Irony Comprehension and Theory of Mind in Young Deaf Signers

Beatrice Giustolisi, Lara Mantovan, and Francesca Panzeri

1. Introduction

Comprehending irony is a matter of oppositions: between speaker meaning and sentence meaning, and between speaker attitude and the attitude conveyed by the literal meaning of the sentence. As Table 1 shows, the context against which a sentence is uttered triggers its literal or ironic interpretation.

Table 1: A brief summary of literal/ironic criticisms/compliments

CONTEXT	REMARK	INTERPRETATION	ATTITUDE
	What an ugly house!	Literal	Criticism
	What a beautiful house!	Ironic	Criticism
	What a beautiful house!	Literal	Compliment
	What an ugly house!	Ironic	Compliment

The complexity of irony comprehension is reflected on its relatively late acquisition. Research with hearing children showed that the comprehension of

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ironic remarks begins only around the age of 6 (Ackerman 1983), and that ironic criticisms are comprehended earlier and better than ironic compliments (Harris & Pexman, 2003; Panzeri & Giustolisi, under review).

As for the factors that might predict the development of irony comprehension, some authors claimed that Theory of Mind (ToM) abilities, and specifically the understanding of second order ignorance (Sullivan, Winner & Hopfield, 1995), are required to understand irony. Once the addressee recognizes that what the speaker said is literally false (e.g., "What a beautiful house" when the house is in fact ugly), he must recognize that the speaker believes that the hearer knows that the house is in fact ugly (second order ignorance) in order to interpret speaker's statement as a joke or as a lie. However, ToM development is tightly linked to language abilities (Happè, 1995, Astington & Jenkins, 1999), and those studies which controlled for children's linguistic competence found that it is linked with irony comprehension, together with, or even beyond, ToM level (Filippova & Astington, 2008, Bosco & Gabbatore, 2017).

The asymmetry in the recognition of ironic criticisms and ironic compliments, on the other hand, might suggest the contribution of other factors in irony understanding. Ironic criticisms constitute the most common form of irony, and thus some scholars emphasized the role of conversational experiences in the development of irony understanding (Dews & Winner, 1997). It was our aim to contribute to this debate, focusing on irony comprehension in a group of deaf signing children.

Studying the acquisition of verbal irony in deaf signers1 is interesting for several reasons. Firstly, deaf signers seem to present peculiar patterns in ToM development. In first order ToM tasks, native signers (i.e., those children who are born from deaf parents, and are exposed to sign language from birth) perform as hearing peers and they outperform late signers (those children who are born from hearing parents, and later acquire sign language) (a.o. Peterson, Wellman & Liu, 2005). As for second order ToM, on the other hand, both native and non-native signers tend to perform worse than hearing peers do, even if native signers later catch up (O'Reilly, Peterson & Wellman, 2014). Moreover, the conversational experience of deaf signers is different from those of the hearing population, and this is also true for native signers. We only have to think at the different possibilities of interaction with peers, for example.

Furthermore, only a few studies investigated the recognition of sarcasm (ironic criticism) in deaf signers, and as far as we know, to date no study has investigated the comprehension of ironic compliments. Peterson, Wellman and Slaughter (2012) tested late signers in Wellman & Liu (2004) 5-step ToM scale, to which a single item with sarcasm was added. They found that deaf children were delayed in all the items with respect to typically developing children, even

[1] An ongoing investigation by our research group suggests that irony in Italian Sign Language is expressed through an inventory of manual and non-manual cues that can be used in domains different from irony, but in ironic remarks they combine simultaneously to convey the non-literal interpretation (Mantovan, Giustolisi and Panzeri, in preparation).

controlling for age and language abilities. O'Reilly and collaborators (2014) found that during childhood deaf native and non-native signers were impaired in sarcasm understanding. However, native signers performed as hearing controls in adulthood, whereas this was not true for non-native signers.

Considering the presence of irony in everyday communication, and that the misinterpretation of ironic remarks might prevent the possibility of enjoying social relationships, we decided to analyze in depth irony comprehension in deaf signers using Italian Sign Language (LIS). Specifically, the goal of the present study was to investigate the development of the comprehension of ironic compliments and criticisms in deaf children and see whether they show a similar pattern as that reported by the literature on hearing children. Moreover, it was our purpose to investigate whether there is a relation between irony comprehension and success in ToM tasks in deaf signers.

2. Methods

2.1. Participants

Ten LIS signers participated (three females and seven males. Age: mean = 9years(y), 2months(m); SD=1y,6m; range = 7y,5m – 11y,7m). They were all born in deaf families, and have been using LIS since birth. IQ was assessed using the Italian standardization of the Raven's Colored Progressive Matrices (Belacchi, Scalisi, Cannoni, and Cornoldi, 2008). Biographical information of the participants is reported in Table 2.

Informed consent was obtained from the parents of all children. The University of Milano-Bicocca Ethical Committee approved the study.

Table 2: Biographical characteristics of the participants

ID	SEX	AGE (y,m)	RAVEN (z-scores)
S1	M	7,5	1.97
S2	M	7,11	0.68
S3	M	8,1	1.33
S4	F	8,3	0.41
S5	M	8,6	-1.62
S6	M	8,6	0.22
S7	M	9,4	-0,16
S8	M	10,8	0.62
S9	F	11,3	1.01
S10	F	11,7*	1.01

*Normative data are until age 11,6:
To calculate S10 Raven z-score, we used mean and SD of the age-group 11,1-11,6

2.2. Materials

ToM and irony comprehension tasks were administered in LIS. All responses were annotated online, but all testing sessions were video recorded to allow offline check.

ToM tasks – We administered two ToM tasks assessing first and second order ToM. Only participants who responded correctly to the first order ToM task could perform the second order ToM task.

As first order ToM task (I ToM, realizing that a person has a wrong belief) we used the Smarties task (Perner, Leekam & Wimmer, 1987; Gopnik & Astington 1988), and as second order ToM task a modified version of the Birthday puppy task (Sullivan, Zaitchik & Tager-Flusberg, 1994), using the drawings of the Enrique's birthday task (Hutchins & Prelock, 2014). The task comprised a second order ignorance question (II Ig, – realizing that person X ignores what person Y knows) and a second order false belief question (II Bel, realizing that person X wrongly believes that person Y has a false belief). Children could thus obtain a maximum score of 3 points, provided they answered correctly also to the control questions.

Irony comprehension task – This task was a translation in LIS of the task used in Panzeri & Giustolisi (under review). The example of one experimental item is reported in Appendix.

The task consisted of ten stories, signed by a deaf native signer and video-recorded, concluding with a remark that needed either literal interpretation (Lit: four remarks: two criticisms and two compliments) or ironic interpretation (six remarks: three criticisms –Iro Cri– and three compliments –Iro Com–). After watching each story, children were asked two questions investigating irony understanding (understanding of signer's meaning and recognition of signer's attitude) and a control question about the context. Accuracy on the irony task was calculated considering the signer's meaning and signer's attitude questions.

Importantly, five deaf adult native signers performed the irony task and they were at ceiling in both literal and ironic stories.

3. Results

Results are reported in Table 3.

ToM tasks – Eight out of ten participants responded correctly to the Smarties task. Among them, seven participants responded correctly to the II order ToM ignorance question. Only two participants responded correctly to the II order ToM false belief question.

Irony comprehension task – Overall, accuracy on literal remarks was 98%, on ironic remarks 59%. As expected, children could perform the task when the final remark triggered a literal interpretation. On the contrary, the performance on ironic remarks was extremely variable.

Considering ironic remarks, mean accuracy was 47% (SD=50) on ironic compliments and 57% (SD=49) on ironic criticisms.

Accuracy on ironic remarks was analyzed using mixed logit models with random intercepts for each subject. As predictors, we entered age and attitude (criticism vs. compliment). None of the two factors reached significance (age: β=.03, SE=.02, z=1.401, p=.16; attitude: β=.48, SE=.40, z=1.20, p=.23). Thus, even if overall ironic criticisms were easier than ironic compliments, this difference did not reach significance, and moreover a closer inspection to the individual data reported in Table 3 reveals that this facilitation for ironic criticisms was not consistent across all participants (see e.g. S3).

Table 3: By-subject results in the ToM and the Irony tasks

ID	I ToM	II Ig	II Bel	Lit	Iro Cri	Iro Com
S1	1	1	0	100	50 (55)	33(52)
S2	1	1	0	100	83(41)	0
S3	1	1	1	100	67(52)	100
S4	1	1	0	100	50(55)	33(52)
S5	0	NA	NA	87 (35)	17(41)	100
S6	1	1	0	100	17(41)	33(52)
S7	1	1	0	100	33(52)	0
S8	1	1	1	100	50(54)	67(52)
S9	0	NA	NA	100	100	0
S10	1	0	0	100	100	100

ToM tasks: 1=correct, 0=incorrect. Irony task: percentage of accuracy (SD).

Irony comprehension and ToM – Considering the by-subject results reported in Table 3 and the aggregate results shown in Table 4, in our small group of deaf children, we could not find any clear relationship between the ToM tasks and the Irony task.

Table 4: Percentage of accuracy in the Irony task in relation to the ToM tasks

ToM	N	Iro Cri	Iro Com
No ToM	2	58 (51)	50 (52)
I order ToM	8	56 (50)	46 (50)
II order ignorance	7	50 (51)	38 (49)
II order false belief	2	58 (51)	83 (39)

No ToM=wrong response in the smarties task; I order ToM=correct response in the smarties task; II order ignorance= correct response to the II order ignorance question; II order false belief= correct response to the II order false belief question; N=number of participants. Iro Cri/Com: percentage of accuracy (SD).

4. Discussion

In this study, we tested first and second order ToM and comprehension of ironic criticisms and compliments in ten young deaf native signers.

All but two participants passed the first order ToM task, whereas only two participants passed the second order false belief task. We were expecting all deaf participants to pass the first order ToM task, because they were all native signers. However, we acknowledge as a limit the fact that we had only one first order ToM question and participants might have failed only because they were distracted or tired. Since our group of deaf participants had a mean age of more than 9 years, the present results indicate a delay in second order ToM development with respect to hearing children, who reach second order ToM level around 6-7 years of age (see Panzeri & Giustolisi, under review). These results were expected considering previous research indicating a delay in second order ToM development in deaf signers (O'Reilly et al., 2014). As Table 4 shows, accuracy was higher for II order ignorance question than for II order false belief, in line with what Sullivan and colleagues (1995) found for hearing children. The irony comprehension task revealed that, contrary to literal language understanding, irony comprehension was a difficult task for the vast majority of our participants. However, some participants' performance was good and, importantly, we controlled our task with five adult deaf native signers and their performance was at ceiling for both ironic criticisms and ironic compliments. Overall accuracy was higher for ironic criticisms than for ironic compliments, in line with spoken language literature (e.g. Harris & Pexman, 2003; Panzeri & Giustolisi, under review). However, the difference was not significant. Moreover, as Table 3 shows, five out of ten participants had a higher score on ironic criticisms than on ironic compliments, but for four out of ten participants the situation was the opposite. Why was it so and what determined a better result either in criticisms or in compliments is a question that needs further investigation and an increased sample size. Nevertheless, our results are in line with those of O'Reilly et al. (2014) showing that deaf native signers are at risk of delays in ironic criticisms comprehension during childhood. Our investigation extends this observation to ironic compliments.

As for the relationship between ToM and irony, our small sample of deaf children suggests that ToM abilities per se do not constitute a good predictor of irony. Considering the two participants failing the first order ToM task, one (S9) responded perfectly to ironic criticisms questions, systematically failing ironic compliments questions, whereas the other (S5) had almost a mirror performance. Moreover, success in the second order ignorance question did not ensure good performance at the irony task, in opposition to what suggested by Sullivan et al. (1995). To this point, it is important to notice that O'Reilly et al. (2014) found that the link between second order ToM success (false belief understanding, in that case) and sarcasm understanding was different between deaf native signers and hearing peers.

Coming back to our research question, i.e. the development of irony comprehension on deaf native signers and the relationship with ToM

development, we can conclude that our deaf participants lag behind hearing peers in both irony and second order ToM understanding. However, ToM abilities do not appear to directly sustain irony comprehension. We think that two different explanations could be provided.

First, we can hypothesize that the task that has been used to assess deaf children mastery of second order ToM might not tap the actual metarepresentational abilities of these children. Sullivan and colleagues (1995) found that a simplification of the syntactic structure of the II order false belief question improved children's performance. Instead of a question with double embedding ("What does X think that Y thinks that Y will get for Y's birthday?"), a third character Z was introduced, who posed a simpler question to X ("What does Y think that Y will get for Y's birthday?), and the child has to answer assuming X's view point. The introduction of a third character might in fact add conceptual complexity due to a more advanced grammatical use of the signing space. In sign languages, abstract spatial locations are used to establish anchors, which are then associated to the discourse referents (Barberà & Zwets, 2013). This anchoring strategy allows the signer to anaphorically refer back to already established referents in the discourse. In our task, the II order false belief question required deaf children to control the simultaneous anchoring of three animated referents (rather than two as in the II order ignorance question) and this might have represented a further complication.

A second type of explanation, put forth in Panzeri and Giustolisi (under review) for typically developing hearing children, assumes an opposite view on the relationship between second order ToM and irony comprehension. Different studies found a correlation between second order ToM and irony, and assumed that ToM is a prerequisite for irony comprehension. The direction of the implication could in fact be reversed. Understanding irony (that is, being able to infer that a speaker uttered a blatantly false statement with the intent of conveying the opposite meaning, because she knows that her addressee knows that the remark is false) might trigger, or at least reinforce, the ability to attribute second order beliefs that is tapped by ToM tasks. According to this hypothesis, then, it is the delay in irony understanding that would slower the development of higher order ToM abilities.

The difficulties in comprehending non-literal language could be attributed also to deaf children scarce exposure to irony in everyday life. As already alluded to, even native signers have less possibilities of interaction with peers. Moreover, reduced access to TV due to scarce subtitle services and reduced reading experience due to the difficulties that deaf children experience in reading development might result in a reduced exposition to all instances of irony, which could lead to the observed developmental delay and the peculiar pattern of results here reported.

Appendix

Example of ironic criticism – English translation from LIS

Background: Tommy is spending the afternoon playing at Paul's home. Tommy asks Paul to pick up the Legos to build a big spaceship. At first, Paul does not want to play with Legos because he is worried that after playing his room would be a mess. Tommy promises that he will help Paul to tidy up the room. However, when it is time for Tommy to go home, he leaves without helping Paul. The room remains a mess. So Paul tells Tommy…

Remark: "Thank you for helping me tidying up!"

Questions: Paul told Tommy: Thank you for helping me tidying up!

A. What did Paul mean? Paul meant that: Tommy helped him/Tommy did not help him?
B. How was Paul's room when Tommy left?
C. Why did Paul thank Tommy for his help? When Paul thank Tommy for his help in tidying up, Paul wanted to compliment or criticize Tommy?

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