

Deafness, Theory of Mind, and Figurative Language Comprehension

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1. Introduction

A full understanding of language requires not only the recognition of the literal meaning of sentences, but also of the communicative intention of the speaker. In figurative language, what the speaker literally said clashes with what she intended to communicate. Suppose a mother comments on a very messy room by uttering (1a) or (2a). What the child needs to do in this case is going beyond the literal meaning, that is clearly false in the specific situation, and derive the mother's communicative intention; that is, the child would recognize the metaphorical interpretation of (1a), paraphrased in (1b), and the sarcastic intent of (2a), which gets eventually interpreted as conveying the opposite meaning, as in (2b):

- (1) a. Your room is a battlefield.
b. Your room is like a battlefield.
- (2) a. Your room is extremely clean.
b. Your room is not clean at all.

As for metaphor comprehension, younger children (from 5 to 6 year-olds) may have some understanding of metaphors grounded on physical- or action-resemblance (Keil, 1986; Vosniadou et al., 1984; Winner et al., 1980), but a full understanding of metaphors is achieved only after 11 years of age (Billow, 1975), and following a clear developmental trend (Cometa & Eson, 1978; Gentner, 1988).

As for irony comprehension, children recognize the nonliteral intent of ironic remarks around 6 years of age (Ackerman, 1981; Dews et al., 1996). In particular, ironic criticisms (i.e., positive remarks used ironically in negative situations) is easier for children than ironic compliments (i.e., negative statement used to congratulate somebody), as suggested by Harris & Pexman (2003) and

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Pexman & Glenwright (2007), at least when the ironic compliment does not directly echo a preceding remark (Nakassis & Snedeker, 2002). Nevertheless, the recognition of the speaker's communicative purpose is reached at a later stage (Demorest et al., 1983).

Several authors linked the comprehension of figurative language to Theory of Mind (ToM) abilities. Sullivan et al. (2005) argue that only typically developing (TD) children who pass 2nd order ToM tasks can distinguish jokes (and irony) from lies; and Happé (1993) tested children with autism spectrum disorders (ASD) and TD 5 year-olds with different levels of ToM, and claimed that 1st order ToM is sufficient for metaphor understanding, whereas irony comprehension calls for 2nd order ToM.

Nevertheless, the link between figurative language comprehension and ToM abilities has been questioned. In the first place, as we have already seen, only metaphors that involve a comparison of physical aspects of the terms are comprehended by younger children, whereas comparisons that require the recognition of abstract properties are grasped only by 11 year-olds, whereas 1st order ToM is reached at 4 years of age. Moreover, Norbury (2005) tested children with communication impairments (ASD and/or language impaired) and found that semantic abilities were a better predictor for metaphor comprehension than other abilities; and Csibra (2013) found that, in TD pre-schoolers, language, but not ToM abilities could predict metaphor understanding, whereas irony comprehension was influenced by chronological age. And, in general, it is well known that the performance on ToM tasks is highly dependent on language abilities (Happé, 1995 and Astington & Jenkins, 1999).

2 The study

To further investigate the cognitive abilities that are involved in nonliteral understanding and disentangle the factors at play in different kinds of figurative language, we compared the understanding of metaphors and irony in a typical and atypical population, i.e. deaf children with conventional hearing aids, whose linguistic and ToM abilities are delayed with respect to their TD peers (Woolfe et al., 2002; Peterson & Siegal, 1999; Peterson, 2004).

2.1. Participants

We tested 22 Italian deaf children (12 female and 10 male) aged 8 to 11 (8;1-11;8; MA 9;7). These children were diagnosed with a hearing loss (41 to 70 db) at a variable age (between 3 and 17-months, MA 10-months-old), and received conventional hearing aids between the age of 6 to 18-months (MA 14-months-old). All children in this group (HA, henceforth) had an exclusively oral education, with no exposure to sign language, and intensive speech and language therapy (with a minimum of 7 years and a maximum of 11 years, depending on age of the child and age in which they received the hearing aid). The characteristics of the HA-group are summarized in Table 1.

Table 1. List of the participants in the HA-group, with the indication of their gender; age (in months); age of first diagnosis of deafness (in months); age in which they received their conventional hearing aids (in months); number of years of speech therapy; linguistic age (in months) as revealed in the two tests administered for the evaluation of linguistic competence (PPTV and TCGB).

Subj	Sex	Age (months)	Diagnosis (months)	HA (months)	Speech therapy (years)	PPTV scores (months)	TCGB scores (months)
1	M	97	11	13	7	56	65
2	F	94	9	12	7	56	63
3	F	101	9	12	7	56	62
4	F	103	16	18	7	56	64
5	F	104	12	18	8	56	73
6	M	104	9	14	8	56	75
7	M	105	6	12	8	66	70
8	F	106	16	16	7	66	67
9	M	109	3	12	9	66	69
10	M	111	15	18	8	66	73
11	F	114	11	12	8	66	75
12	F	115	4	6	9	56	69
13	F	119	15	16	9	66	75
14	M	120	17	18	8	78	77
15	F	122	14	16	8	66	73
16	F	126	16	18	9	90	79
17	F	127	6	12	10	90	81
18	M	129	12	12	9	78	79
19	M	132	12	16	10	90	84
20	M	133	3	8	10	102	81
21	M	136	6	12	11	90	79
22	F	140	3	9	11	102	86

In order to test for their language abilities, HA-children were administered the Italian version of the Peabody Picture Vocabulary Test (PPVT, Stella, Pizzioli & Tressoldi, 2000) for their receptive lexicon, and the Test di Comprensione Grammaticale per Bambini (TCGB, Chilosi & Cipriani, 2006)

for their grammatical abilities. On average, their scores in both of these language tests matched those of 6 year-old children (MA 6;0 for the PPTV; MA 6;2 for the TCGB).

A group of 24 6 year-olds TD-children attending the 1st grade of primary school served as controls.

2.2. Materials and Procedure

Children were administered two ToM tasks: the Smarties Test, that tests 1st order ToM abilities; and the Laura & Gino test, a test for 2nd order ToM abilities, adapted for children with hearing difficulties, that contains a question for 1st order ToM and a question for 2nd order ToM.

We also administered two novel tests for metaphor and irony comprehension. The test for Metaphor was modelled after Norbury (2005) and required the completion of a total of 15 sentences: 5 Metaphors, 5 Similes and 5 Literal sentences. An example for the metaphor condition is given in (3).

(3) Carla leaves a mess wherever she goes. (h e) is really ...

an earthquake	a waitress	a bicycle	a Thursday
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Please note that besides the target (“an earthquake”), there was always a competitor (“a waitress”), i.e., a term that could in principle be predicated of the (female) subject but that in the given context was irrelevant, and two distractors (“a bicycle” and “a Thursday”).

The test for irony comprehension comprised a total of 8 short stories, followed by a remark, that was ironical in 4 stories, and literal in the other 4. Four stories presented a negative context, and the other 4 stories had a positive context. The interaction of the irony-literal and of the negative-positive context resulted in 4 conditions, that are schematized below:

Table 2: Conditions in the test for irony comprehension

	Positive remark	Negative remark
Negative context	Ironic criticism (IrCr)	Literal criticism
Positive context	Literal compliment	Ironic compliment (IrCo)

An examples of the two types of ironic remarks (i.e. ironic criticism, and ironic compliment) are given in (4) and (5) respectively.

(4) Chiara is helping her mother in making a cake. Mum asks her to stir the ingredients, but Chiara let the bowl fall, and the dough ends up on the table and on the floor.

Then mum says to Chiara: *You really did a great job!*

- (5) Daniela tells Lucia to put in the new bookshelves all the books, more than a thousand. At the end of the day, Daniela passes by, and she sees that Lucia finished with all the books.

Then Daniela says to Lucia: *You did nothing at all!*

2.3. Results

As for the ToM tasks, the HA-children's scores were not significantly different from the TD-children ($p=.963$, n.s). Since in both groups some children passed only the Smarties task, but not the 1st order question in Laura & Gino task (whereas all the children who passed 1st order question in Laura & Gino also passed the Smarties task, and all the children who reached 2nd order question in Laura & Gino correctly answered all the other questions), we decided to consider two groups of 1st order ToM, one relative to the Smarties test and one relative to Laura & Gino. HA- and TD-children's distribution with respect to ToM abilities is plotted in Figure 1.

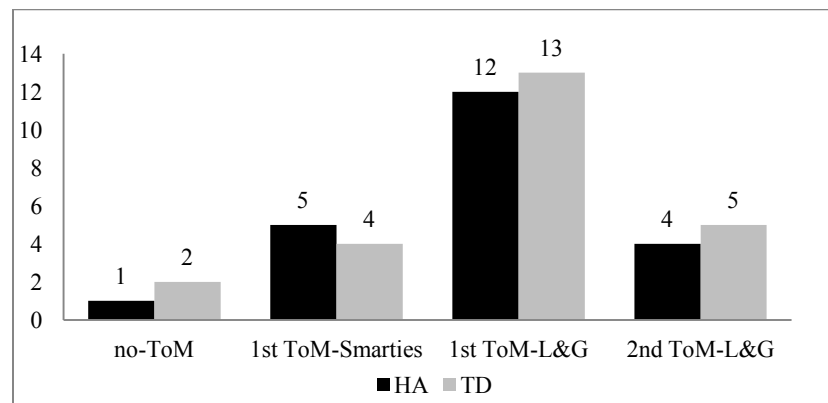


Figure 1. Distribution of children (HA-group=black bars; TD-group=grey bars) with respect to their performance in ToM tasks: no-ToM=children who did not pass any ToM tasks; 1st ToM-Smarties= children who passed the Smarties test; 1st ToM-L&G=children who passed the 1st order task in Laura & Gino test; 2nd ToM-L&G=children who passed the 2nd order task in Laura & Gino test.

As for the Metaphor task, children's performance is plotted in Figure 2.

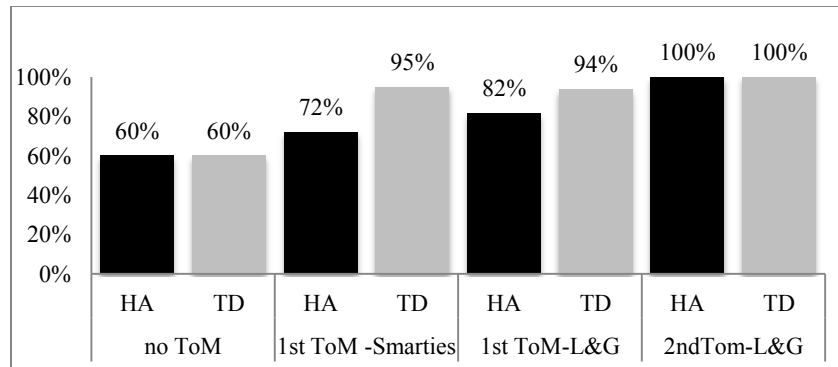


Figure 2. Accuracy in the Metaphor task, by group and level of ToM, as defined in Figure 1.

A one-way analysis of variance ANOVA revealed an overall difference between the performance of the HA- and the TD-group in the Metaphor task ($p=.013$). In the TD-group, only the two children who did not pass any level of ToM (the no ToM-group) had a lower performance compared to the other two groups, that reached an optimal performance (above 94% accuracy overall). In the HA-group, since there was only one child who failed all ToM tasks, he was excluded from further analyses. The group of HA-children that passed 2nd order ToM performed at ceiling (100% accuracy) and differed both from the group of children that only passed the Smarties test, who only reached 72% accuracy ($p=.006$), and from the group that passed the 1st order ToM question in the Laura & Gino task, that performed better (82%), yet not at ceiling ($p=.042$).

As for the Irony task, the accuracy in the Literal conditions was at ceiling for all groups. The accuracy in the two irony conditions (IrCr vs. IrCo) is plotted in Figure 3.

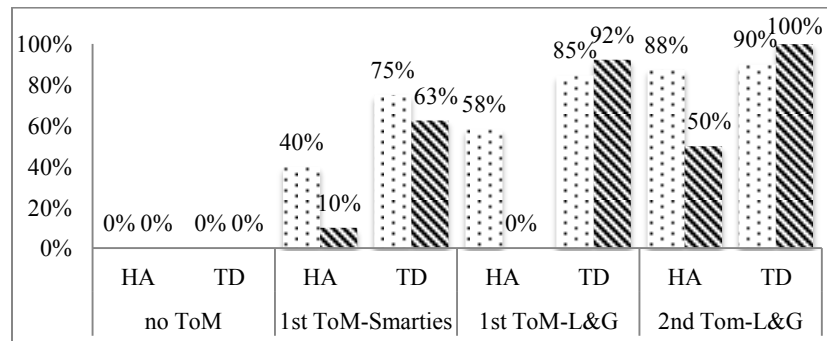


Figure 3. Accuracy in the Irony task, split by type of remark (IrCr=dotted bars, IrCo=striped bars), group and levels of ToM.

In both groups, the children that failed all ToM tests differed from all the other ToM-groups in both ironic conditions. Within the TD-group, all children had a good performance (above 75%) in the IrCr condition (dotted bars in Figure 3), and no difference was revealed across groups for ToM abilities. In the IrCo condition (striped bars in Figure 3), the children that only passed the Smarties test performed significantly worse than those that passed the 1st order ToM task in Laura & Gino (63% vs. 92%, $p=.44$) and those that passed the 2nd order ToM task, whose performance was optimal (63% vs. 100%, $p=.027$). As before, the only child in the HA-group that failed all ToM tests was excluded from the analyses. In the IrCr condition (dotted bars in Figure 3), a significant difference is only revealed between children that passed the Smarties-test and those that passed the 2nd order ToM task (40% vs 88%, $p =.051$). In the IrCo condition (striped bars in Figure 3), the overall accuracy by HA-children is extremely low, ranging from 0% for those children that failed all ToM tests and those that passed the 1st order ToM task in Laura & Gino; to 10% for those children who only passed the Smarties test; and reaching a maximum of 50% accuracy in those children that passed the 2nd order ToM task in Laura & Gino. Pairwise comparisons revealed a difference between the performance of children that passed the Smarties test and the other ToM-groups ($p=0.22$ in the comparison with the children that passed the 1st order ToM task in Laura & Gino; $p=.001$ in the comparison with the children that passed the 2nd order ToM task).

3. Discussion

The results show that HA-children experience serious problems in the comprehension of non-literal language, and their difficulties seem to be more severe than their TD peers with analogous levels of ToM.

In the Metaphor task, 1st order ToM abilities are sufficient for metaphor comprehension in TD-children, consistently with Happé (1993). But this is not the case for HA-children: the accuracy on metaphors in this case is tightly linked to ToM abilities, and children that only pass 1st order ToM tasks perform significantly worse than children that pass 2nd order ToM tasks, and at ceiling performance is only reached by the latter group.

In the Irony task, the three children that do not pass any ToM tasks (1 in the HA-group and 2 in the TD-group), despite their at ceiling performance on Literal controls, fail to recognize all 4 ironical remarks and interpret them literally. In case of ironic criticisms, i.e. the most common form of irony consisting of ironical positive remarks in negative contexts (the only condition tested by Happé), accuracy is above 75% already in TD-children that pass the Smarties-task, i.e. a simple test to assess 1st order ToM abilities, and no significant difference is revealed across children with different levels of ToM in this group. In the HA-group, a continuum in the accuracy scores is observed across groups with different levels of ToM : in particular, accuracy is very low (40%) in those children that only pass the Smarties-test; performance improves

(58%) in those children that pass the first question in the Laura & Gino task (tapping 1st order ToM), but only reaches an adequate level (88%) in those children that pass the 2nd order ToM task.

Ironical negative remarks in positive contexts, the so called ironic compliments, are found to be extremely hard for HA-children: only one child recognized the non-literal interpretation of the two ironic compliments in the test; three children correctly interpreted one ironic compliment out of two, and the other 18 children consistently assigned the literal interpretation to all ironic remarks. The asymmetry in the comprehension of ironic criticisms and ironic compliments is attested also for TD-children (Harris & Pexman, 2003, Pexman & Glenwright, 2007), but the difference between these two forms of irony has never been found to be so extreme.

The fact that ironic compliments are indeed less common in everyday interactions might corroborate the idea that pragmatic factors such as the conventionality of particular forms of irony (Burnett, 2014), or social interaction experiences (Tomasello, 1992) might influence irony comprehension. This might be even more so in case of deaf children, for which exposure to unconventional form of interactions might be even more limited in everyday communicative exchanges.

Summing up, our results suggest (contra Happé, 1993) that 1st order ToM is not sufficient for Metaphor understanding, as demonstrated by the low performance on metaphors by HA-children. As for irony, 2nd order ToM seems not to be a necessary condition, as demonstrated by the high performance of the group of TD-children that only passed the task for 1st order ToM abilities. At the same time, though, 2nd order ToM is not found to be sufficient for a full understanding of irony in the HA-group (69% overall accuracy in both conditions). Thus, our findings do not reveal a clear relation between ToM abilities and metaphor and irony understanding.

While the HA-children showed more variation in the chronological age (from 8;1 to 11;8) and in their corresponding linguistic age (from 5;9 to 7;10) than the TD-children, the two groups did not differ as for ToM abilities. Nonetheless the performance on non-literal language tasks varied significantly between groups. We are currently extending the research testing a novel group of younger TD-children, matched one-by-one to the HA-group on different measures of linguistic age, in order to investigate the relation between linguistic age and irony () and () and ()'s hypothesis that metaphor understanding is predicted by linguistic abilities, whereas irony understanding is more linked to chronological age.

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