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The Role of Age and Oral Lexical Competence in False Belief Understanding by Children and Adolescents With Hearing Loss

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In the past decade, most studies have reported that children who are deaf and hard of hearing who have parents with typical hearing experience a serious delay in the understanding of false belief. False belief understanding consists of the ability to infer that someone else believes that something is true when one knows it to be wrong. This ability has been considered a reference point in studying the development of theory of mind (ToM). The main aim of this work is to evaluate the relationship between age, oral language and understanding of false belief in subjects who are deaf and hard of hearing. We investigated the relationship between age and ToM when the maximum age of participants included in the study was increased to 19 years. We also studied the relationship between the oral linguistic level of the participants and their performance in ToM. The sample consisted of 54 participants who are deaf and hard of hearing (ages 6 to 19 years) and who come from families with typical hearing. The results show that only from age 14 years onward is there a high percentage of success in the resolution of false belief tasks. Besides age, the level of oral lexical competence

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is a variable that can help to explain the differences in ToM performance among individuals with hearing loss.

Introduction

The ability to understand that other people have mental states such as beliefs, intentions, memories and desires that may differ from one's own is known as theory of mind (ToM) (Premack & Woodruff, 1978). How and when children acquire the ability to think about and take account of others' mental states, as well as their own, is a topic of much interest to developmental psychologists. It is easy to see why: The ability influences almost every aspect of human social behavior. To be a good conversationalist, to participate appropriately in a full range of social relationships and to reason intelligently about behavior, an individual must know something about others, how they are similar to and different from oneself, what they are likely to know and how they are likely to behave in various circumstances. ToM enables people to make sense of and predict others' behavior; as such, its development is an important key to social, commmunicative and affective life.

There is no doubt that the main indicator of the development of ToM is the understanding of false belief: people's ability to infer that someone else believes that something is true when they themselves know it to be wrong. In the false belief paradigm, a story is told in which the protagonist is deceived by the situation and holds a false belief regarding an object's whereabouts. The evaluated children have to respond to questions about what the main character would do in the face of his or her false beliefs. Wimmer and Perner (1983) were the first to design this task within this paradigm. This task later was adapted by Baron-Cohen, Leslie and Frith (1985) and became the classic false belief task. Specifically, the task is as follows: A female puppet (Sally) hides a marble in a basket and leaves the scene. While she is gone, the other female puppet (Anne) shifts the marble to a covered box. Sally returns, and the child taking the test is asked, "Where will Sally look for her marble?" (correct answer: basket) followed by two control questions: "Where is the marble really?" and "Where did Sally put the marble in the beginning?" to make sure both that the child has taken note of the marble's new location and that he or she is able to recall the original hiding place.

This ability is used to attribute false beliefs to others in a great variety of everyday situations. For example, after arriving home without warning, Juan knows that Maria thinks he is still at work; or Arturo, after eating his sister Lucia's sweets, knows that when she looks at the box of sweets she will think that it is full and be angry when she finds it empty.

There is an almost unanimous consensus that children with typical development reach this ability around the age of 4 ½ (Gopnik & Astington, 1988; Perner, Leekam & Wimmer, 1987; Wellman, Cross & Watson, 2001; Wimmer & Perner, 1983). However, in certain conditions of task presentation, correct

performances are observed in younger children when resolving classic false belief tasks (Yazdi, German, Defeyter, & Siegal, 2005). In addition to this observation, other abilities associated with understanding false belief, such as attributing to a person the disposition to carry out an action and predicting his or her behavior, also can be observed in even younger children, including those 13 ½ months old (Song, Baillargeon, & Fisher, 2005).

From a theoretical sociocultural viewpoint, social experience and the development of language together are indispensable factors for the development of ToM (Garfield, Peterson, & Perry, 2001). Within this perspective, three types of work can be differentiated. The first type focuses on the daily interactions of children in the home by describing activities and conversations (between adults and children and between peers) that stimulate the development of ToM (Brown, Donelan-McCall, & Dunn, 1996; Dunn, 1994, 1999). The second type shows the relationships between the language used by adults when telling stories and playing with their children and the development of ToM in the children (Astington & Baird, 2005; de Rosnay, Pons, Harris, & Morrell, 2004; Ruffman, Perner, & Parkin, 1999; Ruffman, Slade, & Crowe, 2002). The third type focuses on the relationship between child linguistic development and the development of ToM (Astington & Jenkins, 1999; De Villiers & Pyers, 2002; Happé, 1995; Ziatas, Durkin, & Pratt, 1998).

The first research into the third type was done by Happé (1995), who found that the verbal age of children, as measured by a receptive vocabulary test, is predictive of success in false belief tasks in both children with autism and children with typical development, and that this effect is independent of chronological age. Recent research has provided more specific data concerning the relationships between language and ToM. Ziatas et al. (1998) found a relationship between the understanding of false belief and the use of mental terms (thinking, knowing and guessing) in children with autism, children with Asperger syndrome, children with specific language impairments and children with typical development. Astington and Jenkins (1999) carried out a longitudinal study and verified the effect of early linguistic development (lexicon and syntax) on the development of ToM. De Villiers and Pyers (2002) established a relationship between children's proficiency in the syntax of complementation and their performance in false belief tasks. They argued that the child needs the full syntax of mental verbs plus sentential complements in order to represent in his or her own mind the belief states of other people, not simply to report about them in speech.

Slade and Ruffman (2005) examined the effect of semantic and syntactic development separately in the development of ToM in preschool children. The authors concluded that ToM has more to do with general linguistic ability than syntax or semantics, and that this ability contains both semantic and syntactic components. However, they acknowledged that receptive vocabulary tests, such as the British Picture Vocabulary Scale (BPVS) or Peabody

Picture Vocabulary Test (PPVT), usually correlate with ToM and found that semantic measures correlate highly with those of syntax and age.

The study of the development of ToM in children who are deaf and hard of hearing has been carried out in tandem with the works cited. In their pioneering study, Peterson and Siegal (1995) reported that a very low percentage of children between the ages of 8 and 13 who are deaf and hard of hearing succeeded in the classic false belief task from Baron-Cohen et al. (1985) described earlier. This low performance was attributed to a deficit in ToM, resulting from the lack of access to communication between adults with typical hearing and children who are deaf and hard of hearing in the home (conversational hypothesis). The concept of deficit was endorsed by the lack of significant differences between the age of the group of children who succeeded in the false belief task and the age of the group who did not succeed.

Later studies did not find any relationship between the age of children who are deaf and hard of hearing and their performance on ToM tasks (Courtin, 2000; Courtin & Melot, 1998; Woolfe, Want, & Siegal, 2002). All of these studies share the fact that their samples were made up of children younger than 8 years old with hearing loss, which led to the idea that it would be necessary to evaluate older children with hearing loss for age to be a predicting variable. The research of Russell et al. (1998), using a sample of participants up to 16 years old who are deaf and hard of hearing, helps to clarify this point, as they found that improvements in false belief understanding begin from the age of 13 onward.

Subsequently, Peterson and Siegal (1999) found correlations between age and success in false belief tasks with a wider sample of children who are deaf and hard of hearing than in their first study. These data led them to switch from their concept of deficit to delay. Another key contribution by Peterson and Siegal (1999) was the introduction of the variable "linguistic development." The authors found a correlation between the linguistic ability of children who are deaf and hard of hearing who have parents with typical hearing and their success in false belief tasks. Nevertheless, it is necessary to point out that the role of language is relative because, when its effect is parcelled out, the differences in ToM performance observed between children with hearing loss whose parents have hearing loss and use sign language (native signers) and children with hearing loss whose parents have typical hearing (non-native signers) continue to be significant.

The conclusions reached by Woolfe et al. (2002) are very similar to those of Peterson and Siegal (1999). When two groups of children who are deaf and hard of hearing and who have similar "signing" age are compared, native signers still present better performance. In this study, as in others (Courtin, 2000; Jackson, 2001; Peterson, Wellman, & Liu, 2005; Woolfe et al., 2002), children with hearing loss who were native signers did not have difficulties in solving false beliefs tasks. These results led the authors to support the

conversational hypothesis that Peterson and Siegal (1995) had already formulated.

De Villiers and de Villiers (2000) based their work on deafness and ToM on a linguistic rather than a conversational hypothesis. Starting from the hypothesis that children with hearing loss who use spoken language have limited language, their vocabulary and syntax at the age of 4 are still insufficient to refer to others' beliefs. These authors evaluated the understanding of false belief using, besides classic tasks, a task that they called "less verbal." This task is basically a version of the unexpected content concept, but rather than verbally reporting what someone thinks is in the box, the child must predict whether a character is surprised or not when he sees the unusual content, choosing the right facial expression. Their results showed that the utterance of complex sentences, including verbs referring to cognitive states, predicted the performance of children who are deaf and hard of hearing in their sample in verbal and "less verbal" false belief tasks and that this relation was maintained even when the effect of age was parcelled out. However, the authors did not find any correlation between children's verbal age, measured with the Peabody Picture Vocabulary Test–Revised (PPVT-R) and their performance in false belief tasks.

Jackson's study (2001) provided data that supported the hypothesis of de Villiers and de Villiers (2000). To evaluate the linguistic level of native and non-native signing children who are deaf and hard of hearing, she used the British Sign Language receptive skills test of Herman, Holmes and Woll (1999). The receptive linguistic level of children with hearing loss who use spoken language was assessed with the BPVS. These results showed a positive correlation between language and ToM, which was maintained for children with hearing loss who either were non-native signers or who used spoken language, even when the effect of age was parcelled out. Jackson indicated, in line with de Villiers and de Villiers (2000), that properties specific to language are required for ToM development over and above experiences related to age and neurological maturation.

The study by Pyers (2005) also supports this thesis. In a study of Nicaraguan adolescents and adults who are deaf and hard of hearing, the variable associated with false belief understanding was the lexical and syntactic development of their sign language, more than age and experience combined. Pyers (2005) defended the view that language is key to the uniquely human capacity to represent the thoughts and belief of others; without adequate language, humans fail to acquire a mature ToM.

In summary, the main findings of our review are as follows:

1. Most children with hearing loss who are non-native signers present very low performance in false belief understanding.
2. When the participants are under 13 years old, few studies found correlations between age and performance in false belief tasks.

3. There is a relationship between the dominance of sign language and the understanding of false belief in children who are deaf and hard of hearing who use sign language and also between oral linguistic development and the understanding of false belief in children with hearing loss who use spoken language.

The first of these conclusions is widely supported by empirical studies, but little work has been done on the second and third.

In addition, most available studies include children up to the age of 10; a few deal with older children up to 13 years old and, on rare occasions, up to 16 years old. However, as already pointed out, only with a wide age range can any significant relationship between age and ToM be found. Furthermore, we found just one study that included a sample of Spanish participants who were deaf and hard of hearing (Figueras-Costa & Harris, 2001); however, the ToM assessment was conducted using a nonverbal version of standard false belief tasks.

The main aim of our study was to evaluate the relationship between age, language and understanding of false belief in participants with hearing loss who learned sign language at a later age. We investigated the relationship between age and ToM when the age of participants includes individuals up to 19 years old and the relationship between the linguistic level of the participants and their performance in ToM.

Methods

Participants

The original sample consisted of 61 participants. Seven participants were excluded because of low IQ or difficulties in understanding ToM tasks (see Assessment), so the final sample consisted of 54 participants. The participants' ages ranged from 6 to 19 years; 27 were between 6 and 13 years old (mean age 9.9) and the remaining 27 were between 14 and 19 years (mean age 16.3). All of the children had parents with typical hearing, most of whom used the oral modality with their children. The participants attended a school for children who are deaf and hard of hearing with an oral approach in Málaga (Spain). These children acquired sign language at a later stage through contact with peer children at school. Around 81.5% began to attend a special school when they were older than 4 years of age. Of these, 27.3% began when they were older than 7 years of age, having previously been educated in ordinary oralist state schools. All of the subjects presented prespeech deafness with losses of 70 dB or more in their better ear (38.9% severe losses and 61.1% profound losses), and none had a cochlear implant. Of the participants,

50% were male and 50% were female; 50% had a low sociocultural level, 43.1% an average level and only 6.9% a high one.

Assessment

All participants were evaluated with the Leiter International Performance Scale–Revised (Leiter-R) for nonverbal intelligence (Roid & Miller, 1997) to verify that they did not have associated intellectual deficiencies. Four participants were excluded from the original sample because they scored lower than 70 (mental deficiency according to Leiter-R). Furthermore, all the participants were evaluated in the following variables:

1. Oral Lexical Competence: This was evaluated through the Test de Vocabulario en Imágenes Peabody (TVIP), the Hispanic-American adaptation by Dunn, Padilla, Lugo and Dunn (1986) of PPTV-R by Dunn and Dunn (1981). The PPTV-R already has been used in some studies dealing with the oral language–ToM relationship in people who are deaf and hard of hearing, for example, in de Villiers and de Villiers (2000). This test was chosen for several reasons: Its application fit the age range of our sample; it was easy and fast to administer and to correct; and it provided the verbal age of subjects. The test assesses the level of oral receptive vocabulary of subjects by having participants identify words through lip-reading and then point to the drawing from a set of four that corresponds to the target word. Words were articulated correctly and clearly to ensure recognition via lip-reading.
2. Theory of Mind: Two classic false belief tasks were used. They were narrated in sign language (because all the study participants preferred this modality), and each sequence was acted out. To ascertain whether, in addition to attributing a false belief to others, participants understood what motivates it, we introduced a justification question to the classic experimental question.
   2.1. *Change of Location* ("marble task" of Baron-Cohen et al., 1985). The task was adapted by including a character of each sex to facilitate the participants' identification with the characters in the story (as in Peterson & Siegal, 1995). In this way, the participants could resort to the signs for *boy* or *girl* if they forgot a character's name. The Spanish names Paco and María also were substituted. In brief, the procedure consisted of two trials, each involving two puppets. In the first trial, a puppet, María, hides a marble in a basket and leaves the scene. While she is gone, the other puppet, Paco, shifts the marble to a covered box. María returns, and the child taking the test is asked, "Where will María look for her marble?" (correct answer: basket) and "Why?" followed by two control questions: "Where is

the marble really?" and "Where did María put the marble in the beginning?"

2.2. *Unexpected Contents Task* ("Smarties task" of Hogrefe, Wimmer, & Perner, 1986). Following the modification introduced by Gopnik and Astington (1988), we used different container-material pairs to prevent children from communicating information about recipients and contents to each other. Each participant was presented with just one container-material pair. All containers used had clear pictures of the expected contents and were familiar to the children. In brief, the task involved a misleadingly familiar sweets container (Smarties) that actually held pencils. The participants were shown a container and asked what they thought was inside. All participants replied "Smarties", "chocolates" or "sweets." They were then shown that the container really contained pencils. Then, the participants were asked what a naive classmate would say on first seeing the closed container and why, followed by two control questions: "What was really in the container?" and "What did you first think was in the container?"

In each story the participants replied to two experimental questions: The first one (attribution question) helped evaluate whether the participants attributed a false belief to the character; the second (justification question) helped verify whether participants understood why the character had such a false belief. As in Perner et al. (1987), we introduced a series of control questions to ensure that the participants understood and recalled the essential aspects of the story. Only the participants who replied correctly to the control questions were entered into the sample. Three participants (age 6) were excluded from the original sample because they failed the control questions.

Taking into account the two tasks and the two experimental questions per task, each participant could attain one of the following overall scores:

0: He/she did not answer any of the questions correctly.
1: He/she replied correctly to the attribution question in one task but did not justify it correctly.
2: He/she replied correctly to the two questions in one task.
3: He/she replied correctly to the two questions in the two tasks.

There were no cases in which the two tasks were successfully done and only one of them was correctly justified. The scores are shown in Table 1.

The tests were administered as follows: Leiter-R in the first session and TVIP and ToM tasks in the second. All the tasks were administered by the researchers, with the assistance of an interpreter in sign language for ToM tasks.

Table 1. Distribution of ToM Scores Across All Subjects

	ToM			
	0	*1*	*2*	*3*
N	10	6	6	32
%	18.5	11.1	11.1	59.3

Results

Before analyzing the relationships between age, language and ToM performance in the children and adolescents with hearing loss in this study, we tested whether other variables specific to the sample (sex, level of hearing loss and sociocultural level) had an effect on their performance in false belief tasks. To this end, we carried out a one-way analysis of variance (univariate), taking as the dependent variable the ToM score, and as the independent variable each of the cited variables. Upon comparing the groups of participants defined by these variables, we found no significant differences in ToM scores: sex, $F(1,52) = 0.030$, p = ns; level of hearing loss, $F(1,52) = 0.023$, p = ns; and sociocultural level, $F(2,51) = 0.917$, p = ns. Therefore, we considered it unnecessary to control for the effect of sex, hearing loss level, or sociocultural level of the participants in subsequent analyses.

To analyze the effects of the variables "age" and "oral linguistic level" on ToM, we carried out a 3 × 2 (age groups × oral level groups) univariate analysis of variance. For the variable "age", participants were divided into three groups: young (age range 6–10, mean age 8.6), middle (age range 11–13, mean age 12) and old (age range 14–19, mean age 16.3). This age choice was based on the fact that most studies included participants whose age was up to 10 years old, that only one study included those age 16 (finding improvement from the age of 13 onward) and that no studies included participants over age 16. We obtained oral linguistic level by converting the direct scores into equivalent ages provided by TVIP. In light of the low scores obtained by participants in oral linguistic level, we assigned them to two groups: 4 years old or younger and older than 4 years old.

Of the two factors included in the model (age and oral linguistic level), the groups defined by the variable age, $F(2,48) = 5.83$, Mean Squared Error (MSE) = 4.03, $p = 0.005$, and by the variable oral linguistic level, $F(1,48) = 12.16$, MSE = 8.41, $p = 0.001$, had significantly different scores in ToM. There was no significant interaction between age and oral linguistic level, $F(2,48) = 2.43$, MSE = 1.68, $p = 0.09$.

Multiple comparisons with the Games-Howell post-hoc tests ($p < 0.05$) were carried out to help us learn in more detail whether there were significant differences in ToM between the three age groups. Data regarding the age

Table 2. ToM Performance According to Age

		Theory of Mind (ToM)					
Age	*N*	*0*	*1*	*2*	*3*	*Mean*	*S.D.*
6–10 years	14	8 (57.2)	3 (21.4)	0 (0)	3 (21.4)	0.86	1.231
11–13 years	13	1 (7.7)	3 (23)	4 (30.8)	5 (38.5)	2	1.000
14–19 years	27	1 (3.7)	0 (0)	2 (7.4)	24 (88.9)	2.81	0.62

Note. Percentage in parentheses.

factor revealed significant differences in ToM scores among all the age groups, and the differences were always in favor of the older group. The descriptive data above provide more detail on these differences.

As can be seen in Table 2, the participants usually did not succeed in either of the tasks up to 10 years of age. Between the ages of 11 and 13, most participants (69.3%) succeeded in and correctly justified one or two of the tasks. From the age of 14, the vast majority of participants (88.9%) attained the highest scores. The mean scores in ToM increased in relation to age. Furthermore, the most heterogeneous group regarding the mean is the one with a younger chronological age (6-10 years).

To provide further details regarding the effect of oral linguistic level on ToM, we grouped the descriptive data of the participants' performance in ToM presented as a function of their oral linguistic level.

As can be seen in Table 3, more than half the participants with an oral linguistic level equivalent to 4 years old or younger (57.5%) did not reach the highest score, whereas the majority of children with oral linguistic levels above age 4 (85.7%) reached the highest score. The mean scores in ToM increased in relation to the linguistic age of the participants, and the most heterogeneous group regarding the mean was the one with a low oral age.

Also provided is descriptive data on the participants' performance in ToM grouped as a function of their age and oral linguistic level.

As seen in Figure 1, the participants with a higher oral linguistic level performed better in ToM than did those with a lower level, independently of whether they belong to the young, middle or older group. This difference in

Table 3. ToM Performance According to Oral Level

		Theory of Mind (ToM)					
Oral Level	*N*	*0*	*1*	*2*	*3*	*Mean*	*S.D.*
≤4 years	33	10 (30.3)	5 (15.1)	4 (12.1)	14 (42.5)	1.67	1.315
>4 years	21	0 (0)	1 (4.8)	2 (9.5)	18 (85.7)	2.81	0.112

Note. Percentage in parentheses.

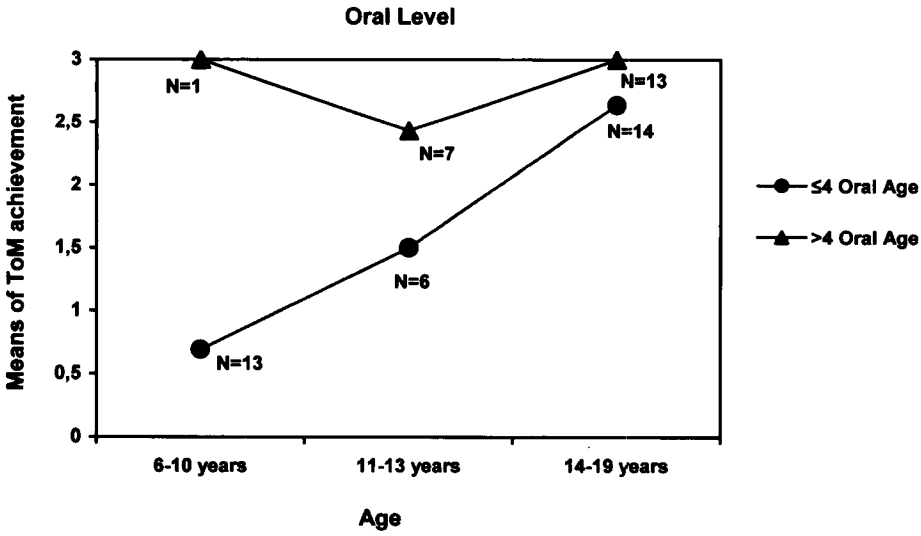

Figure 1. *Note.* ToM = Theory of Mind

ToM performance is very pronounced in the young group and decreases in the middle and older groups; the figure shows only a small difference between scores in ToM between those with higher and lower oral levels among the older group.

Discussion

The first aim of our study was to test whether the relationship between age and ToM identified by most authors changes when the age of the subjects studied is expanded to include those up to the age of 19. The first observation of interest is that the percentage of participants attaining maximum performance was high (59%) compared with other studies; for example, in studies by Peterson and Siegal (1998, 1999), with a sample of 5- to 12-year-old participants, the percentage solving false belief tasks did not reach 50%; in the research by Russell et al. (1998), with participants ranging from 4 to 16 years old, only 28% were successful in the task. This difference seems due to the fact that the age range of our sample was expanded, thereby increasing the percentage of participants who succeeded in the tasks.

Another finding of interest is that 22% of the participants showed a certain ability to understand false belief even if they did not attain maximum performance (those obtaining intermediate scores of 1 or 2). Moreover, our data indicate that succeeding in the two tasks before the age of 11 was infrequent, whereas intermediate scores abounded among 11- and 13-year-old children. This information is of note because the data can lead to the idea that the

understanding of false belief by participants who are deaf and hard of hearing can be progressive, instead of dichotomous (pass/fail) as was considered conventionally. It seems that, first, the attribution is made, then the participant reflects on it and justifies it accordingly, and finally, the ability is generalized to different situations.

This partial understanding of false belief observed in some participants led to further consideration of research on this issue.

First, it is possible that, before the conceptual change taking place that enables full development of ToM, defended by Wellman et al. (2001), children who are deaf and hard of hearing may pass through a prior transitional period in the same way as children with typical hearing. The children who are deaf and hard of hearing in the sample who scored a 1 (those carrying out false belief attributions in a task but not managing to explain their attributions) may be in this transitional period.

Second, there seems to be a sequence of steps in ToM evolution in preschoolers who are developing typically that is also observed in subjects who are deaf and hard of hearing, albeit at older ages than among children with typical hearing (Peterson et al., 2005). This sequence evolves from understanding diverse desires to understanding hidden emotions. Other achievements occur between these two steps, such as understanding diverse belief, knowledge access and false belief. Our data suggest that if there are general stages in ToM, there could also be a specific sequence in the understanding of false belief. Within the setting of this sequence, before attributing false beliefs in a general and justified way, some children who are deaf and hard of hearing manage to attribute false belief correctly in some of the tasks without apparent prior analysis or make attributions and offer justifications in one task but not in others.

Regarding the age at which better performance in ToM is found, by the age of 14, the participants in the sample who were deaf and hard of hearing reached a level of performance similar to that of children 4 to 6 years old with typical hearing; 88% of the participants between 14 and 19 years old reached the maximum scores. In fact, all participants older than 16 reached the maximum scores. In this regard, our data confirm the findings of Russell et al. (1998) who reported participants improving their performance in ToM from the age of 13 onwards. It is unclear what competencies might be present in older children who are deaf and hard of hearing that facilitate their development of a mature ToM. Up to the age of 14, communicative experiences with their families, peers and teachers, aided by their own linguistic development, probably have contributed to achieving this development in ToM. This observation leads to the idea that it may be possible to accelerate the development of ToM.

The other aim of this study was to test whether the level of oral lexical competence had an effect on ToM performance among the participants. The results show that oral linguistic age is a significant variable in explaining the

variance in participants' ToM performance. In this regard, the data are consistent with those of Happé (1995), who reported that oral linguistic age (as measured with the PPVT) correlated with performance in ToM in a sample of autistic children and children who are developing typically. The data also agree with those of Jackson (2001), who found positive correlations in children with hearing loss who use spoken language between ToM and linguistic age measured through receptive vocabulary (BPVS). However, the data do not match those of de Villiers and de Villiers (2000), who did not report a significant relationship between the oral linguistic age of children who are deaf and hard of hearing (using PPVT-R) and the understanding of false belief. A reason for this discrepancy might be found in the age of the participants from their sample (4 to 9 years old), who were younger than those in the current study and represent a more limited age range. It is likely that, at these ages, there is not enough variability in the oral linguistic level of participants to explain the variance in the performance of false belief tasks.

It has to be pointed out that because we are dealing with children and adolescents who are deaf and hard of hearing but who live in families with typical hearing, it seems that the experiences suited to stimulating the development of ToM are provided by the oral modality most widely used in the communicative exchanges. In this study, the differences in ToM performance related to the oral linguistic level of the participants were significant when participants with a linguistic age of 4 or younger were compared to those older than 4. As indicated in the introduction, children with typical hearing achieve false belief understanding at 4 ½ years old; thus, it is not surprising that better ToM performance was found in the participants in this study who were deaf and hard of hearing when their oral lexical competence was higher than 4 years. We think that reaching a linguistic age higher than 4 years old in TVIP involves wider linguistic abilities than simple lexical understanding. Other authors share this assumption; Ruffman, Slade, Rowlandson, Rumsey and Garnham (2003), when analyzing the relationship between the measures in receptive vocabulary and ToM, pointed out the possibility that these measures of lexical development also reflect syntactic development. Happé (1995) considered that the verbal age obtained with the PPVT can represent a measure of general ability. It seems that these abilities facilitate the understanding of false belief, since they make possible communication and social interaction and provide the necessary representation tools.

Therefore, chronological age—involving a personal history of social experiences—and level of oral lexical competence are variables that explain the differences in ToM performance in participants who are deaf and hard of hearing. These data confirm the idea that the delay in ToM traditionally attributed to the population who are deaf and hard of hearing arises from the following fact: The communicative experiences and the language development necessary for the development of ToM converge at a later age in children who are deaf and hard of hearing than in children with typical hearing.

This conclusion agrees with that of de Rosnay et al. (2004), who stated that children with better linguistic development can include and incorporate information about mental states from communicative experiences better than can those who are at an earlier stage of language development.

In light of the practical importance of a functional ToM as a social tool facilitating communication and social interaction with others, children who are deaf and hard of hearing are likely to face communication problems in everyday social situations, in addition to those stemming from difficulties with speech and language (Russell et al., 1998). This fact indicates the importance of a suitable intevention. In contrast to younger children, for whom early linguistic intervention could ensure a typical development of ToM, it seems that intervention in older children—in particular, the study participants who, even at age 15, still had not reached false belief understanding—should be based on situations that simulate the ordinary interaction contexts in which the development of ToM occurs (e.g., solving conflicts or understanding other peoples' intentions, desires and feelings).

Finally, other variables, such as the quality of the interaction in the family, social experience and sign linguistic development, should be taken into account to complete the analysis of the factors accounting for inter-individual differences in the development of ToM in people who are deaf and hard of hearing. It would be of interest to study the development of ToM in people who are deaf and hard of hearing beyond false belief understanding in contexts such as attributing complex communicative intentions like irony, lying or hiding emotions.

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