel-wise uncorrected  $p < .001$ . \*The activation in the PC is significant only if we use cluster-wise FDR corrected  $p < .05$  and voxel-wise uncorrected  $p < .005$ .

statistical power. These contrasts, however, were not central to the present experiment.

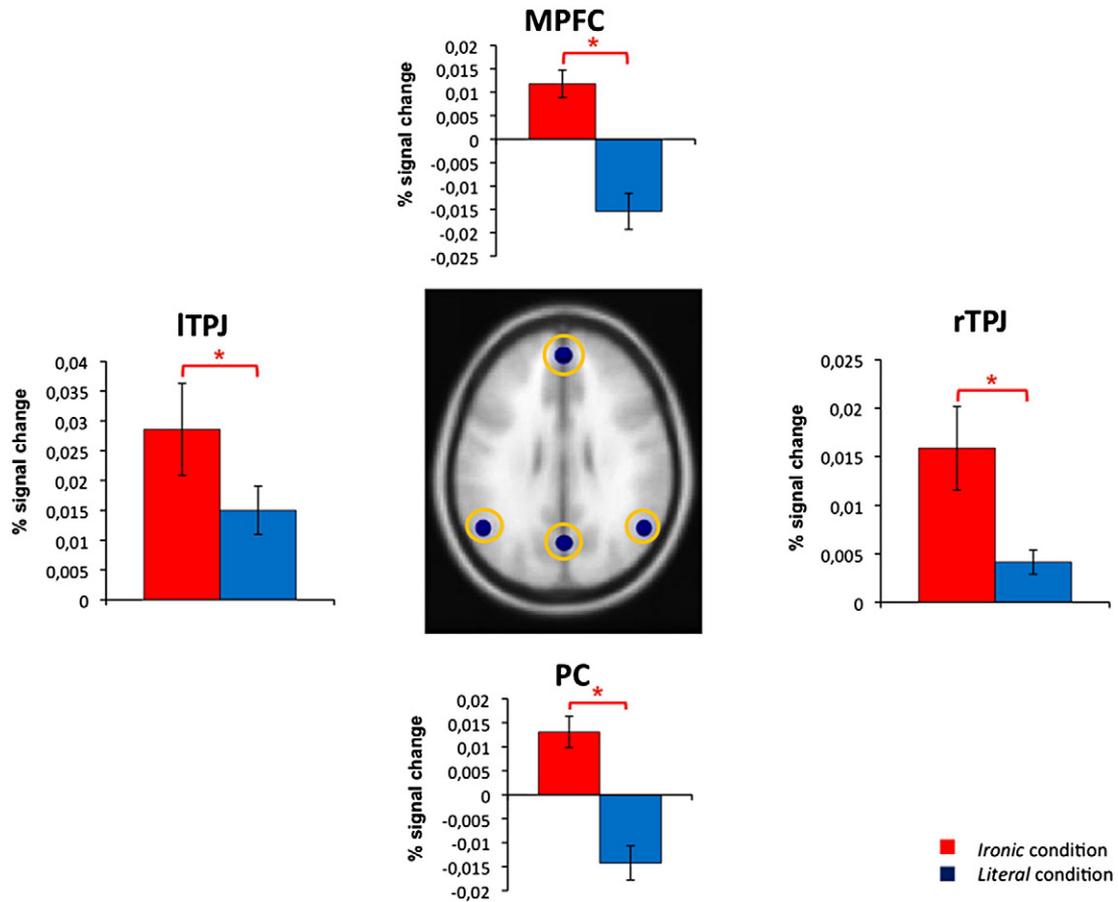
### ROI analysis

The ROI analysis revealed greater activity for the target sentence of *Ironic* than *Literal* stories in all four regions – the rTPJ, the lTPJ, the MPFC and the PC (see Fig. 3). Specifically, paired t-tests revealed a significant increase of activity in the *Ironic*>*Literal* contrast for the rTPJ ( $t(19) = 2.42$ ,  $p = .026$ ), the MPFC ( $t(19) = 2.92$ ,  $p = .009$ ) and the PC ( $t(19) = 2.31$ ,  $p = .032$ ), whereas the lTPJ showed an activation increase that was marginally significant ( $t(19) = 1.98$ ,  $p = .062$ ).

To ensure that our results were not due to longer reading times in the *Ironic* compared to the *Literal* condition, we also ran a model adding the reading times for the target sentence as a covariate of no interest. The results obtained with this model (controlling for differences in reading times) did not alter the results obtained with our initial model. Specifically, all the clusters that were significantly more active in the *Ironic* versus *Literal* condition in the main analysis remained so when reading times were included as a covariate. That is, there was still enhanced activity in the rTPJ ( $x = 62$   $y = -55$   $z = 29$ ;  $Z = 4.42$ ), lTPJ ( $x = -59$   $y = -43$   $z = 30$ ;  $Z = 3.32$ ), PC ( $x = 9$   $y = -60$   $z = 34$ ;  $Z = 3.33$ ) and MPFC ( $x = -6$   $y = 39$   $z = 40$ ;  $Z = 5.23$ ). This indicates that none of our results were due to differences in reading times when comparing *Ironic* and *Literal* conditions.

### Psychophysiological interaction analysis

With respect to the *Ironic* condition compared to the *Literal* one, the PPI analysis revealed an increase in functional connectivity between the ventral part of the MPFC seed ( $x = 0$   $y = 55$   $z = 6$ ) and the left IFG (peak:  $x = -50$   $y = 31$   $z = 0$ ). There was also an increase of functional connectivity between the MPFC seed and the right IFG (peak:  $x = 53$   $y = 18$   $z = 25$ ) (see Fig. 4). Again, note that this occurs after we ensured that the seed region was not associated with activity that varied as a function of type of story (*Ironic* vs. *Literal*, see Materials and methods). On the other hand, the PPI analysis using the precuneus as seed region did not reveal any activation in any of the regions that were activated in the whole brain analysis for the contrast *Ironic*>*Literal*.



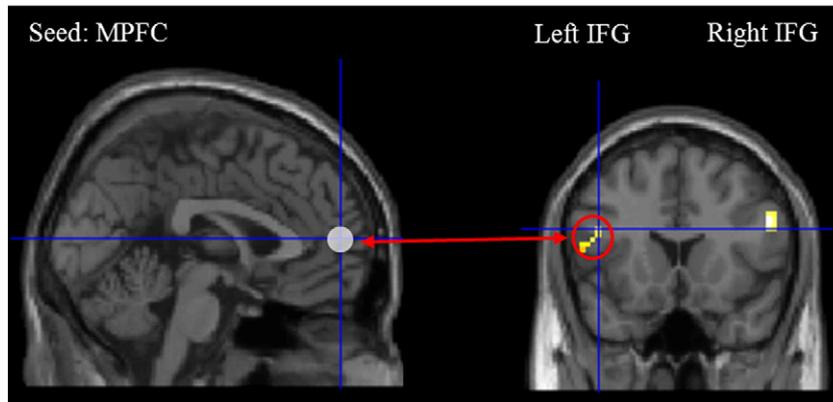
**Fig. 3.** ROIs of the four main areas of the ToM network. The coordinates come from a review of the neuroscientific literature on Theory of Mind performed by Van Overwalle (2009). MPFC ( $x = 0$   $y = 50$   $z = 20$ ), rTPJ ( $x = 50$   $y = -55$   $z = 25$ ), ITPJ ( $x = -50$   $y = -55$   $z = 25$ ), PC ( $x = 0$   $y = -60$   $z = 40$ ). There was significantly greater activity in the *Ironic* than in the *Literal* condition in all four regions. Specifically, for the rTPJ:  $t(19) = 2.42$ ,  $p = .026$ , for the MPFC:  $t(19) = 2.92$ ,  $p = .009$ , and for the PC:  $t(19) = 2.31$ ,  $p = .032$ , whereas the ITPJ showed an activation increase that was marginally significant ( $t(19) = 1.98$ ,  $p = .062$ ). The graphs report the percentage signal change for the target sentence of the two critical conditions, for each ROI.

**Discussion**

This investigation was designed to determine the extent to which the Theory of Mind network is involved in the on-line processing of a pragmatically rich linguistic stimulus, if at all. We focused our investigation on ironic utterances because it is uncontroversial that such an utterance gives a listener access to a speaker’s state of mind. Below, we review the results that demonstrate that Ironic utterances – when compared to their Literal controls – do indeed activate the neural ToM network as

well as prompt interactions with language areas. We also consider how these data impact ongoing debates and correspond with prior results.

Both the whole brain and ROI analyses conducted here show that understanding verbal irony engages a network of brain regions typically associated with Theory of Mind (the rTPJ, the ITPJ, the MPFC, and the PC; see for example Mitchell, 2009; Saxe et al., 2004; Van Overwalle and Baetens, 2009; also see Frith and Frith, 2006). *Ironic* target sentences – when compared to their *Literal* controls – consistently elicited significant differences in each of four ROIs that were chosen in a top-down



**Fig. 4.** Psychophysiological interaction (PPI) analysis. It shows the increase of functional connectivity between the ventral part of the MPFC (seed;  $x = 0$   $y = 55$   $z = 6$ ) and the left IFG (peak:  $x = -50$   $y = 31$   $z = 0$ ) for the contrast *Ironic* > *Literal*. There is also an increase of functional connectivity between the MPFC and the right IFG (peak:  $x = 53$   $y = 18$   $z = 25$   $x = -50$   $y = 31$   $z = 0$ ) for the same contrast.

manner and on the heels of an extensive and recent meta-analysis of the literature on ToM (Van Overwalle, 2009). Importantly, our fMRI findings are unique when one takes into consideration the current neuroimaging literature on irony, which had shown very little ToM activity or none at all. We attribute the differences between our study and the prior seven to the materials and the presentation in that we aimed to bring the current study on irony in line with those found in the behavioral literature.

Critically, our investigation was also designed to determine whether or not irony processing would uncover evidence of integration between language and ToM processing and the results were positive. The PPI analysis showed that the functional connectivity between the ventral part of the MPFC and the left IFG increases when reading the target sentence in the *Ironic* condition when compared to the *Literal* one. Given that the vMPFC is crucial for ToM processing (e.g., Ma et al., 2011) and that the left IFG is strongly involved in the integration process in language (e.g., Hagoort, 2005), it is highly plausible that there would be an exchange of information and integration precisely between these two regions. Importantly, the PPI analysis was carried out with seed regions that were chosen in a very conservative manner (i.e., the seed regions were not associated with the significant results reported above for the *Ironic* versus *Literal* contrasts). This arguably represents the strongest evidence yet that ToM is directly integrated with the language network while processing an utterance. Given that the procedure we used to determine inclusion into the PPI analysis was quite strict, the rTPJ and ITPJ were eliminated as potential seed regions. We are thus not in a position to determine their connectivity to language areas. More research needs to be done on this topic. For the moment, it is reasonable to suppose that the integration between different networks relies, not only on specific clusters of activation but also, on their patterns of connectivity.

As we said earlier, a growing body of literature associates coactivation of MPFC, rTPJ, ITPJ and PC with Theory of Mind processing (for reviews, see Mitchell, 2009; Saxe et al., 2004; Van Overwalle and Baetens, 2009; also see Frith and Frith, 2006). Therefore, the concomitant activation of these four regions in the present study is consistent with the hypothesis that irony processing involves ToM. Each of these regions, however, might cover a different aspect of what is more generally called “mentalizing activity.” For example, it has been proposed that the rTPJ specifically supports the uniquely human ability to reason about the contents of mental states (Saxe, 2006). The MPFC, on the other hand, might be divided into two functional areas: the ventral part that might be implicated in emotional empathy, and the more dorsal part that might be involved in representing the triadic relations between two minds and an object (a critical ability supporting shared attention and collaborative goals) (Saxe, 2006). Because the present study does not allow us to break down mentalizing activity into component parts, the question as to what role each ToM region plays in irony processing remains open. At present, we conclude only that irony processing simultaneously engages four regions typically associated with ToM.

Now that we have circumscribed the import of our data with respect to ToM, we would be remiss if we did not address the general psycholinguistic implications of our findings. We thus describe how these data speak to prior work on language processing in general and on irony-processing in particular by (i) considering how the ROIs can be viewed independently of ToM concerns, (ii) addressing potential criticisms from a psycholinguistic point of view and; (iii) considering how factors other than ToM and linguistic processing can have an influence on our results.

Although our findings are suggestive, we do not want to claim that the four regions on which we focus are *exclusively* dedicated to ToM processing. In fact, some specific aspects of language processing have been associated with these regions. For instance, the PC activations reported here can be viewed independently as a cluster that has been associated with integrating a sentence into context, in line with claims that link activity in the PC with situation model updating (e.g., Speer et al., 2007). Similarly, MPFC activations are often cited as evidence of general inference making

(e.g., by Ferstl and von Cramon, 2002). In fact, it is not surprising that the results reported here are consistent with findings reported in the neurobiology of language. One can see the general consistency between our own findings with prior summaries by considering Ferstl and colleagues' model for language processing, the Extended Language Network (ELN), which highlights the regions that most frequently appear in studies on text comprehension (Ferstl et al., 2008). Besides the classic Broca's and Wernicke's areas, the network includes their right homologues, the middle and superior temporal lobes and, crucially for our purposes, the ToM regions (especially the dorso-medial prefrontal cortex).

One potential criticism of our study is that it is unbalanced because positive contexts are always followed by a positive target sentence whereas negative contexts are followed by either an ironic sentence or by one having a decoy (a positive and negative sentence, respectively). The critique is that this leaves the target sentence in the *Literal* condition more predictable. Our response to this is threefold. First, the target sentences in the *Literal* condition were *designed* to be unremarkable and the source of floor effects so that they could be effective controls. If one comes up with unusual target sentences (e.g., a rare type of negative irony, which would provide a negative comment in light of a positive event) for the sake of having multiple controls, one could compromise the entire experiment. Consider Gibbs (1986) who – with similar reasoning – included a control for an irony study in which a negative event was followed by a brutally honest remark (e.g., “You're not helping me” when a brother failed to show up to help on a construction project); the net result was that this control (a) provided the slowest reading times overall, (b) made *Literal* target sentences appear exceptional for their banality, which, in turn, (c) made *Literal* target latencies comparable to the *Ironic* ones. Our overall goal was to have ecologically valid remarks throughout that allowed for careful comparisons between the ironies and their controls. Second, there were no significant *Literal*>*Ironic* contrasts or any other indication that target sentences in the *Literal* condition were marked in some way. This indicates that there is nothing about the target sentences in the *Literal* condition that stands out when compared to those in the *Ironic* condition and that the control worked as intended. Third, while the *Literal* condition is a convenient name for our study, we underline that from a participant's point of view, target sentences in this condition are simple, unmarked events similar to banal continuations. In the end, nearly half of banal continuations were read in the context of a negative event (as decoys) and the rest in the context of a positive one (*Literal* condition).

While the current study includes features that advance the neuroimaging literature on irony, while specifically underlining a role for ToM in irony processing, it rules out a potential cognitive confound too; namely, we showed how the study's irony-related effects persist even when reading times were included as a covariate. That said, there remain other extralinguistic issues that this study is not in a position to address. For instance, as indicated above, it would be relevant to know whether one would continue finding the results reported here when the ironic utterance itself is negative and its context is positive (e.g., “That was a failure” said upon completion of a successful event). On a similar front, it would be useful to rule out that ironic and the literal utterances yield differences because the implicit emotional valences for the ironic utterances (which are arguably negative) differ from their controls (which are arguably positive). Although we consider it likely that the reported ToM effects here would be maintained regardless of valences (e.g., see Morelli et al., 2012), this would need to be established experimentally. In any case, we obviously do not want to claim that this single study is in a position to resolve all psycholinguistic and neural issues related to irony. Our modest but important goal from the start was to determine whether or not one can establish that ToM is intrinsically involved in irony processing; while this is a feature of irony that theoretical approaches take for granted it is a factor that experimental investigations have not detected until now.

Before concluding we address one last question: Do these results contradict the RH hypothesis? Given that we found activity in the RH, as expected, our response is necessarily negative. Nevertheless, our results do provide insights about the brain regions that are responsible for the deficits in irony processing in patients with RH lesions. If the rTPJ or the right part of MPFC is affected by lesions, then patients should be significantly impaired in their ability to infer others' mental states. This hypothesis calls for further investigation. Both lesion and TMS studies should help clarify the specific role that RH regions play in irony processing.

To summarize, we investigated verbal irony in order to determine the extent to which one finds activity in the ToM network as a result of a linguistic stimulus. Following a large number of studies on ToM processing, we focused on the rTPJ, the ITPJ, the MPFC and the precuneus and found greater activation in these regions for the *Irony* condition when compared to the *Literal* condition. Moreover, analyses of functional connectivity suggest that information shared by the MPFC and with the left IFG is crucial for linking ToM activity with language processing. These results are in stark contrast with previous studies on verbal irony, which have found very little pointing to ToM activation. Although verbal irony represents perhaps one of the most obvious cases of pragmatic processing, we do not believe that evidence of ToM activity will be limited to such cases. It is our view that these findings on irony, based on ecologically valid materials, represent the tip of an iceberg. After all, one of the main tenets of pragmatics is that the linguistic code in all utterances underdetermines a speaker's meaning. It follows that all utterances require some amount of pragmatic processing in order to be understood by a listener. This points to a role for ToM. This study outlines how to go about finding ToM activity in language processing, which is by identifying circumstances that ought to engage a ToM network and by uncovering how the language network coordinates with it during the on-line processing of an utterance.

**Acknowledgments**

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**Appendix A. Experimental stimuli**

Condition	French (as presented)	English translations
Irony	Cynthia et Léa chantent dans le même opéra. Le soir de la première, elles se retrouvent au théâtre. Le spectacle commence pile à l'heure. Durant la représentation, elles font beaucoup de fausses notes. Après le spectacle, Cynthia dit à Léa: « Ce soir on a fait une performance magistrale. » Tandis qu'elles se démaquillent, les deux filles continuent à parler du spectacle. Question : À votre avis, est-ce que la performance est le matin ?	Cynthia and Léa sing together in the same opera. On the night of the premiere they meet at the theatre. The show begins exactly on time. During their performance they often sing off key. After the show, Cynthia says to Léa: "Tonight we gave a superb performance." As they take off their make-up they continue to discuss the show. Question: In your opinion, do you think that the performance was in the morning?
	Literal	Cynthia et Léa chantent dans le même opéra. Cynthia and Léa sing together in the same opera.

**Appendix A. (continued)**

Condition	French (as presented)	English translations
Irony	Le soir de la première, elles se retrouvent au théâtre. Le spectacle commence pile à l'heure. La représentation est excellente et les chanteurs sont longuement applaudis. Après le spectacle, Cynthia dit à Léa : « Ce soir on a fait une performance magistrale. » Tandis qu'elles se démaquillent, les deux filles continuent à parler du spectacle. Question : À votre avis, est-ce que la performance est le matin ?	On the night of the premiere they meet at the theatre. The show begins exactly on time. The show was excellent and the singers were given a long applause. After the show, Cynthia says to Léa: "Tonight we gave a superb performance." As they take off their make-up they continue to discuss the show. Question: In your opinion, do you think that the performance was in the morning?
	Lors d'un dîner, Patrick parle à son collègue Pascal de sa fondation contre l'anorexie. Il explique à Pascal sa nouvelle idée. Il lui dit qu'il va lancer une nouvelle campagne de financement. Quelques mois après ils se retrouvent pour évaluer les résultats décevants de la campagne. Les gens ont donné beaucoup moins cette fois-ci et Pascal dit à Patrick : « Avec cette campagne on a fait un grand coup. » Patrick et Pascal commencent à penser aux nouvelles activités pour la fondation. Question : A votre avis, est-ce que Pascal et Patrick sont collègues ?	While at dinner, Patrick talks to his colleague Pascal about his foundation to combat anorexia. He explains to Patrick his new idea. He tells him that he is going to begin a new fundraising campaign. Several months later, they meet again to evaluate the disappointing results of the campaign. People gave much less this time and Pascal says to Patrick: "This campaign has really been a hit." Patrick and Pascal start to think of new activities for the foundation. Question: In your opinion, do you think Pascal and Patrick are colleagues?
Literal	Lors d'un dîner, Patrick parle à son collègue Pascal de sa fondation contre l'anorexie. Il explique à Pascal sa nouvelle idée. Il lui dit qu'il va lancer une nouvelle campagne de financement. Quelques mois après ils se retrouvent pour évaluer les excellents résultats de la campagne. Les gens ont donné beaucoup plus que les années précédentes et Pascal dit à Patrick : « Avec cette campagne on a fait un grand coup! » Patrick et Pascal commencent à penser aux nouvelles activités pour la fondation. Question : A votre avis, est-ce que Pascal et Patrick sont collègues ?	While at dinner, Patrick talks to his colleague Pascal about his foundation to combat anorexia. He explains to Patrick his new idea. He tells him that he is going to begin a new fundraising campaign. Several months later, they meet again to evaluate the excellent results of the campaign. People gave much more than in previous years and Pascal says to Patrick: "This campaign has really been a hit!" Patrick and Pascal start to think of new activities for the foundation. Question: In your opinion, do you think Pascal and Patrick are colleagues?
Irony	Luc parle de ses investissements à Alfred qui est courtier en bourse. Luc voudrait investir son argent dans les actions d'une petite entreprise. Alfred lui explique les avantages et les inconvénients. Luc achète les actions mais un mois plus tard leur valeur a diminué de moitié. Lors de la réunion suivante, Luc en reparle à Alfred et dit :	Luc talks about an investment with Alfred, who is a stockbroker. Luc is interested in buying shares of a small company. Alfred describes the advantages and inconveniences of such an investment. Luc buys the stocks, but one month later their value has dropped by half. At the next meeting, Luc talks about it with Alfred again and

(continued on next page)

## Appendix A. (continued)

Condition	French (as presented)	English translations
	« C'est ce qui s'appelle un investissement rentable. »	says: "This is what's called a worthwhile investment."
	Pendant qu'ils parlent, les nouveaux cours de la bourse s'affichent sur le portable de Luc.	As they are talking, Luc's laptop displays new stock quotes.
	Question : A votre avis, est-ce que Luc veut investir dans une grande entreprise ?	Question: In your opinion, does Luc want to invest in a big company?
Literal	Luc parle de ses investissements à Alfred qui est courtier en bourse. Luc voudrait investir son argent dans les actions d'une petite entreprise.	Luc talks about an investment with Alfred, who is a stockbroker. Luc is interested in buying shares of a small company.
	Alfred lui explique les avantages et les inconvénients.	Alfred describes the advantages and inconveniences of such an investment.
	Un mois plus tard, le cours des actions de Luc a déjà doublé. Au cours d'un déjeuner, il en reparle à Alfred :	One month later their value, Luc's stocks have already doubled. Over a lunch, Luc talks about it again with Alfred:
	« C'est ce qui s'appelle un investissement rentable. »	"This is what's called a worthwhile investment."
	Pendant qu'ils parlent, les nouveaux cours de la bourse s'affichent sur le portable de Luc.	As they are talking, Luc's laptop displays new stock quotes.
	Question : A votre avis, est-ce que Luc veut investir dans une grande entreprise ?	Question: In your opinion, does Luc want to invest in a big company?
Ironie	Clara et Isabelle doivent décider quel film aller voir au cinéma. Elles remarquent l'affiche d'un film dans la rue.	Clara and Isabelle must decide which film to see at the cinema. They see a poster for a film outside.
	Elles ne le connaissent pas mais décident d'aller le voir.	They aren't familiar with it but they decide to go see it.
	Les deux amies achètent les billets et des pop-corn.	The two friends buy tickets and popcorn.
	Le film se révèle être banal et très ennuyeux, Clara dit alors à Isabelle :	The film turns out to be banal and very boring, so Clara says to Isabelle:
	« Nous sommes allées voir un film formidable. »	"We went to see a wonderful film."
	Elles sortent de la salle et vont s'acheter une glace.	They leave the theater and go buy an ice cream.
	Question : A votre avis, est-ce que Clara et Isabelle vont s'acheter une glace ?	Question: In your opinion, do you think Clara and Isabelle went to buy an ice cream?
Literal	Clara et Isabelle doivent décider quel film aller voir au cinéma. Elles remarquent l'affiche d'un film dans la rue.	Clara and Isabelle must decide which film to see at the cinema. They see a poster for a film outside.
	Elles ne le connaissent pas mais décident d'aller le voir.	They aren't familiar with it but they decide to go see it.
	Les deux amies achètent les billets et des pop-corn.	The two friends buy tickets and popcorn.
	Le film se révèle être excitant et surprenant, Clara dit alors à Isabelle :	The film turns out to be exciting and surprising, so Clara says to Isabelle:
	« Nous sommes allées voir un film formidable. »	"We went to see a wonderful film."
	Elles sortent de la salle et vont s'acheter une glace.	They leave the theater and go buy an ice cream.
	Question : A votre avis, est-ce que Clara et Isabelle vont s'acheter une glace ?	Question: In your opinion, do you think Clara and Isabelle went to buy an ice cream?
Ironie	Léonard propose à son nouveau collègue Gustave de lui montrer la ville.	Léonard offers to show his new co-worker Gustave around town.
	Ils veulent commencer par la place principale.	They want to start at the main square.
	La ville est grande et ils décident de se rejoindre tôt dans l'après-midi.	The city is big and they decide to meet up early in the afternoon.
	Il se met à pleuvoir et ils sont forcés de rester au café sans rien voir de la ville.	It begins to rain and they are forced to stay at a café without seeing any of the city.

## Appendix A. (continued)

Condition	French (as presented)	English translations
	Le soir Léonard dit à Gustave : « Nous avons fait une visite fantastique. »	That evening, Léonard says to Gustave: "We've carried out a fantastic tour."
	Les deux collègues se donnent alors rendez-vous le lendemain au bureau.	The two colleagues then plan to meet again the next day at work.
	Question : A votre avis, est-ce que Gustave habite dans cette ville depuis de nombreuses années ?	Question: In your opinion, do you think Gustave has lived in that city for many years?
Literal	Léonard propose à son nouveau collègue Gustave de lui montrer la ville.	Léonard offers to show his new co-worker Gustave around town.
	Ils décident de commencer par la place principale.	They decide to start at the main square.
	La ville est grande et ils décident de se rejoindre tôt dans l'après-midi.	The city is big and they decide to meet up early in the afternoon.
	Ils marchent tout l'après-midi et découvrent toutes les merveilles de la ville.	They walk around all afternoon and see all the sights of the city.
	Le soir Léonard dit à Gustave : « Nous avons fait une visite fantastique. »	That evening, Léonard says to Gustave: "We've carried out a fantastic tour."
	Les deux collègues se donnent alors rendez-vous le lendemain au bureau.	The two colleagues then plan to meet again the next day at work.
	Question : A votre avis, est-ce que Gustave habite dans cette ville depuis de nombreuses années ?	Question: In your opinion, do you think Gustave has lived in that city for many years?
Ironie	Olivier a pris du poids et décide d'aller chez son médecin.	Olivier has gained weight and he decides to go see his doctor.
	Ce dernier lui prescrit un régime.	The doctor puts him on a diet.
	Olivier regarde les recettes et achète tout le nécessaire pour suivre le régime.	Olivier looks at the recipes and buys everything you need to follow the diet.
	Un mois après le début du régime, il n'a même pas perdu un gramme.	One month after starting the diet, he has not even lost one gram.
	Olivier dit alors à son médecin : « Ce régime me donne beaucoup d'espoir. »	So Olivier tells his doctor: "This diet really gives me hope."
	Olivier prend un nouveau rendez-vous pour contrôler son poids un mois plus tard.	Olivier makes a new appointment to check on his weight a month later.
	Question : A votre avis, Olivier refuse-t-il de suivre le régime ?	Question: In your opinion, does Oliver refuse to follow the diet?
Literal	Olivier a pris du poids et décide d'aller chez son médecin.	Olivier has gained weight and he decides to go see his doctor.
	Ce dernier lui prescrit un régime.	The doctor puts him on a diet.
	Olivier regarde les recettes et achète tout le nécessaire pour suivre le régime.	Olivier looks at the recipes and buys everything you need to follow the diet.
	Un mois après le début du régime, il a déjà perdu sept kilogrammes.	One month after starting the diet, he has already lost seven kilograms.
	Olivier dit alors à son médecin : « Ce régime me donne beaucoup d'espoir. »	So Olivier tells his doctor: "This diet really gives me hope."
	Olivier prend un nouveau rendez-vous pour contrôler son poids un mois plus tard.	Olivier makes a new appointment to check on his weight a month later.
	Question : A votre avis, Olivier refuse-t-il de suivre le régime ?	Question: In your opinion, does Oliver refuse to follow the diet?
Ironie	En sortant d'une conférence à l'étranger, Benoît croise son collègue Thierry.	While leaving a conference abroad, Thierry runs into his colleague Benoît.
	Il lui demande où se trouve la cafétéria de l'université.	He asks him where the university cafeteria is.
	Thierry lui propose de l'accompagner et Benoît accepte.	Thierry offers to accompany him and Benoît accepts.
	Après de longues recherches ils arrivent enfin à la cafétéria.	After a long search they finally arrive at the cafeteria.
	Benoît says: "We found the cafeteria quickly."	

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Benoît dit : « On a trouvé la cafétéria rapidement. » Les places sont toutes prises, il y a déjà beaucoup de monde à l'intérieur. Question : A votre avis, est-ce que la cafétéria est ouverte ? En sortant d'une conférence à l'étranger, Benoît croise son collègue Thierry. Il lui demande où se trouve la cafétéria de l'université. Thierry lui propose de l'accompagner et Benoît accepte. Ils trouvent la cafétéria tout de suite, elle est au coin de la rue. Benoît dit : « On a trouvé la cafétéria rapidement. » Les places sont toutes prises, il y a déjà beaucoup de monde à l'intérieur. Question : A votre avis, est-ce que la cafétéria est ouverte ?	There are already a lot of people inside, and all the seats are taken. Question: In your opinion, is the cafeteria open? While leaving a conference abroad, Thierry runs into his colleague Benoît. He asks him where the university cafeteria is. Thierry offers to accompany him and Benoît accepts. They find the cafeteria right away; it is just around the corner. Benoît says: "We found the cafeteria quickly." There are already a lot of people inside, and all the seats are taken. Question: In your opinion, is the cafeteria open?
	Claude rencontre son collègue Steve sur la route qui mène à l'université. Ils ont le même cours ce matin. Ils s'installent et écoutent le professeur. Les deux étudiants trouvent le cours difficile, sans intérêt et soporifique. A la fin Claude dit à Steve : « Aujourd'hui, le professeur était captivant. » Fatigués, les deux étudiants vont boire un café avant le cours suivant. Question : A votre avis, Claude et Steve suivent-ils des cours différents ?	Claude meets his colleague Steve on the road leading up to their university. They have the same class this morning. They settle in and listen to the professor. The two students find the lecture difficult, uninteresting and tiresome. At the end Claude says to Steve: "The professor was in captivating today." Tired, the two students go to drink a coffee before their next class. Question: In your opinion, do Claude and Steve take different courses?
	Claude rencontre son collègue Steve sur la route qui mène à l'université. Ils ont le même cours ce matin. Ils s'installent et écoutent le professeur. Le cours se révèle être très intéressant et stimulant pour les deux étudiants. A la fin Claude dit à Steve : « Aujourd'hui, le professeur était captivant. » Fatigués, les deux étudiants vont boire un café avant le cours suivant. Question : A votre avis, Claude et Steve suivent-ils des cours différents ?	Claude meets his colleague Steve on the road leading up to their university. They have the same class this morning. They settle in and listen to the professor. The presentation proved to be very interesting and stimulating for both students. At the end Claude says to Steve: "The professor was captivating today." Tired, the two students go to drink a coffee before their next class. Question: In your opinion, do Claude and Steve take different courses?
	Josiane est malade et demande à son colocataire Félix de lui préparer un remède aux plantes. Josiane doit rester au lit et se reposer toute la journée. Son colocataire lui prépare sa boisson aux plantes. Après l'avoir bu, Josiane se sent encore plus mal et finit par vomir. Son colocataire voit que son état a empiré et lui dit : « Ce remède a montré son efficacité. »	Josiane is ill and asks her roommate to prepare her an herbal remedy. Josiane must stay in bed and rest all day. Her roommate makes her the herbal drink. After drinking it, Josiane feels even worse and ends up vomiting. Her roommate sees that she is even sicker and says to her: "This remedy has really shown its effectiveness."

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Le soir, Josiane et son colocataire regardent un film à la télé. Question : A votre avis, est-ce que Josiane est malade ? Josiane est malade et demande à son colocataire Félix de lui préparer un remède aux plantes. Josiane doit rester au lit et se reposer toute la journée. Son colocataire lui prépare sa boisson aux plantes. Peu de temps après l'avoir bu, Josiane se sent beaucoup mieux. Son colocataire voit que son état s'est amélioré et lui dit : « Ce remède a montré son efficacité. » Le soir, Josiane et son colocataire regardent un film à la télé.	That evening, Josiane and her roommate watch a movie on television. Question: In your opinion, is Josiane sick? Josiane is ill and asks her roommate to prepare her an herbal remedy. Josiane must stay in bed and rest all day. Her roommate makes her the herbal drink. Shortly after drinking it, Josiane feels much better. Her roommate sees that she feels better and says to her: "This remedy has really shown its effectiveness." That evening, Josiane and her roommate watch a movie on television.
	Question : A votre avis, est-ce que Josiane est malade ? Tom et Dave parlent des élections du conseil d'administration de la faculté. Dave est représentant des étudiants et sait que les résultats sont importants. Le vote a commencé il y a quelques minutes. Après plusieurs heures, ils apprennent que le parti du président actuel a perdu. Tom dit à Dave : « Le président doit sans doute être ravi. » Tom et Dave continuent de parler des élections durant un bon moment.	Question: In your opinion, is Josiane sick? Tom and Dave are talking about the elections for the university's board of directors. Dave is the student representative and knows that the results are important. The voting began a few minutes ago. After several hours they learn that the current president's party lost. Tom tells Dave: "The president must certainly be delighted." Tom and Dave continue to talk about the elections for a while.
Ironic	Question : A votre avis, est-ce que Tom et Dave sont membres du conseil d'administration ? Tom et Dave parlent des élections dans le conseil d'administration de la faculté. Dave est représentant des étudiants et sait que les résultats sont importants. Le vote a commencé il y a quelques minutes. Après plusieurs heures, ils apprennent que le parti du président actuel a largement gagné. Tom dit à Dave : « Le président doit sans doute être ravi. » Tom et Dave continuent de parler des élections durant un bon moment.	Question: In your opinion, are Tom and Dave members of the board? Tom and Dave are talking about the elections for the university's board of directors. Dave is the student representative and knows that the results are important. The voting began a few minutes ago. After several hours they learn that the current president's party won decisively. Tom tells Dave: "The president must certainly be delighted." Tom and Dave then continue to talk about the elections for a while.
	Question : A votre avis, est-ce que Tom et Dave sont membres du conseil d'administration ? Michel et Jim pêchent ensemble une fois par an dans un lac. Comme d'habitude, ils discutent en attendant que les poissons mordent à l'hameçon. Ils se racontent leurs aventures de pêche. A la fin de la journée, aucun d'entre eux n'a réussi à attraper un seul poisson.	Question: In your opinion, are Tom and Dave members of the board? Michel and Jim go fishing together once a year in a lake. As usual, they talk while waiting for the fish to bite. They talk about their fishing adventures. At the end of the day, neither of them managed to catch a single fish. As they were leaving, Michel told Jim:

(continued on next page)

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	En partant, Michel dit à Jim : « Cette journée a été très productive. »	“This has been a really productive day.”
	Michel et Jim rentrent chez eux profitant des derniers rayons du soleil.	Michel and Jim return home with the last rays of the sun.
	Question : A votre avis, est-ce que Michel et Jim rentrent chez eux dans la soirée ?	Question: In your opinion, do Michel and Jim return home in the evening?
	Michel et Jim pêchent ensemble une fois par an dans un lac.	Michel and Jim go fishing together once a year in a lake.
	Comme d'habitude, ils discutent en attendant que les poissons mordent à l'hameçon.	As usual, they talk while waiting for the fish to bite.
	Ils se racontent leurs aventures de pêche.	They talk about their fishing adventures.
	Aujourd'hui, les deux pêcheurs ont rempli entièrement leurs nasses à poissons.	Today, the two fishermen have completely filled their nets with fish.
	En partant, Michel dit à Jim : « Cette journée a été très productive. »	As they were leaving, Michel told Jim: “This has been a really productive day.”
	Michel et Jim rentrent chez eux profitant des derniers rayons du soleil.	Michel and Jim return home with the last rays of the sun.
	Question : A votre avis, est-ce que Michel et Jim rentrent chez eux dans la soirée ?	Question: In your opinion, do Michel and Jim return home in the evening?
Ironic	Cédric et Bob se retrouvent dans le même avion pour New York. Tous les deux prennent très souvent l'avion.	Cédric and Bob find themselves on the same plane to New York. Both of them fly often.
	Pendant le vol, ils parlent de leur voyage professionnel.	During the flight, they talk about their business trip.
	A cet instant, on leur annonce que leur arrivée sera retardée.	Just then, the pilot announces that their arrival will be delayed.
	Cédric dit à Bob : « Je suis impressionné par leur ponctualité. »	Cédric says to Bob: “I am impressed by their punctuality.”
	Une fois arrivés, ils partent tout de suite à la recherche d'un taxi libre.	Once there, they go immediately in search of a taxi.
	Question : A votre avis, est-ce la première fois que Bob prend l'avion ?	Question: In your opinion, is this the first time Bob rides an airplane?
	Cédric et Bob se retrouvent dans le même avion pour New York. Tous les deux prennent très souvent l'avion.	Cédric and Bob find themselves on the same plane to New York. Both of them fly often.
	Pendant le vol, ils parlent de leur voyage professionnel.	During the flight, they talk about their business trip.
	A cet instant, on leur annonce que leur avion sera à l'heure.	Just then, the pilot announces that their plane will land on time.
	Cédric dit à Bob : « Je suis impressionné par leur ponctualité. »	Cédric says to Bob: “I am impressed by their punctuality.”
Literal	Une fois arrivés, ils partent tout de suite à la recherche d'un taxi libre.	Once there, they go immediately in search of a taxi.
	Question : A votre avis, est-ce la première fois que Bob prend l'avion ?	Question: In your opinion, is this the first time Bob rides an airplane?
	Cédric et Bob se retrouvent dans le même avion pour New York. Tous les deux prennent très souvent l'avion.	Cédric and Bob find themselves on the same plane to New York. Both of them fly often.
	Pendant le vol, ils parlent de leur voyage professionnel.	During the flight, they talk about their business trip.
	A cet instant, on leur annonce que leur avion sera à l'heure.	Just then, the pilot announces that their plane will land on time.
	Cédric dit à Bob : « Je suis impressionné par leur ponctualité. »	Cédric says to Bob: “I am impressed by their punctuality.”
	Une fois arrivés, ils partent tout de suite à la recherche d'un taxi libre.	Once there, they go immediately in search of a taxi.
	Question : A votre avis, est-ce la première fois que Bob prend l'avion ?	Question: In your opinion, is this the first time Bob rides an airplane?
	Karen et Jean-Claude jouent aux échecs dans un parc.	Karen and Jean-Claude are playing chess in a park.
	Ils viennent juste de commencer leur partie.	They have just started their game.
Ironic	Chacun élabore sa propre stratégie d'attaque.	Each plans out their own strategy of attack.
	Après seulement six coups, Karen parvient à battre Jean-Claude.	After only six moves, Karen manages to beat Jean-Claude.
	Jean-Claude lui dit alors : « C'est clair, nous avons tout à fait le même niveau. »	So Jean-Claude says to her: “Clearly, we have exactly the same level.”
	Karen et Jean-Claude programment un autre rendez-vous pour rejouer ensemble.	Karen and Jean-Claude schedule a new appointment to play together again.
	Question : A votre avis, est-ce que Karen et Jean-Claude aiment jouer aux échecs ?	Question: In your opinion, do Jean-Claude and Karen like to play chess?
	Karen et Jean-Claude jouent aux échecs dans un parc.	Karen and Jean-Claude are playing chess in a park.
	Ils viennent juste de commencer leur partie.	They have just started their game.
	Chacun élabore sa propre stratégie d'attaque.	Each develops its own strategy of attack.
	Après deux heures de jeu, personne n'a pris l'avantage.	After two hours of play, no one had taken the lead.
	Jean-Claude lui dit alors : « C'est clair, nous avons tout à fait le même niveau. »	So Jean-Claude says to her: “Clearly, we have exactly the same level.”

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Question : A votre avis, est-ce que Karen et Jean-Claude aiment jouer aux échecs ?	Question: In your opinion, do Jean-Claude and Karen like to play chess?
	Karen et Jean-Claude jouent aux échecs dans un parc.	Karen and Jean-Claude are playing chess in a park.
	Ils viennent juste de commencer leur partie.	They have just started their game.
	Chacun élabore sa propre stratégie d'attaque.	Each develops its own strategy of attack.
	Après deux heures de jeu, personne n'a pris l'avantage.	After two hours of play, no one had taken the lead.
	Jean-Claude lui dit alors : « C'est clair, nous avons tout à fait le même niveau. »	So Jean-Claude says to her: “Clearly, we have exactly the same level.”
	Karen et Jean-Claude programment un autre rendez-vous pour rejouer ensemble.	Karen and Jean-Claude schedule a new appointment to play together again.
	Question : A votre avis, est-ce que Karen et Jean-Claude aiment jouer aux échecs ?	Question: In your opinion, do Jean-Claude and Karen like to play chess?
	Joan et Marc sont deux critiques gastronomiques qui doivent évaluer un restaurant.	Joan and Marc are two food critics who must evaluate a restaurant.
	Installés à leur table, ils attendent d'être servis.	Seated at their table, they are waiting to be served.
Ironic	Entre temps, ils discutent du travail.	Meanwhile, they discuss their job.
	Le serveur n'arrive qu'après un long moment et accumule les erreurs durant toute la soirée.	The server takes a long time to arrive and accumulates errors throughout the evening.
	Lorsque le serveur apporte l'addition à la fin du repas, Joan dit à Marc : « On ajoutera deux points pour le service. »	When the waiter brings the bill at the end of the meal, Joan says to Marc: “We'll add two points for the service.”
	Après l'inspection du restaurant, Joan et Marc reprennent leur examen.	After inspecting the restaurant, Joan and Mark resume their examination.
	Question : A votre avis, est-ce que Joan et Marc vont donner leur avis sur le restaurant ?	Question: In your opinion, are Joan and Marc going to give their opinion about the restaurant?
	Joan et Marc sont deux critiques gastronomiques qui doivent évaluer un restaurant.	Joan and Marc are two food critics who must evaluate a restaurant.
	Installés à leur table, ils attendent d'être servis.	Seated at their table, they are waiting to be served.
	Entre temps, ils discutent du travail.	Meanwhile, they discuss their job.
	Ils sont servis rapidement et le serveur reste très attentionné pendant toute la soirée.	They are served quickly and the server remains very attentive throughout the evening.
	Lorsque le serveur apporte l'addition à la fin du repas, Joan dit à Marc : « On ajoutera deux points pour le service. »	When the waiter brings the bill at the end of the meal, Joan says to Marc: “We'll add two points for the service.”
Literal	Après l'inspection du restaurant, Joan et Marc reprennent leur examen.	After inspecting the restaurant, Joan and Mark resume their examination.
	Question : A votre avis, est-ce que Joan et Marc vont donner leur avis sur le restaurant ?	Question: In your opinion, are Joan and Marc going to give their opinion about the restaurant?
	Hélène et Gérard sont à une vente aux enchères de tableaux.	Helen and Gerard are at an art auction.
	Gérard, qui est amateur d'art, explique à Hélène la valeur des toiles présentées.	Gerard, who is an art lover, explains to Helen the value of the paintings presented.
	Hélène est très intéressée et l'écoute attentivement.	Helen is very interested and listens to him carefully.
	A ce moment, un tableau d'art moderne est proposé mais personne ne surenchérit.	A modern art painting is presented, but no one bids on it.
	Hélène dit alors à Gérard : « La concurrence est rude pour ce tableau. »	So Helen says to Gerard: “The competition is stiff for this painting.”
	Question : A votre avis, est-ce que Joan et Marc vont donner leur avis sur le restaurant ?	Question: In your opinion, are Joan and Marc going to give their opinion about the restaurant?
	Hélène et Gérard sont à une vente aux enchères de tableaux.	Helen and Gerard are at an art auction.
	Gérard, qui est amateur d'art, explique à Hélène la valeur des toiles présentées.	Gerard, who is an art lover, explains to Helen the value of the paintings presented.

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Avant de partir, Gérard parvient à conclure quelques très bonnes affaires. Question : A votre avis, est-ce que Hélène et Gérard sont à une exposition d'art ? Hélène et Gérard sont à une vente aux enchères de tableaux. Gérard, qui est amateur d'art, explique à Hélène la valeur des toiles présentées. Hélène est très intéressée et l'écoute attentivement. A ce moment, un tableau d'art moderne est très prisé et les enchères montent très haut. Hélène dit alors à Gérard : « La concurrence est rude pour ce tableau. » Avant de partir, Gérard parvient à conclure quelques très bonnes affaires. Question : A votre avis, est-ce que Hélène et Gérard sont à une exposition d'art ?	Before leaving, Gerard manages to get some good deals. Question: In your opinion, are Helen and Gerard at an art exhibition? Helen and Gerard are at an art auction. Gerard, who is an art lover, explains to Helen the value of the paintings presented. Helen is very interested and listens to him carefully. One modern art painting was very popular and the bidding went very high. So Helen says to Gerard: "The competition is stiff for this painting." Before leaving, Gerard manages to get some good deals. Question: In your opinion, are Helen and Gerard at an art exhibition?
	Armelle et Sally partent en voyage à la campagne avec une vieille voiture. Des amis les attendent le soir même dans une maison pour dîner. Durant le voyage, elles discutent de leur soirée à venir. Après une heure de trajet, la voiture tombe en panne. Sally dit à Armelle : « Comme ça c'est sûr qu'on arrivera à l'heure. » A cet instant, leurs amis les appellent pour savoir où elles se trouvent. Question : A votre avis, est-ce qu'Armelle a une vieille voiture ? Armelle et Sally partent en voyage à la campagne avec une vieille voiture. Des amis les attendent le soir même dans une maison pour dîner. Durant le voyage, elles discutent de leur soirée à venir. Au milieu de l'après-midi, elles sont déjà presque arrivées. Sally dit à Armelle : « Comme ça c'est sûr qu'on arrivera à l'heure. » A cet instant, leurs amis les appellent pour savoir où elles se trouvent. Question : A votre avis, est-ce qu'Armelle a une vieille voiture ?	Armelle and Sally leave for a trip to the countryside in an old car. Their friends wait for them to arrive at the house for dinner that evening. During the trip, they discuss their evening to come. After an hour's drive, the car breaks down. Sally says to Armelle: "At this rate we're sure to get there on time." At that moment, their friends call them to find out where they are. Question: In your opinion, does Armelle have an old car? Armelle and Sally leave for a trip to the countryside in an old car. Their friends wait for them to arrive at the house for dinner that evening. During the trip, they discuss their evening to come. By mid-afternoon, they are already almost there. Sally says to Armelle: "At this rate we're sure to get there on time." At that moment, their friends call them to find out where they are. Question: In your opinion, does Armelle have an old car?
Ironic	Georges fait la lessive avec son colocataire Yves. Yves fait remarquer que Georges a beaucoup de chemises à laver. Ils passent un peu de temps à chercher le bon programme et la bonne température. Au moment d'étendre le linge, ils voient que les chemises sont encore pleines de tâches. Georges dit à Yves : « Cette machine fait un lavage impeccable. »	Georges is doing the laundry with his roommate Yves. Yves points out that Georges has a lot of shirts to wash. They spend some time looking for the right program and the right temperature. When hanging up the laundry, they see that the shirts are still full of stains. Georges says to Yves: "This washing machine does an impeccable job." Having hung up the laundry, they go to drink a beer in the kitchen.

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Après avoir étendu le linge, ils vont boire une bière dans la cuisine. Question : A votre avis, est-ce que Georges et Yves vont dans un pub ? Georges fait la lessive avec son colocataire Yves. Yves fait remarquer que Georges a beaucoup de chemises à laver. Ils passent un peu de temps à chercher le bon programme et la bonne température. Au moment d'étendre le linge, ils voient que les chemises n'ont plus aucune tache. Georges dit à Yves : « Cette machine fait un lavage impeccable. » Après avoir étendu le linge, ils vont boire une bière dans la cuisine. Question : A votre avis, est-ce que Georges et Yves vont dans un pub ?	Question: In your opinion, do Georges and Yves go to a pub? Georges is doing the laundry with his roommate Yves. Yves points out that Georges has a lot of shirts to wash. They spend some time looking for the right program and the right temperature. When hanging up the laundry, they see that the shirts no longer have any stains. Georges says to Yves: "This washing machine does an impeccable job." Having hung up the laundry, they go to drink a beer in the kitchen. Question: In your opinion, do Georges and Yves go to a pub?
	Richard téléphone à son colocataire Gérald pour qu'il enregistre la finale de handball. Gérald est d'accord et réalise l'enregistrement. Dès que l'enregistrement est terminé, il le prépare pour Richard. Une fois rentré du travail, Richard le regarde avec Gérald. La qualité d'image est très mauvaise et Richard dit à Gérald : « Ce lecteur fonctionne à la perfection. » Ils passèrent alors la soirée à regarder le match en mangeant des chips. Question : A votre avis, est-ce que Richard regarde un match enregistré ? Richard téléphone à son colocataire Gérald pour qu'il enregistre la finale de handball. Gérald est d'accord et réalise l'enregistrement. Dès que l'enregistrement est terminé, il le prépare pour Richard. Une fois rentré du travail, Richard le regarde avec Gérald. La qualité de l'image est vraiment parfaite et Richard dit à Gérald : « Ce lecteur fonctionne à la perfection. » Ils passèrent alors la soirée à regarder le match en mangeant des chips. Question : A votre avis, est-ce que Richard regarde un match enregistré ?	Richard calls his roommate Gerald to ask him to record the handball final. Gerald agrees to do it and he makes the recording. Once the recording is complete, he prepares it for Richard. After getting home from work, Richard watches it with Gerald. The picture quality is very poor and Richard says to Gerald: "This player works perfectly." They spend the evening watching the game and eating chips. Question: In your opinion, does Richard watch a match that was taped? Richard calls his roommate Gerald to ask him to record the handball final. Gerald agrees to do it and he makes the recording. Once the recording is complete, he prepares it for Richard. After getting home from work, Richard watches it with Gerald. The picture quality is really perfect and Richard says to Gerald: "This player works perfectly." They spend the evening watching the game and eating chips. Question: In your opinion, does Richard watch a match that was taped?
Ironic	Eve et sa nouvelle colocataire Aline réfléchissent à ce qu'elles vont faire ce soir. Eve veut aller en boîte de nuit. Aline accepte et se prépare. En arrivant, elles constatent que la musique est démodée et que la piste est déserte. Aline se tourne vers Eve et dit : « Ce soir la discothèque est palpitante. »	Eve and her new roommate Aline are thinking about what they will do tonight. Eve wants to go to a nightclub. Aline accepts and she gets ready. Upon arriving, they find that the music is outdated and that the dance floor is empty. Aline turns to Eve and says: "This club is thrilling tonight." It had been a long time since either of them had gone to a club.

(continued on next page)

## Appendix A. (continued)

Condition	French (as presented)	English translations
Literal	Cela faisait très longtemps que ni l'une ni l'autre n'étaient allées en boîte. Question : A votre avis, est-ce qu'Eve et Aline vont souvent en boîte ?	Question: In your opinion, do Eve and Aline go to clubs often?
	Eve et sa nouvelle colocataire Aline réfléchissent à ce qu'elles vont faire ce soir. Eve veut aller en boîte de nuit. Aline accepte et se prépare. En arrivant, elles constatent que la musique est géniale et que la piste est pleine. Aline se tourne vers Eve et dit : « Ce soir la discothèque est palpitante. »	Eve and her new roommate Aline are thinking about what they will do tonight. Eve wants to go to a nightclub. Aline accepts and she gets ready. Upon arriving, they find that the music is great and the dance floor is full of people. Aline turns to Eve and says: "This club is thrilling tonight."
	Cela faisait très longtemps que ni l'une ni l'autre n'étaient allées en boîte. Question : A votre avis, est-ce qu'Eve et Aline vont souvent en boîte ?	It had been a long time since either of them had gone to a club. Question: In your opinion, do Eve and Aline go to clubs often?
	Justine aide sa voisine Aurore à déménager. Justine transporte un gros carton. Aurore la remercie vivement car c'est le dernier carton. En fait, le carton est tellement lourd que Justine n'arrive pas à le soulever. Elle dit à Aurore : « J'ai l'impression que ce carton est vide. » Le soir Aurore fait un dîner pour sa crémaillère avec ses amis.	Justine is helping her neighbor Aurore move. Justine is carrying a large cardboard box. Aurore thanks her profusely because it is the last one. Actually, the box is so heavy that Justine cannot manage to lift it. She says to Aurore: "It's as though the box were empty." That evening, Aurore cooks dinner to celebrate her housewarming with her friends.
Ironic	Question : A votre avis, est-ce que Justine aide Aurore à déménager ?	Question: In your opinion, does Justine help Aurore move?
	Justine aide sa voisine Aurore à déménager. Justine transporte un gros carton. Aurore la remercie vivement car c'est le dernier carton. Le carton est très léger et Justine parvient à le descendre rapidement. Elle dit à Aurore : « J'ai l'impression que ce carton est vide. » Le soir Aurore fait un dîner pour sa crémaillère avec ses amis.	Justine is helping her neighbor Aurore move. Justine is carrying a large cardboard box. Aurore thanks her profusely because it is the last one. The cardboard box is very light and Justine manages to bring it down quickly. She says to Aurore: "It's as though the box were empty." That evening, Aurore cooks dinner to celebrate her housewarming with her friends.
	Question : A votre avis, est-ce que Justine aide Aurore à déménager ?	Question: In your opinion, does Justine help Aurore move?
	Question : A votre avis, est-ce que Justine aide Aurore à déménager ?	Question: In your opinion, does Justine help Aurore move?

## Appendix B. (continued)

French (as presented)	English translation
Quelques jours plus tard, Matéo fête son emménagement avec des amis. Question: A votre avis, est-ce que Mateo et Paul ont déménagé le miroir sans problème? Damien et Myriam vont faire les soldes.	A few days later, Mateo celebrates his move with his friends. Question: In your opinion, do Mateo and Damien move the mirror without problems? Damien and Myriam go shopping for clothes on sale.
Damien n'a pas une idée trop claire sur ce qu'il veut acheter. Myriam lui propose de tester différents magasins. En ressortant d'une cabine d'essayage, Damien est vêtu d'une manière très extravagante. En voyant le résultat, il dit à Myriam : « Je n'aime pas ces habits. »	Damien doesn't have a very clear idea of what he wants to buy. Myriam suggests that he try different stores. Damien comes out of one dressing room clothed in a very extravagant manner. Seeing himself in the mirror, he says to Myriam: "I don't like these clothes."
Ils décident alors de passer au prochain magasin. Question: A votre avis, est-ce que Damien et Myriam vont chercher des nouveaux vêtements ? Emma organise une surprise pour l'anniversaire d'une copine. Elle demande à Romain de l'aider. Romain est tout à fait d'accord. Malheureusement, la copine en question découvre le secret une semaine avant la fête. Emma dit à Romain : « L'effet de surprise est complètement raté. »	They decide to move on to the next store. Question: In your opinion, do you think Damien and Myriam are shopping for new clothes? Emma organizes a surprise party for a (female) friend's birthday. She asks Romain to help her. Romain agrees. Unfortunately, the friend in question discovers the secret a week before the party. Emma says to Romain: "The surprise is completely ruined."
« Je n'aime pas ces habits. » Question: A votre avis, est-ce qu'Emma cherche à organiser une surprise ?	They decide to move on to the next store. Question: In your opinion, do you think Emma tried to organize a surprise party?
Hugo travaille dans une usine de voiture au service de la sécurité routière. Joël vient le voir le jour des crashes tests.	Hugo works at a car factory in the department of road safety. Joel comes to see him on the day of the crash tests.
Hugo lui montre les procédures pour les tests. Ils réalisent alors un test avec un mannequin assis dans la voiture. Le mannequin est complètement détruit à la fin du test et Hugo dit à Joël : « Il y a sûrement eu une erreur quelque part. »	Hugo shows him the testing procedures. They run a test with a dummy seated in the car. The dummy is completely destroyed at the end of the test and Hugo says to Joel: "There must have been an error somewhere."
Hugo pense alors aux études faites avec les nouvelles normes de sécurité. Question : A votre avis, est-ce que le mannequin est intact après le test ? Martin part manger dans son restaurant habituel. Il commande un steak. Peu après avoir commandé, le serveur lui apporte son assiette. Le steak n'est pas du tout salé. Quand le serveur repasse, Martin lui dit : « Pouvez-vous m'apporter du sel ? » Après le plat principal, il commande un dessert délicieux. Question : A votre avis, est-ce que Martin va souvent dans ce restaurant ? L'imprimante de l'entreprise de Maxence était toujours en panne. Il demanda à sa secrétaire Nelly de la changer. Nelly commanda un nouveau modèle. La nouvelle imprimante se révéla être très compliquée à utiliser. Quand Maxence parvient par s'en servir, il dit : « Au moins elle imprime très bien. » Des clients arrivèrent et Maxence partit les accueillir.	Then Hugo remembers the studies done using the new safety standards. Question: In your opinion, is the dummy intact after the test? Martin goes to eat at his usual restaurant. He orders a steak. Shortly after he orders, the waiter brings him his dish. The steak is not at all salted. When the server returns, Martin says: "Could you bring me the salt?" After the main course he orders a delicious dessert. Question: In your opinion, does Martin go to this restaurant often? The printer at Maxence's business is always broken. He asked his secretary Nelly to change it. Nelly orders a new model. The new printer turns out to be very complicated to use. When Maxence manages to use it, he says: "At least it prints very well." Some clients are arriving and Maxence goes to greet them.

## Appendix B. Decoys

French (as presented)	English translation
Matéo déménage et doit déplacer un miroir lourd et très fragile. Il demande à Paul de l'aider. Paul est disponible tout de suite.	Matéo is relocating and has to move a very fragile and heavy mirror. He asks Paul for help. Paul makes himself available immediately.
A peine a-t-il soulevé le miroir ce dernier se brise en mille morceaux. Matéo dit à Paul: « On a fait une grosse bêtise. »	As soon as Paul lifts the mirror it breaks into a thousand pieces. Mateo says to Paul: "We have made a big mistake."

## Appendix B. (continued)

French (as presented)	English translation
Question : A votre avis, est-ce que la nouvelle imprimante est facile à utiliser ?	Question: In your opinion, is the new printer easy to use?

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