The Impact of Sign Language on the Cognitive Development of Deaf Children: The Case of Theories of Mind

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The ability to attribute false beliefs (i.e., demonstrate theory of mind) by 155 deaf children between 5 and 8 years of age was compared to that of 39 hearing children ages 4 to 6. The hypotheses under investigation were (1) that linguistic features of sign language could promote the development of theories of mind and (2) that early exposure to language would allow an easier access to these theories. Deaf children were grouped according to their communication mode and the hearing status of their parents. The results obtained in three false belief tasks supported the hypotheses: effective representational abilities were demonstrated by deaf children of deaf parents, whereas those born to hearing parents appeared delayed in that regard, with differences according to their communication mode.

Some authors may have felt in the past that deaf children's cognitive abilities were inferior to those of normal hearing children (e.g., Oléron, 1957), perhaps because they did not consider the value of sign language. Many authors today believe that deaf children of deaf parents have the same cognitive abilities as hearing children. This is a tenable idea, although it may still not fully account for the linguistic variable. Yet sign language affects cognitive functioning, leading to greater creativity (Everhart & Marschark, 1997, Marschark, West, Nall, & Everhart 1985), better spatial cognition (Bellugi et al., 1990; Parasnis, Samar, Bettger, & Sathe, 1996), more flexibility (Courtin, 1997), enhancement of episodic memory (Rönnberg, Söderfeldt, & Risberg, 1998), and so on. Can the particularities of the linguistic system also lead to differences in the way representations of human cognitive functioning are built and manipulated (i.e., theories of mind)? This article presents a study aimed at testing this idea, especially interesting because theories of mind allow individuals to understand the others' "ways of being" and thus are the bases of proper socialization.

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Theory of Mind

The research field concerning "theories of mind" studies children's acquisition of the ability to consider the human mind as a generator of representations. The idea is to find out how children manage to understand that the mind creates mental entities (representations) that are not necessarily exact replicas of reality, that such representations may therefore differ across individuals, and thus people may act differently in the context of an apparently identical event.

The study of how children grasp the representation-generating mind is not new. It began with Piaget and Inhelder's (1948) work on "perspective relating" and the so-called "three mountain" task. The issue was resumed and further developed by Flavell and his colleagues (see Flavell's review, 1990), who used a simple experimental method to show that the coordination of visual perspectives is the first skill a child acquires in the pathway toward understanding the representational mind. By about the age of three or three and a half, children know that each person's visual represen-

tation of a particular object (e.g., a drawing depicting a turtle) depends on the point of view from which that person sees the object (e.g., frontward or backward); they have learned that there is not just one visual representation. At this age, children are also able to switch from one representation to another according to an experimenter's requests.

The ability to understand and manipulate mental representations is then gradually transferred from the perceptual domain to the conceptual domain (Melot, Houdé, Courtel, & Soenen, 1995; Melot & Komano, 1997). Knowing that it is possible to falsely represent reality at the visual level (and hence, to have a "misrepresentation" as Perner, 1991, p. 3, termed it) may be a precursor for learning to attribute false beliefs (Gopnik, Slaughter, & Meltzoff, 1994), where once again, "decentering" is required. The child must break away from egocentrism (in Piaget's use of the term) at the perceptual level before making the step at the conceptual level. At this stage of conceptual decentration, a child becomes capable of understanding and predicting the actions of others in accordance with what the others know (and thus in accordance with their potentially erroneous beliefs and misrepresentations of reality) and no longer solely as a function of his or her own knowledge.

A typical example of the kind of task that can be used to test for this knowledge in children was described by Melot (1999, p. 115) as follows (in translation): "An object is placed in place X in the presence of a person [or puppet] who then leaves the room. While the person is gone, the object is put in place Y. When the person finally comes back, he wants the object. The child who has witnessed this scenario is then asked the following question: 'Where will the person look for the object, in X or Y?'" The child must then disregard his or her own knowledge (the transfer of the object from X to Y) and predict the other person's action based on that person's knowledge and misrepresentations, here named "false belief" (he believes the object is in X and will go look for it in X).

Thus, the ability to attribute false beliefs is rooted primarily in the mastery of visual perspectives. As pointed out by Courtin and Melot (1998), the communication modality used by deaf children and their parents must be carefully considered, because the properties of sign languages may be crucial in determining whether and when visual perspective taking is mastered.

Like all languages, sign languages are full-fledged systems composed of sublexical structures: hand configuration, place of articulation, and movement (e.g., Bellugi & Klima, 1978; Stokoe, 1960). Sign languages also have rules that specify the ways in which the signs are linked to each other in space so as to express well-organized sentences. In this study, the property of sign language to be considered is syntax.

Three main points must be highlighted here. First, the referential perspective of a message is generally understood to be the signer's perspective (Emmorey, 1996). This creates the need for visual perspective changes: the addressee has to reorient the linguistic space to see it from the signer's viewpoint. Second, some verbs require dividing the linguistic space into subspaces, each one referring to a single item (subject or object) that will be part of the signed scene. This linguistic process is called "spatial mapping." Third, the frame of reference in sign language discourse is sometimes shifted in space when the signing is done from the viewpoint of one of the protagonists of a signed story, or when opposing ideas are being confronted (see Poulin & Miller, 1995). Note that these three features force the addressee to understand multiple visual perspectives of the same entity. In other words, sign-language expression requires a certain understanding of the relativity of perspectives.

Thus, because visual perspective-taking is considered a precursor to representing theories of mind, sign languages may promote their development inb children as young as 3 years old, the age at which children understand these three features of sign language[1] (Bellugi et al., 1990; Lillo-Martin, Bellugi, Struxness, & O'Grady, 1985; Marschark, 1993; Petitto & Bellugi, 1988; Poizner, Klima, & Bellugi, 1987; Wilbur, 1987). It is important, then, to distinguish children according to their communication mode, even before looking at semantic content: children who sign should develop theories of mind earlier than speaking ones.

Of course, the semantic content of an utterance is also important, regardless of the communication modality. Courtin and Melot (1998) discussed the importance of the interpersonal exchanges children have with

their parents (or with any other person, for that matter). Such exchanges can bring out the conflicting cognitive representations of each partner and potentially lead the child to awareness of multiple mental representations. This point is at the basis of most past research on theory of mind in deaf children (e.g., Peterson & Siegal, 1995, 1996). Thus, it is not necessary to discuss further these well-known variables.

Several findings support the idea that "oral " deaf children of hearing parents are at a disadvantage compared to deaf children of Deaf parents. First, deaf children of hearing parents have late access to communication compared to second-generation deaf children (Harris, 1978; Mayberry, 1989), and among them, oral children are at a handicap compared to signing children. Besides, this communication is poorer in content (with a weak activation of metacognitive processes), since only here-and-now communication normally takes place, with regard to observable variables (Harris, 1992; Marschark, 1993). Deaf children of hearing parents accordingly receive fewer explanations about emotions or motives for action, that, in principle, should have an impact on the development of theories of mind (Dunn, 1994; Dunn, Bretherton, & Munn, 1987; Jenkins & Astington, 1996; Perner, Ruffman, & Leekam, 1994). Thus, deaf children of deaf parents should obtain higher scores on tasks that test their theories of mind than deaf children of hearing parents.

Linguistic variables are not the only important ones. Pretend play should also be considered, for it provides a means of acquiring and manipulating some kinds of representations (see Flavell, 1988; Spencer & Hafer, 1998) and, as such, is another precursor to theories of mind. Let us use the definition of pretend play proposed by Lillard (1994, p. 214): "Pretence entails six defining features: 1) a pretender, 2) a reality, and 3) a mental representation that is 4) projected onto reality, with 5) awareness and 6) intention on the part of that pretender." A child's play partner must let the child develop his or her own play or help him or her do so by promoting involvement and elaboration of the roles assigned. Here again, for the reasons stated above, deaf children of deaf parents are probably at an advantage: compared to deaf mothers and hearing mothers of hearing children, hearing mothers of deaf children appear to be more directive and intrusive in their verbal as well as nonverbal interaction (but see Ledeberg, 1993, who maintains that hearing mothers of hearing children are not more intrusive when the children's linguistic competency is controlled).

Children whose actions are constrained either because the mother is overly directive, or because her rapport with the child is centered on her own child-raising interests instead of creating a playful relationship tuned to the child's activity, may lag behind in pretend play development. Accordingly, deaf children of deaf parents should exhibit a greater ability to understand mental representations, which is what Spencer (1996; Spencer & Deyo, 1993) showed for pretend play, although we do not really know whether the effect was due to sign language communication per se or to the greater linguistic skills of these children as compared to deaf oral children. Therefore, deaf children born to deaf parents may be able to attain higher levels of mastery in pretend play than deaf children of hearing parents, due to better parental tuning to the deaf child.

Ideally, in order to test these ideas, we need to compare deaf children of deaf parents who are either native users of sign language or native users of spoken language and deaf children of hearing parents who are either "oral" or late learners of sign language. The working hypotheses here are that within native and late speakers, signing children will exhibit better performance on false belief attribution tasks than those who communicate orally. Furthermore, native speakers should obtain higher scores than children who have had late access to communication.

Method

Participants

One hundred and fifty-five deaf children were tested for this study. The two general criteria for selecting the deaf participants were their degree of deafness and their age. All participants had bilateral profound deafness (loss of more than 90 decibels in the better ear at ordinary conversation frequencies, as stated in the audiological records available at their school). All participants were from 5 to 8 years old. Children had no

associated handicap (except sometimes a visual one, corrected by lenses).

Assigning deaf children to the signing or oral category was a touchy operation. No so-called "signing" child is totally ignorant of spoken language (at least not in France, due to current educational practices). Conversely, very few so-called "oral" deaf children use only spoken language, because signing is more or less openly tolerated in all institutions, at least during free playtime. But, although the signs used in this case are genuine signs, they can hardly form a language, because the lexicon is so rudimentary. Another important consideration is that some previously oral deaf children are sent to schools that foster the use of sign language because they fail to develop "satisfactory" oral skills. As a result, apart from a few children who are true oral children and some others who are true signing children—the latter, by the way, are all born of Deaf parents—deaf children can only be labeled as "predominantly signing" or "predominantly oral." Such judgments here were made on the basis of their communication preference and the opinions of at least two adults who know them (teachers, parents, counselors and other staff members, special education teachers, and so on).

The subjects were recruited in 15 schools for deaf children and 8 deaf classes integrated in hearing schools, in 16 different cities throughout France.

Group Assignments

The deaf children who could be properly tested were divided into three main groups on the basis of their parents' hearing status (deaf or hearing) and the child's communication modality (predominantly signing or predominantly oral). This classification created three groups of deaf children instead of four, because oral children born to deaf parents were too few, and their data are not included in the study. The group of deaf children born to deaf parents includes here only children with both parents deaf, communicating in sign language.

A group of hearing children was added to the three deaf groups. Hearing children were chosen so as to match in gender and socioeconomic status (SES) with deaf children of deaf parents. For practical reasons, hearing children were recruited in two schools near Paris, instead of throughout all France like the deaf children.[2] The 39 hearing children were 4 to 6 years old.[3] Within each of the three deaf children groups, there were four age groups (see Table 1), with mean ages of 5 years (range: 4;7 to 5;6), 6 years (range: 5;7 to 6;6), 7 years (range: 6;7 to 7;6), and 8 years (range: 7;7 to 8;6).

It is clear from Table 1 that the group sizes for the deaf children were far from equal. However, given the

Table 1 Distribution of the 194 children according to hearing status and age

Groups	Age (and limits)	No. of subjects	Total (and mean ages)
Deaf children of	5 years (4;10–5;4)	9	$n = 37$
Deaf parents	6 years (5;7–6;6)	10	(6;6 years)
	7 years (6;8–7;6)	9	
	8 years (7;6–8;5)	9	
Signing deaf children of	5 years (4;11–5;6)	4	$n = 54$
hearing parents	6 years (5;7–6;5)	5	(7;4 years)
	7 years (6;9–7;6)	17	
	8 years (7;7–8;7)	28	
Oral deaf children of	5 years (5;0–5;6)	4	$n = 45$
hearing parents	6 years (5;11–6;6)	14	(6;11 years)
	7 years (6;7–7;5)	16	
	8 years (7;8–8;7)	11	
Hearing children	4 years (4;1–4;6)	15	$n = 39$
	5 years (4;11–5;4)	12	(5;1 years)
	6 years (5;11–6;3)	12	

specificity of this research topic and its methodological requirements, it was not possible to balance the number of subjects in each hearing-status group and age group.

Material

The results reported here concern only false belief tasks, which are the "litmus tests" of theory of mind and the ones most commonly used by a number of authors (Peterson & Siegal, 1995, 1996; Remmel, Bettger, & Weinberg, 1998; Russell et al., 1998; Steeds, Rowe, & Dowker, 1997). Three tasks were presented to the children: two "unexpected change" tasks (Wimmer & Perner, 1983) and one "unexpected content" task (Gopnik & Astington, 1988; Hogrefe, Wimmer, & Perner, 1986).

The unexpected content task consisted of showing a box whose content the child would "know" even before opening it (e.g., a box of Smarties) but which had in fact secretly been changed before presentation. The box was shown closed and the child was asked what it contained. After the child had said it contained candy, he or she was shown the true content, a pencil. The experimenter then closed the box and asked the child what a doll who saw the box and had not been told what was really in it would think it contained.

In the unexpected change tasks, borrowed from Wimmer and Perner (1983), the child was shown two dolls, three easy-to-distinguish boxes (e.g., a blue, a red, and a brown one), and a marble (a candy bar for the second task). After a short scenario during which the two dolls were "playing" with the marble, one of the dolls put the marble in one of the boxes and left the scene ("went away"). While she was gone, the other doll "decided" to continue playing and took the marble back out. After that, she put it away in one or the other of the two remaining boxes. Then the first doll, "who didn't see the marble change of box" came back and the child was asked "Where will she look for the marble first?" Note that Wimmer and Perner (1983) did not include the word "first" in the question. This term was added here in answer to Siegal and Beattie's (1991) and Siegal and Peterson's (1994) criticism and also to make the method more similar to the one generally used in past research on deaf children (Peterson & Siegal, 1995, 1996; Steeds et al., 1997). Regardless of the child's response, a control question was asked to make sure the story was properly understood: when the child succeeded to attribute a false belief, the control question pertained to the marble's current location; when the child failed, it was about the marble's initial location.

Procedure

The children were tested individually in a single session that usually lasted about 10 minutes, in a room made available in the child's school. Deaf myself, I tested the deaf signing children personally, in French Sign Language (FSL). For the part of the experiment involving oral children, I was assisted by another person. The assistant, who was always familiar to the child, gave the instructions that he or she had been given in advance. (I checked the accuracy of my assistant's oral utterances by lip-reading. Whenever the instructions were poorly reported despite the preparatory explanations and practice given before the experiment, the data for that child was discarded.). The hearing children were tested individually in their school by a hearing experimenter used to this kind of testing. The three tasks were presented in random order.

Results

To avoid acceptance of "chance" answers, the whole result of each child over the three tasks has been considered instead of the results on the separate tasks. Thus, a child is said to have "succeeded" on false belief attribution if he or she answered correctly on at least two of the three tasks (giving correct answers to both the test question and the control question). If the child did not reach this criterion of two out of three tasks, he or she is said to fail. If the child did not respond correctly to one or more control questions, regardless of the correctness of his or her response to false belief attribution, his data are discarded—the latter pattern of response occured only two times in hearing children, once in a second-generation deaf child, seven times in signing deaf children of hearing parents, six times in oral deaf children of hearing parents. Table 1 excludes these children.[4]

Given that children were defined as either "succeeding" or "failing," the statistical test used for such nominal-level data was a nonparametric test (chi-square). Some ANOVAs on group mean results nonetheless will be provided, with hearing status as a between-subjects factor.

Within-group performance comparisons will be given first. Performance differences were expected between hearing children and deaf children of deaf parents, and between the latter and deaf children of hearing parents. The between-group comparisons will be presented in the following order: (1) hearing children ages 5–6 versus deaf children of deaf parents ages 5–6, (2) hearing children ages 4–6 versus deaf children of hearing parents ages 5–8, (3) deaf children of deaf parents ages 5–8 versus same-age deaf children of hearing parents, and (4) deaf children of hearing parents compared to each other.

Effect of setting. The results of deaf children have been analyzed in order to determine any difference of performance between children from institutional settings versus hearing schools. However, no significant difference was found, and data have thus been collapsed for the remaining analyses.

Effect of age. No significant age-related performance differences were found within each hearing status group. There is nonetheless an evident global descriptive improvement of performance with age in each group, except in deaf children of deaf parents since they perform near ceiling as soon as 5 years of age.

Effect of hearing status. (1) Hearing children versus deaf children of deaf parents: comparison of the performance of 5-year-old hearing children with deaf children of deaf parents yielded a marginally significant difference ($\chi^2_1 = 2.74$, $p = .09$). At the age of 6, the difference was more pronounced ($\chi^2_1 = 4.02$, $p < .05$). When the data for the 5- and 6-year-olds with the same hearing status was pooled to obtain two groups with the same mean age (5;7 for hearing, 5;6 for second-generation deaf), the performance difference was significant ($\chi^2_1 = 6.68$, $p < .01$, $F_{1,42} = 7.50$, $p = .01$) and reflected greater success for the second-generation deaf children (see Figure 1).[5]

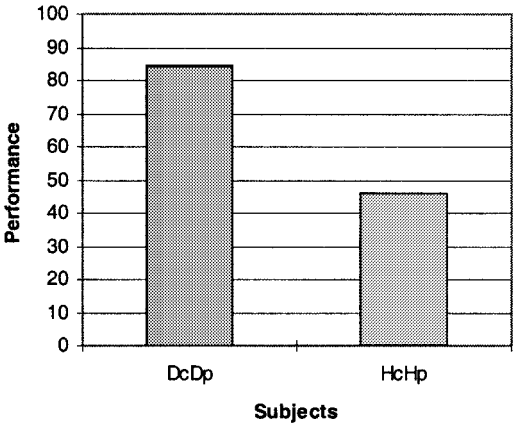

Figure 1 Success rate, in percentages of children reaching the criterion (2 out of 3) on false belief attribution tasks according to hearing status. With DcDp = deaf children of Deaf parents, and HcHp = hearing children of hearing parents. Both groups ages 5 and 6.

(2) Hearing children versus deaf children of hearing parents : comparing the hearing children with the deaf children of hearing parent is more difficult. Likely because of the small number of subjects in these two groups, no significant differences were found between hearing children *of the same age,* which may suggest similar abilities on false belief tasks between these different groups of children. Only the combined results of the deaf oral 5- and 6-year-olds, but not the signing children, yielded a significant difference from the hearing children of these same ages combined ($\chi^2_1 = 3.94$, $p < .05$).

Note, however, that the performance of the 8-year-old signing deaf children of hearing parent differed, but only marginally, from that of the hearing 4-year-olds ($\chi^2_1 = 2.87$, $p = .09$) but not from the hearing 5-year-olds ($\chi^2_1 = 0.48$, ns). The scores of all age groups of hearing-parent deaf signing children pooled did not yield a significant difference from the hearing children pooled ($\chi^2_1 = 0.33$, ns ; $F_{1,89} = .19$, ns) despite the difference in mean age (7;4 vs. 5;1, respectively) (see Figure 2).

As for the oral deaf children, not even the 8-year-olds were able to outperform the hearing 4-year-olds ($\chi^2_1 = 0.99$, ns). The comparison of the success rates of all oral children pooled (mean age 6;11) and all hearing subjects pooled did not yield any differences either.

However, an ANOVA on the mean number of tasks

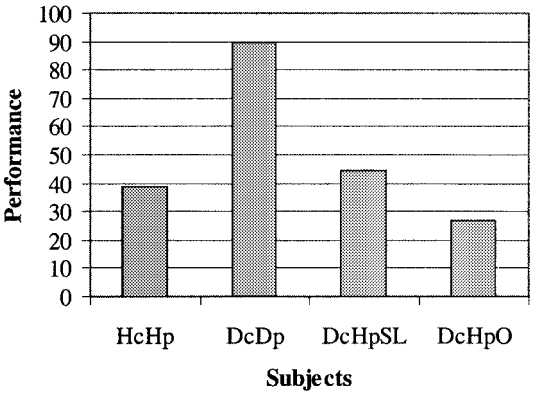

Figure 2 Success rate, in percentages of children reaching the criterion (2 out of 3) on false belief attribution tasks according to hearing status. With HcHp = hearing children (ages 4 to 6), DcDp = deaf children of Deaf parents (ages 5 to 8), DcHpSL = signing deaf children of hearing parents (ages 5 to 8), and DcHpO = oral deaf children of hearing parents (ages 5 to 8).

(out of three) correctly performed by the children in these two pooled groups did indicate significantly better performance of the hearing children compared to the oral children ($F_{1,82} = 4.49$, $p < .05$).

(3) Deaf children of deaf parents versus deaf children of hearing parents: comparison of second-generation deaf children with either group of deaf children of hearing parents indicated consistently significant performance differences at every age and for all age groups together (see Figure 2, deaf-parent deaf children vs. hearing-parent deaf signing children, $\chi^2_1 = 18.78$, $p < .0001$, $F_{1,89} = 25.81$, $p < .0001$; deaf-parent deaf children vs. hearing-parent deaf oral children: $\chi^2_1 = 32.05$, $p < .0001$, $F_{1,80} = 55.80$, $p < .0001$). There was only one marginally significant difference, obtained when comparing Deaf-parent deaf children to hearing-parent deaf signing children at age 5 ($\chi^2_1 = 3.26$, $p = .07$). These results are a testimony to the consistent superiority of second-generation deaf children over other deaf children in false belief attribution tasks like the ones used here.

(4) Deaf children of hearing parents compared to each other : the two groups of deaf children with hearing parents did not differ from each other at any of the ages studied, although as a whole, the hearing-parent deaf signing children tended to outperform the hearing-parent deaf oral children ($\chi^2_1 = 3.35$, $p = .07$; $F_{1,97} = 3.42$, $p < .07$). This is due to the fact that, while failures predominated in the result patterns of both groups, the difference between failures and successes was greater for the oral children than for the signing children.

In brief, it is clear that the deaf children of deaf parents outperformed all the other children on these tasks. The overall similarity between the performance of the hearing children and of the deaf children of hearing parents nevertheless masked the relatively poor performance of the latter for their age, especially the oral children, who tended to perform slightly below deaf signing children of hearing parents.

Discussion

Several hypotheses were set forth here. In particular, I suggested that sign language should help deaf children acquire theories of mind. Research on the effects of linguistic modality should therefore be primarily based on comparisons of groups that differ solely (or nearly so) on this variable. This means comparing hearing children with deaf signing children born to deaf parents, and signing deaf children of hearing parents with oral children ones.

Second-generation deaf children ages 5 and 6 were found here to be particularly good at false belief tasks, excelling quite markedly relative to same-age hearing children. The results obtained here for the hearing children were surprising in light of current research on this topic, but the fact is, most studies have used simple tasks and success has been assessed on the basis of a single task. Further, middle-class children have generally been tested. In this study, the children were tested on three tasks, so the results are more like the ones obtained elsewhere using this method (see Perner et al., 1994, second experiment). Similarly, the hearing children in this study were not from the middle class; their background was more of an underprivileged one quite similar to that of most French deaf adults.

Among the deaf children of hearing parents, ages 5 to 8, the signing children tended to outperform the oral children. This trend of difference among deaf children of hearing parents suggests that the linguistic variable had less impact in these children. Even if this is seen to support the idea that perspective taking at the linguistic level improves the ability for false belief attribution

of these signing children as it does for the native signing children, it is not the sole explanation here. The difference of performance between signing and oral deaf children of hearing parents may also result from other different linguistic factors, such as greater language fluency leading to differences in pretend play, and so forth. Thus, if sign language leads deaf children of hearing parents to have better performance on the false belief tasks, it may be for other reasons than those for second-generation deaf children.

These findings do not yield a statement about the age at which differences between signing children and nonsigning children will start to appear, which would have to be determined in other research. Second-generation deaf children differ from hearing children as early as 5 years of age, the youngest age I have tested. Deaf children of hearing parents do not significantly differ according to their communication mode at any particular age. Some other tasks for estimating theories of mind development may be useful for determining these ages of differentiation.

These data thus seem to support the hypothesis concerning the effect of using a sign language on the acquisition of theories of mind. The perspective-taking process inherent in sign language can help children grasp the idea that other individuals do not have the same visual perspectives of objects as their own. This visual-perspective effect is the basis for success on false belief tasks: the child now knows that others have to see a critical fact in order to be aware of it. But does the child know how to take the informative value of this critical fact into account (conceptual perspective taking)? That question remains to be answered.

Effect of Early Exposure to a Linguistic System

The beneficial effect of using a sign language on false belief tasks was clearly demonstrated here. In determining the impact of early exposure to a linguistic system, irrespective of modality, it therefore seems important to begin by distinguishing children according to whether they are signing children or nonsigning children, so that this effect will not be confounded with "early language exposure." However, this "early languge exposure" is necessarily confounded with other important factors of theory-of-mind development, such as the abilities on pretend play, the actual fluency, and so on, factors that in part depend on the age of exposure to language.

Not surprisingly, early exposure to language plays a highly important role in false belief attribution. The hearing children outperformed the oral deaf children, whereas the second-generation deaf signing children outperformed the signing children of hearing parents. The existence of early exposure effects and sign-language use effects is also confirmed here by the performance differences observed for combinations of these factors. Early exposure to a linguistic system in conjunction with use of a sign language was by far the most favorable situation, as shown by the differences between the deaf-parent deaf signing children and the hearing-parent deaf oral children. Second-generation deaf children consistently outperformed oral deaf children.

Moreover, the consequences of the lack of early language exposure apparently can be partially countered by exposure to a sign language, as suggested by the finding that the hearing children's performance was not significantly different from that of the deaf signing children born to hearing parents. Thus, while early exposure to a linguistic system appears to have a particularly strong impact on the development of theories of mind, relatively late exposure to a sign language may lead to faster catch-up in this regard than exposure to a solely oral language. For the time being, however, we still do not know whether signing affects the deaf child of hearing parents at the representational level per se (as seems to be the case for second-generation deaf children), or at other levels such as pretend play, communication abilities, and so on.

Significantly, even signing deaf children of hearing parents seem to develop only weak representational skills for performing false belief attribution tasks. Although these deaf signing children as a whole could not be differentiated statistically from the hearing children, there was a clear-cut difference in age, since the signing deaf children, as a whole group, were more than two years older than the hearing children (7;4 vs. 5;1 years, respectively). In addition, the 8-year-old deaf children did not get better scores than the 5-year-old hearing children. For the oral children, deaf children age 8 were comparable to hearing children age 4. The impor-

tance of early communication is blatant here, and late exposure to signs only changes a few things. These results are comparable to the main findings obtained so far in past studies (Peterson & Siegal, 1995, 1996; Remmel et al., 1998; Russell et al., 1998; Steeds et al., 1997) suggesting that, as a whole, the children in those studies no doubt lacked early communication even if one cannot say they lacked a theory of mind (cf. Mitchell, 1994). False-belief tasks are not the only paradigm available for assessing theories-of-mind development, and it may be that researchers need to improve their testing skills. Furthermore, due to lack of information about some parents, the signing deaf children of hearing parents here have not been separated according the fluency of both child and his or her parents. This separation could be fruitful in determining the role of sign language versus language on success for false belief tasks.

Some alternative explanations of the findings reported here have to be addressed. For example, I, of course, was not unaware of the working hypotheses and, having tested all signing children (from both deaf and hearing parents), I could have unintentionally helped these children by a way of signing nearer the correct place or some other method. However, if testing through spoken language provides fewer visual cues than sign language does, one should not forget eye-gaze, which could also be inadvertently used by any experimenter in such tasks.[6] More important, it should be noted, against this idea of unwitting help from the experimenter, that the task of unexpected content, for which no help could even have been provided, was not more difficult than that of unexpected changes (indeed it even seemed to be easier to all children).

Another problem could arise from the fact that oral deaf children have been tested by someone else in my presence. That is, they were tested in the presence of two adults, whereas other children were tested in the presence of only one adult (the hearing experimenter or me). There is of course no way to know if this can have had any effect on oral deaf children's performances; further research may be needed for determining this point.

In conclusion, this study confirms the preliminary results obtained by Courtin and Melot (1998), which allow us to contend that second-generation deaf children have effective representational capacities for tasks involving the attribution of false beliefs. Although the performance of these deaf children was even higher than that of the hearing children, it would not be wise to claim that cognitive processes are better in native deaf signing children than in hearing children. The cognitive processes of deaf and hearing children are probably fundamentally the same; they may "simply" be optimized by the linguistic variable (Courtin, 1997).

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Notes

1. Note that the term "understand" and not "master" is used here, implying that what is at stake is the age at which children are able to *understand* these features, not necessarily when they are able to correctly *use* them.

2. It should be noted that, in France, there is a general trend for schools in the north of the country to be turned toward oral politic of education, whereas in the south schools tend to favor sign language or total communication politic of education. For this reason, except for few important cities where both politics can be found, as in Paris, the general choice of oralism versus signing is not dependant on socioeconomical status of the parents but on geographic situation.

3. Classical studies show that hearing children succeed in false belief attribution tasks at approximately the age of 5. This is why hearing children older than age six were not tested here since it was assumed they would correctly pass the test. Thus, their ages do not exactly match those of the deaf children. Given that the goal of this study was to determine the age at which deaf children succeed in these tasks, 5- to 8-year-olds were tested.

4. It should be clear that it is impossible to say that these discarded children have failed the false-belief task as a theory-of-mind assessment. Using a strict methodology of passation (not the case for all authors, e.g., Steeds et al., 1997, who do not take into account these responses to control questions), there can be assessment only if these control questions are passed. The failure on control question tells us that children missed a piece of information when answering, due to communication difficulties, memory weakness, temporary attentional disturbance, or something else (it is impossible to determine clearly the source of this missing). There is no way to be sure that the failure is due to any theory-of-mind difficulty.

5. The number of subjects per hearing status group and, within each status, the size of each age group were never the same. Because of this, the unit of measure used for the figures was the percentage of children who succeeded on at least two out of three tasks. As such, the figures no longer exactly correspond to the data upon which the comparisons were made. They should therefore be taken as rough indications and should always be considered relative to the total number of subjects in each group, presented in Table 1.

6. The experimenters who worked with oral deaf children were not unaware of the expected results. But, on an ecological ground, it should be added that these experimenters were *de facto* surely not "sign language advocates." They should have been much more prone to favor oral children instead of the working hypotheses. I thus maintain that I fully trust their work as a neutral one and thank them for having helped me.

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