Journal of Deaf Studies and Deaf Education, 2019, 1–10

doi:10.1093/deafed/enz001
Empirical Manuscript

EMPIRICAL MANUSCRIPT

The Understanding of Communicative Intentions in Children with Severe-to-Profound Hearing Loss

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Abstract

The ability to distinguish lies from sincere false statements requires understanding a speaker's communicative intentions and is argued to develop through linguistic interaction. We tested whether this ability was delayed in 26 children with severe-to-profound hearing loss who, based on vocabulary size, were thought to have relatively limited access to linguistic exchanges compared to typically hearing peers ($n = 93$). Children were presented with toy bears who either lied or made a false statement sincerely. Despite identifying speakers' knowledge/ignorance, deaf or hard of hearing (DHH) children were delayed in identifying lies and sincere false statements when matched for chronological age. When matched for receptive vocabulary, observed discrepancies diminished. Deaf children who experienced early access to conversations with their deaf parents demonstrated no delay. Findings suggest limited access to linguistic exchanges delays the development of a key pragmatic skill.

When engaging in a conversation with another person, we frequently make inferences about the communicative intentions behind their utterances. Pragmatics is concerned with understanding language in its social context (Matthews, 2014). Pragmatic skills are increasingly recognized as essential for children's social wellbeing (e.g., Murphy, Faulkner, & Farley, 2014) motivating research to better understand their developmental basis (O'Neill, 2014). One important pragmatic skill is the ability to process a false statement by distinguishing whether it was a lie or a statement made in good faith (i.e., a mistake). If a speaker produces a statement that we know to be false, interpreting this speech act depends on gauging the speaker's knowledge state (their knowledge/ignorance of the false nature of the statement) and inferring whether or not the communicative intention was to deceive. The current study explores the development of this ability in typically hearing and deaf or hard of hearing (DHH) children with varying levels of language abilities.

The Relationship between Pragmatic Reasoning and Mental State Understanding

To infer a person has made a false statement in good faith we need to understand: (a) their knowledge state (i.e., their ignorance of the true state of affairs); and (b) their intention in making the statement (i.e., that it was sincere, and not intended to deceive). Conversely, to infer a person has told a lie we need to understand: (a) their knowledge state (i.e., their knowledge of the true state of affairs); and (b) their intention in making the statement (i.e., to create a false belief in the mind of their communicative partner—to deceive them). We first review the literature pertinent to the first step (understanding the knowledge/ignorance states of others) before considering the second (understanding their communicative intentions), which is the focus of this study.

Received June 6, 2018; revisions received January 20, 2019; editorial decision January 23, 2019; accepted January 31, 2019

Understanding of Beliefs in Typically Hearing and DHH Children

It is well established that typically hearing children's understanding of beliefs undergoes rapid development in the preschool years (for an overview see Apperly, 2010). However, less is known about what drives this development. One prominent hypothesis is that early conversational interaction with caregivers is critical (e.g., Astington & Baird, 2005, p. 9). Research into the developmental outcomes of DHH children supports the conversational-interaction hypothesis. Depending on factors that affect access to conversation (e.g., parents' fluency in sign, early cochlear implantation), DHH children can experience anything from good to very limited access to conversations in the early years. While it is often the case that parental hearing status predicts performance of DHH children on social-cognitive tasks (with DHH parents who are native signers finding it easier to interact conversationally with their DHH children), it is important to make clear that the underlying explanation for this lies with the communicative experiences that parents can offer their young children rather than parents' hearing status itself.

Regardless of whether their language environment is spoken or signed, DHH children who have had limited access to conversation early in life tend to be significantly delayed in Theory of Mind development (Courtin & Melot, 2005; Figueras-Costa & Harris, 2001; Holmer, Heimann, & Rudner, 2016; Jones, Gutierrez, & Ludlow, 2015; Ketelaar, Rieffe, Wiefferink, & Frijns, 2012; Lederberg, Schick, & Spencer, 2013; Morgan & Kegl, 2006; Peterson & Siegal, 1995, 1999, 2000; Peterson, Wellman, & Liu, 2005; Russell et al., 1998; Schick, de Villiers, de Villiers, & Hoffmeister, 2007; Tomasuolo, Valeri, Di Renzo, Pasqualetti, & Volterra, 2013; Ziv, Most, & Cohen, 2013). In contrast, DHH children who experience unimpeded access to early interaction generally demonstrate appropriate language (Schick, 2003) and Theory of Mind development (Courtin & Melot, 2005; Courtin, 2000; Meristo et al., 2007; Woolfe, Want, & Siegal, 2002). While most evidence regarding positive outcomes stems from DHH children who are native signers, there is emerging evidence that early cochlear implantation mitigates the risk of delayed Theory of Mind development (Remmel & Peters; 2008; Sundqvist, Lyxell, Jönsson, & Heimann, 2014). However, although increasing early access to hearing technologies such as cochlear implants means the prevalence and extent of Theory of Mind delays is changing, continued delays are reported for DHH children with poor language skills (Macaulay & Ford, 2006).

This evidence supports the hypothesis that early access to conversational interactions plays a crucial role in development (Astington & Baird, 2005; Hughes, 2011; Meristo, Strid, & Hjelmquist, 2016; Moeller & Schick, 2006; Vaccari & Marschark, 1997). Early access to conversation is likely important for several reasons. The need to co-ordinate attention to make conversation successful emphasizes that others have different perspectives (e.g., Astington & Baird, 2005; Morisseau, Davies, & Matthews, 2013). Even without explicitly discussing mental states, differences in perspective become clear through misunderstandings and unexpected utterances, and striving to reconcile these could promote the ability to understand the mental states of others. Furthermore, during conversation, parents sometimes explicitly talk about abstract concepts including mental states such as beliefs, thoughts, feelings, and intentions. Such terms form approximately 5% of typically hearing 19- to 28-month-olds' early conversational input, yet are scarcely found in the spoken input to DHH children (Morgan et al., 2014).

Given the observed risk of delay in Theory of Mind development in DHH children, and the underlying risk of reduced access to conversation, it is plausible that pragmatic skills which build on developing Theory of Mind and interactional experience would also be at risk. Indeed, there is evidence of pragmatic delay in DHH children's early development.

Pragmatic Development in DHH Children

Dammeyer (2012) studied three DHH children with cochlear implants longitudinally and found that despite improvements in speech production and comprehension over time, pragmatic skills like turn taking, responding and repairing, remained areas of pronounced difficulty (see also Rinaldi, Baruffaldi, Burdo, & Caselli, 2013). Jeanes, Nienhuys, and Rickards (2000) also report difficulty with managing conversational breakdowns through the use of clarification requests. Furthermore, using Prutting and Kirchner's (1987) pragmatic protocol, Most, Shina-August, and Meilijson (2010) found that DHH children (using spoken language only) with cochlear implants, showed reduced pragmatic ability at around 7 years of age in comparison to their typically hearing peers. Such delays could be due to (a) delayed "formal" language acquisition having an impact on pragmatic abilities; (b) less exposure to a wide variety of pragmatic behaviors and communication strategies, thus fewer opportunities for incidental learning about the appropriate use of behaviors and strategies; and/or (c) difficulties in understanding the complex mental states and perspectives of others in the context of social interaction.

One aspect of pragmatic competence that should be particularly impaired, if mental state understanding is affected, is the understanding of nonliteral language including jokes, deception, and irony. Hearing parents of young DHH adults report specific problems with their children's understanding of nonliteral speech (see Gregory, Bishop, & Sheldon, 1995, for jokes & sarcasm). Two more recent studies reported by O'Reilly, Peterson, and Wellman (2014) confirm this, with sarcasm being delayed into adulthood. Tasks assessing the comprehension of sarcasm require understanding that a speaker/signer thought their addressee would know they were not being literal (i.e., second-order Theory of Mind) and understanding the ironist's attitude in producing the statement (Filippova, 2014; Filippova & Astington, 2008). This represents advanced understand of nonliteral language use. It remains unclear whether DHH children would also experience delays in their understanding of more basic speech acts including the ability to understand deception.

The understanding that a false statement is either an intentional lie or an innocent mistake emerges between 3 and 5 years of age for typically hearing children depending on task demands (Siegal & Peterson, 1996, 1998; Taylor, Lussier, & Maring, 2003), and is known to relate to the development of first-order Theory of Mind (Bosco & Gabbatore, 2017). Siegal and Peterson (1996) developed an engaging task that most typically hearing 3-, 4-, and 5-year-olds are able to pass. Children were shown some contaminated food (moldy bread) and two teddy bears, only one of whom could see the mold. An experimenter concealed the mold with Vegemite (an Australian breakfast spread), again while only one bear was watching and then both bears made false statements to a third party that the contaminated food was acceptable to eat. Children were asked two questions: (a) Did each bear know about the mold? and (b) Did each bear lie or make a mistake? The former question assessed if children were aware of each bear's knowledge/ignorance about the status of the bread. The latter gauged whether children could infer if the speaker's communicative intention was to deceive or not. Of course, in reality the bears have neither mental states nor vision; however, in Siegal and Peterson (1996), most 3- to 5-year-olds attributed these qualities to the toys spontaneously.

The Present Study

The aim of the present study was to investigate whether DHH children with reduced language development would be delayed in their ability to draw pragmatic inferences about the communicative intentions behind false statements. The present study was an extension of Siegal and Peterson (1996) using the same methods but with different groups of children. As the aim was to determine if children could use their understanding of each bears' knowledge state to infer the intentions behind the bears' subsequent false statements, the knowledge state questions were used as control rather than test questions. That is, understanding the knowledge state of each bear was considered a prerequisite for assessing understanding of communicative intentions.

We first tested a large group of typically hearing children to assess ability over a wide age range and to facilitate matching to DHH children. We then compared the performance of a group of 26 DHH children to the typically hearing children, first matching for age and then for language level. These children (DHH Group 1) were being raised to learn spoken English by hearing parents and were tested at school (where English was also their primary language, with some sign supported English [SSE] and Total Communication [TC]). Based on their delayed vocabulary development, our assumption was that these children were very likely to have had somewhat restricted access to conversational interaction as young children. Our research questions were therefore (a) Whether DHH children would be delayed in understanding the intention to deceive when chronologically age matched with typically hearing peers? and (b) Whether any delays would remain when children were matched on language age? Based on the Theory of Mind literature, we predicted that typically hearing children would be able to distinguish a lie from a mistake by 7 years of age and that DHH Group 1 would be significantly delayed in this understanding. We also predicted that matching by language age would diminish the difference between groups as language ability can be seen as a proxy measure for conversational experience (Schick et al., 2007).

Finally, we also tested a smaller group of DHH children whose first language was British Sign Language (BSL). These children (DHH Group 2) each had two fluent signing deaf parents and used BSL as their primary language at school. We assumed that DHH Group 2 would have had good access to communication in early childhood, although this was not tested and given the small sample size, the related analyses are exploratory in nature. Our final research question was therefore: (c) Whether these native signing children would differ from their typically hearing peers on task performance? We predicted that they would not show a delay. It is important to note that this hypothesis was based on assumed access to conversation based on teacher-reported family circumstances. Not all deaf parents use a signed language with their deaf children. Stuckless and Birch (1997) report from questionnaires on the use of manual communication, that 5 out of 71 deaf parents of deaf children in their sample did not use a signed language (see also Mitchiner, 2015). In cases of poor access to communication (in whatever modality), it is likely there would be delay. That is, we predict that it is access to conversation that affects pragmatic development, not the hearing status of parents or mode of communication per se.

Method

Participants

For pragmatic reasons (i.e., time and resource restrictions), participants were recruited using convenience sampling, from schools within relatively close proximity to the research team. Fourteen schools in the United Kingdom were invited to take part in the present study, with 13 schools accepting and 1 mainstream school declining participation as they did not wish for children to be withdrawn from teaching. The 13 schools who took part were composed of 2 preschools, 2 mainstream schools, 1 University Summer Programme, 6 mainstream schools with an integrated resource facility for DHH children, and 2 specialist schools for DHH children. Two of the mainstream schools with an integrated resource facility for DHH children and 1 of the specialist schools for DHH children had taken part in previous research with the same experimenter. The ages targeted were within the ranges reported in the original Siegal and Peterson (1996) study on the development of understanding of lies and mistakes, and in previous Theory of Mind related research on DHH children with a range of language learning backgrounds. Ninety-three typically hearing children and 36 DHH children (26 children in DHH Group 1 and 10 children in DHH Group 2) were included in this study. A further seven children were excluded because they either failed at least one control question (one child in DHH Group 1 aged 5;3 and 3 typically hearing children aged 3;9, 4;4, and 5;7) or they had a language age below 3 years and might not have understood the test questions (three children in DHH Group 1 aged 5;6, 8;11, and 10;3 with language ages of 2;11, 2;11, and 2;10, respectively). The control questions and methods to establish language age are described in detail in the next section. All children had informed parental consent to participate. None of the DHH children were reported to have a developmental disorder.

The 93 typically hearing children (54 girls and 39 boys) were aged between 3;0 and 11;7 (mean = 6;9). They attended either a preschool, mainstream school, the University Summer Programme or a mainstream school with an integrated resource facility for DHH children. None of the typically hearing children were reported to have a developmental disorder, hearing loss, or language delay. The 26 children in DHH Group 1 (10 girls and 16 boys) were aged between 6;6 and 11;7 (mean = 9;7) and the 10 children in DHH Group 2 (5 girls and 5 boys) were aged between 4;8 and 11;5 (mean = 8;4). The DHH children had severe (from 65 dB) to profound (over 90 dB) bilateral hearing losses. In DHH Group 1, deafness was congenital for 25 children and was diagnosed at 18 months for the remaining one child. In this group, 11 children wore bilateral hearing aids, 4 children had bilateral cochlear implants, 4 had unilateral cochlear implants, and 7 had 1 cochlear implant and 1 hearing aid. Age at implantation ranged between 1;6 and 8;2 (mean = 4;5). For all children in DHH Group 2, deafness was congenital and all children had two deaf parents, with 7 having at least one deaf sibling. These children were fluent BSL users. All wore bilateral hearing aids except for one child who did not use any individual amplification systems due to the severity of his hearing loss.

Schools used various modes of communication: spoken English, SSE, TC, and BSL. Deaf or hard of hearing Group 2 used BSL in school, while DHH Group 1 used either English only or English with some SSE and/or TC. Before testing, schools advised the experimenter what each child's primary mode of communication was at school and home, which was used for testing. All children in DHH Group 1 were tested using spoken English by the first author. All children in DHH Group 2 were tested in BSL by a classroom assistant fluent in BSL in the presence of the first author (whose BSL was sufficient to check the procedure was followed appropriately). Further details can be found in Table 1.

Materials

The British Picture Vocabulary Scale ll (BPVS II; Dunn, Dunn, Whetton, & Burley, 1997) was used to test the receptive spoken English vocabulary of the children in DHH Group 1. Following Siegal & Peterson (1996) three teddy bears, moldy bread, and jam were used for the lies/mistakes test.

Procedure

Each child was tested individually in one session lasting approximately 20 min wearing their usual hearing technologies (this was confirmed with either their teacher or classroom assistant). All children participated in the lies/mistakes test with children in DHH Group 1 tested in English and children in DHH Group 2 tested in BSL by a fluent signer, as described previously. The children in DHH Group 2 were not assessed on language since we did not have access to a standardised test of signed vocabulary. The children in DHH Group 1 were tested on the BPVS II and the lies/mistakes test with the order of tests alternating across participants. For the lies/mistakes test, all children were seated at a table alongside the experimenter. Following the original methodology, the experimenter described the task saying/signing "I am going to tell you a story about 3 teddy bears and then I will ask you a few questions. Is that OK?" All children consented to continue. The children were then asked to watch/listen carefully to the story. Following this, the experimenter introduced Ben the bear who had his back turned to both experimenter and child and was reading a book whilst also listening to music through headphones. It was emphasized that Ben could not see or hear the experimenter or the child because he was turned away reading and listening to music. This ruled out the possibility that the child might believe Ben could somehow witness the scenario. A second bear (of a different color) was then introduced as Tom and was placed in front of both child and experimenter as an onlooker. To ensure the child knew that this bear could see and hear events, the experimenter stated, "Tom is watching what we're doing. He can see and hear us."

Following the introduction of the bears, the experimenter presented a moldy piece of bread into the story stating, "Here is a moldy old piece of bread! Is it OK to eat or not OK to eat?" Following the child's response (which was in all cases that it was not OK), the experimenter said, "Let's put some jam over the mold so we can't see it. Let's hide the mold." The experimenter then stated, "Now, before I go on with the story do you think one of these bears is naughty or not naughty?" Children were asked this question to determine if they had any preconceptions about either bear. If a child replied that neither bear was naughty, the experimenter continued with the story. If a child said, "yes, one is naughty," they were then asked, "Which one is naughty?" If they chose one of the bears, they were then asked, "why?" For all groups most children said/signed neither bear was naughty in equal numbers.

The experimenter continued by saying/signing, "Now, let's get back to the story" and introduced a third teddy bear. "This is a friend who is hungry and would like to eat the bread, he asks if the bread is OK to eat." Pointing to the bear with his back turned (the uninformed bear) the experimenter stated, "Ben did not see the mold on the bread." The child was then asked a control question, "Does Ben know about the mold?" Following the child's response, the experimenter continued, "Ok, so Ben did not see the mold on the bread. He said that it is OK to eat the bread." The child was then asked the test question, "Did Ben lie or make a mistake?" Pointing to the onlooker bear the experimenter then stated, "Tom did see the mold on the bread, he was watching us." The child was then asked a second control question, "Does Tom know about the mold?" Following the child's response the experimenter continued by saying "Ok, so Tom did see the mold on the bread. He said that it is OK to eat the bread." This was followed by the test question, "Did Tom lie or make a mistake?" The control and test questions were counterbalanced for order across participants and the lie and mistake target responses were alternated across participants (i.e., for half of the trials the experimenter asked "did [bear's name] lie or make a mistake?" whereas for the other she asked "did [bear's name] make a mistake or lie?"). The experimenter then asked a final test question by pointing between Ben and Tom

Table 1 Schools' communication methods and children's primary mode of communication

School type	Schools' methods of communication	Children's primary mode of communication	DHH G1 (*n*)	DHH G2 (*n*)
Specialist Facility (*n* = 3)	Spoken English (oral/aural approach only)	Spoken English Only	5	NA[a]
Specialist Facility (*n* = 3)	SSE, BSL and spoken English, where appropriate (child centered approach to communication). Aim is to support development of speech and language	Spoken English Only	3	0
		Spoken English (+SSE)	5	0
		BSL	0	3
		Bilingual	0	3
Specialist School (*n* = 1)	TC, SSE and BSL, offering a child centered approach to communication	Spoken English (+TC)	2	0
		BSL (+some TC)	0	1
		Bilingual	0	1
Specialist School (*n* = 1)	SSE, BSL and spoken English, where appropriate (child centered approach to communication)	Spoken English (+some SSE)	11	0
		BSL	0	2

Note: Modes of communication reported in brackets = children's secondary mode of communication. DHH G1 = deaf or hard of hearing children Group 1. DHH G2 = deaf or hard of hearing children Group 2. Bilingual = BSL and spoken English.
[a]No DHH children in Group 2 attended these schools.

and saying "Do you think one of these bears is naughty?" If a child said yes, they were then asked "Which one is naughty?" If the child selected the bear they thought was naughty, they were then asked "Why?"

There were various ways we checked if children followed the experiment. We used the BPVS II to check whether children were able to understand the language used in the test scenario. Only children who had a language age of 3 years and above were included in analyses. The control questions are considered a prerequisite for making a pragmatic inference about the speaker's communicative intention (to deceive or not), which is assessed by the lie/mistake test questions. Consequently, children who failed the question "does X know about the mold?" were not included in the analysis. By asking additional test questions about whether either of the bears were naughty, we checked that failure to answer test questions was not because of language. The word "naughty" is a higher frequency word in British child directed speech than the terms "lie" or "mistake" as verified by a corpus search using the Manchester Corpus available on CHILDES (MacWhinney, 2000; Theakston, Lieven, Pine, & Rowland, 2001).

Coding

Children's responses to all questions were scored live by the experimenter (the first author). Responses to all test questions by all children in both groups were scored as correct or incorrect. Questions in BSL required only a YES/NO answer and so the same experimenter scored these. Responses to the final test question, "Do you think one of these bears is naughty?" were coded as correct if the child said yes and selected the onlooker bear in answer to the follow-up question, "Which one is naughty?" Responses were coded as incorrect if the child stated that yes one was naughty and selected the uninformed bear in answer to the follow-up question, or if the child stated that neither bear was naughty. Justifications as to why either bear was naughty were coded as correct if the child: (a) had identified the onlooker bear in the naughty test question; and (b) explained that the onlooker bear told a lie or had stated that the bread was OK to eat even though it was not. Incorrect justifications included children stating that the uninformed bear was the naughty bear because he wasn't looking and/or he was listening to music. If children gave no justification, even if they correctly identified the onlooker bear in the naughty test question, justification was coded as incorrect for the purposes of analysis. Finally, an overall score out of 4 was calculated for each child, with 1 point for each test question answered correctly (this included the justification question).

We were unable to carry out intercoder reliability because during data collection schools did not allow recording of the testing. However, children gave binary responses (i.e., saying either lie or mistake) and there was very little room for qualitative explanation from the children. This meant there was no need for the coder to interpret responses (i.e., it was clear whether the child thought there was a lie, or a mistake). Furthermore, the experimenter followed a script for questions. In order for other researchers to replicate our methodology, the script and original dataset is deposited in the University of Sheffield's open access Online Research Data (ORDA) repository. Please contact C. Kelly for details: ciara.kelly@sheffield.ac.uk.

Results

We first consider the performance of the typically hearing children. We then compare this with DHH Group 1 when chronologically age matched and when matched according to language age. Finally, we consider the performance of the smaller DHH Group 2.

Typically hearing children's performance on each test question increased with chronological age and was at ceiling by 7 years of age (see Figure 1). Three logistic regression analyses confirmed that chronological age significantly predicted children's performance on the mistake test question ($\chi^2(1) = 16.23$, $p < .001$. Nagelkerke's $R^2 = .280$), the lie test question ($\chi^2(1) = 20.99$, $p < .001$. Nagelkerke's $R^2 = .364$), and the naughty test question ($\chi^2(1) = 34.31$, $p < .001$. Nagelkerke's $R^2 = .464$). Each child's language age equivalent was derived from their raw scores on the BPVS II. Language age and chronological age were positively correlated, $r = .92$, $p < .001$.

Each child in DHH Group 1 was matched with a typically hearing child of the same chronological age (in years and months). Details of this matching are given in Table 2. When matched for chronological age, DHH Group 1 had a significantly lower language

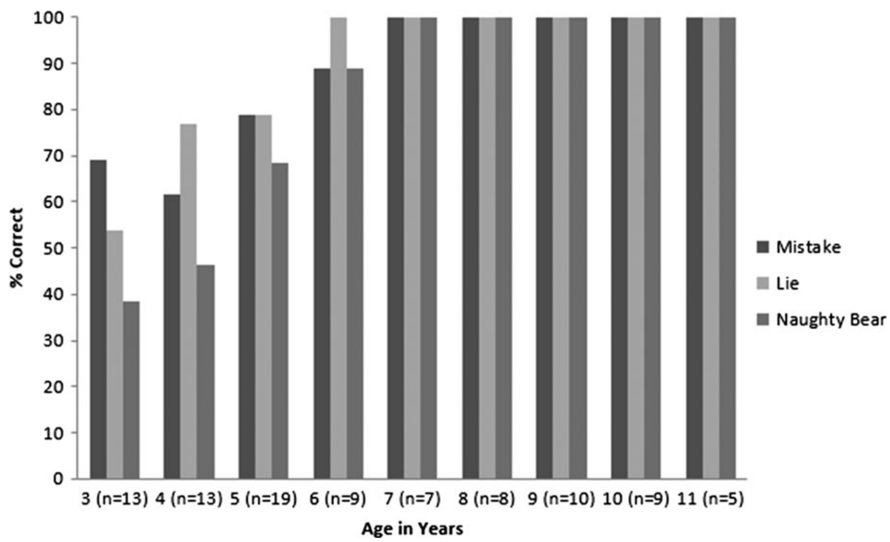

Figure 1 Percentage of typically hearing children correctly identifying the mistake, the lie, and the naughty bear as a function of chronological age.

Table 2 Chronological Age Matching of Participants

	Typically hearing group	DHH Group 1
n	26	26
Mean chronological age (SD)	9 years, 7 months (1 year, 3 months)	9 years, 7 months (1 year, 4 months)
Mean language age equivalent (SD)	10 years, 4 months (1 year, 11 months)	5 years, 11 months (1 year, 8 months)
Chronological age range	6 years, 6 months—11 years, 7 months	6 years, 6 months—11 years, 7 months
Language age equivalent range	7 years, 3 months—15 years, 4 months	3 years, 0 months—9 years, 11 months

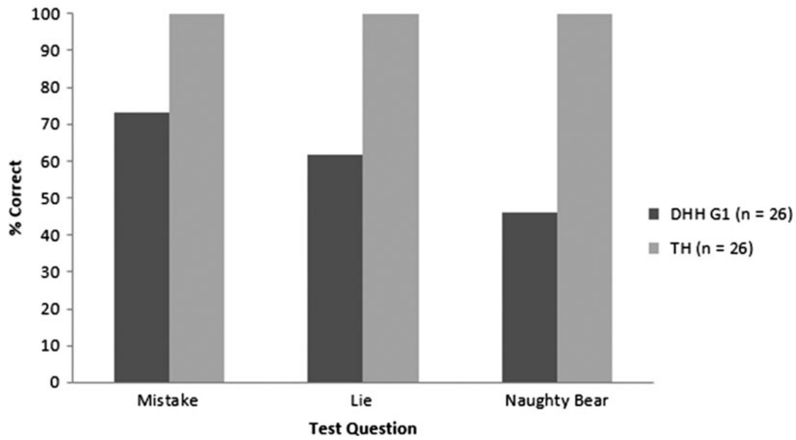

Figure 2 Percentage of children in each group correctly identifying the mistake, the lie, and the naughty bear when chronologically age matched. DHH G1 = deaf or hard of hearing children in Group 1. TH = typically hearing children.

Table 3 Language Age Matching of Participants

	Typically hearing group	DHH Group 1
n	26	26
Mean language age equivalent (SD)	5 years, 11 months (1 year, 7 months)	5 years, 11 months (1 year, 8 months)
Mean chronological age (SD)	5 years, 5 months (1 year, 10 months)	9 years, 7 months (1 year, 4 months)
Language age equivalent range	3 years, 3 months—9 years, 11 months	3 years, 0 months—9 years, 11 months
Chronological age range	3 years, 0 months—9 years, 10 months	6 years, 6 months—11 years, 7 months

age (M = 5.95 years, SD = 1.72 years) than the typically hearing group (M = 10.25 years, SD = 1.98 years), $t(50) = 8.35$, $p < .001$.

Figure 2 illustrates the percentage of children correctly answering the test questions as a function of hearing status. Chi-square analyses for each test question revealed a significant association between hearing status and pass rates for the mistake ($\chi^2(1) = 8.09$, $p < .001$), the lie ($\chi^2(1) = 12.38$, $p < .001$), and the naughty bear posttest questions ($\chi^2(1) = 19.16$, $p < .001$). Likewise, when comparing children's total score out of 4, typically hearing children performed significantly better (M = 4.00, SD = 0.00) than DHH Group 1 (M = 2.15, SD = 1.46), $t(25) = 6.44$, $p < .001$.

To test whether language ability could account for differences in ability to detect lies and mistakes, each child in DHH Group 1 was matched with a typically hearing child with the same language age (in years and months) derived from the BPVS II (see Table 3).

Figure 3 illustrates the percentage of children correctly answering the test questions as a function of hearing status. When matched according to language age, Chi-square analyses revealed that there were no significant differences in ability to correctly respond to any of the test questions. Furthermore, a t-test on children's total score out of 4 revealed that the typically hearing group's scores (M = 2.77, SD = 1.63) and the DHH Group 1's scores (M = 2.15, SD = 1.46) were not significantly different, $t(50) = 1.43$, $p = .158$ ($d = 0.40$).

Figure 4 shows the percentage of correct responses for the 10 children in DHH Group 2 and a group of 10 typically hearing children who were chronologically age matched. As can be seen, the children in DHH Group 2 follow a numerically identical pattern of results as the typically hearing group.

Discussion

The present study investigated whether DHH children would be delayed in the ability to distinguish a lie from a mistake. The typically hearing children in the current study reached ceiling on a test of this ability by 7 years of age, in line with previous studies (Siegal & Peterson, 1996). We assumed DHH Group 1 would have had somewhat limited access to linguistic exchanges than their typically hearing peers, based on the fact that they had hearing parents and had delayed receptive vocabulary in their first language (English). Children in DHH Group 1 had substantial difficulty with the lies/mistakes task when compared with typically hearing children of the same chronological age. This group difference was diminished when children were

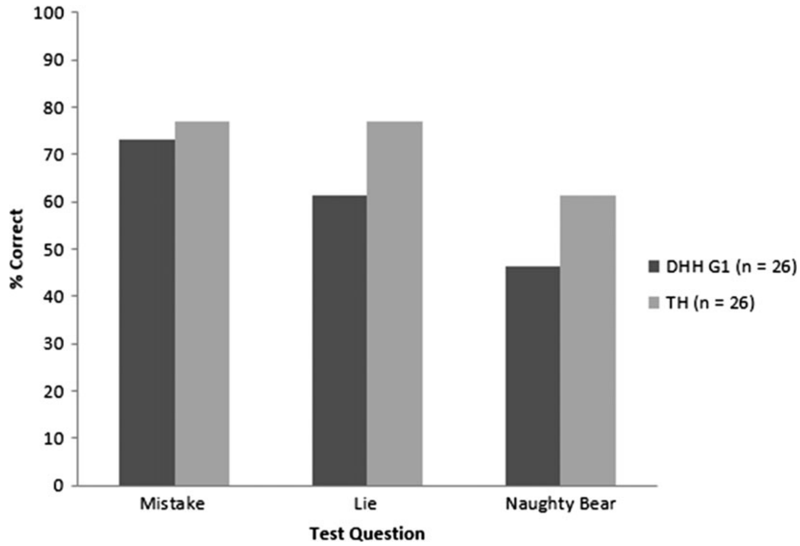

Figure 3 Percentage of children in each group correctly identifying the mistake, the lie, and the naughty bear when language age matched. DHH G1 = deaf or hard of hearing children in Group 1. TH = typically hearing children.

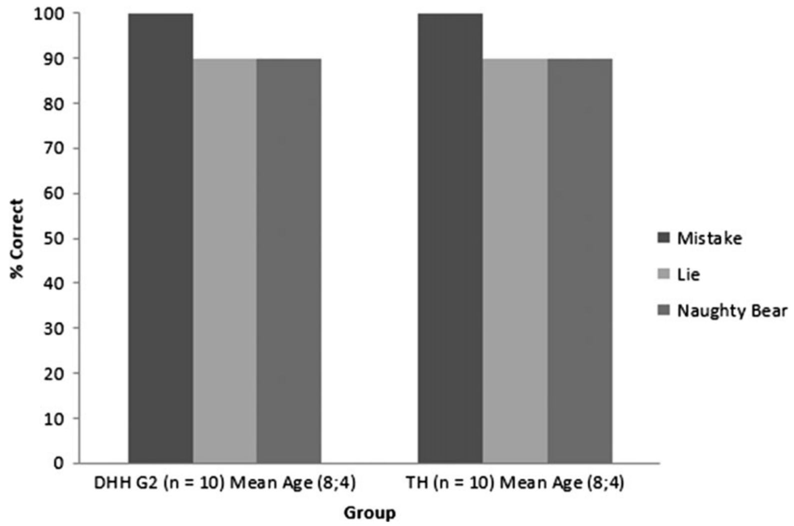

Figure 4 Percentage of children in each group correctly identifying the mistake, the lie, and the naughty bear. DHH G2 = deaf or hard of hearing children in Group 2; TH = typically hearing children.

matched by language age. There are two possible interpretations for this set of results.

The first possibility is that the DHH children in Group 1 had difficulty understanding the lexical items specific to the test questions (i.e., the words “lie,” & “mistake”). On this account, children cannot label the misdemeanors they observe even though they understand the communicative intentions. We were careful to exclude any children with a language age below 3 years for whom a verbal test may not be appropriate. We also included an additional question about which bear was “naughty” (a high frequency word in British English) to diminish reliance on the terms “lie” and “mistake.” However, DHH children in Group 1 were still delayed in their understanding of how lies and mistakes differ. Future studies might consider training children in the understanding of the term “naughty” in a different domain (i.e., a misdemeanor that does not involve mental states). One could then be more confident that the lexical item had been understood and any incorrect responses were specific to understanding communicative intentions.

We argue a more likely interpretation of the results is that the DHH children in Group 1 had a genuine delay in pragmatic development. Although children were aware of which bear was knowledgeable, they were less able to take the extra step of reasoning about his communicative intentions (i.e., that he was being deliberately deceptive). The most likely explanation for this pragmatic delay would be limited access to conversations involving similar real-world scenarios compared to the typically hearing children (Jeanes et al., 2000; Meristo et al., 2016; Most et al., 2010; Rinaldi et al., 2013). Conversational experience could be effective in three specific ways. First, it could promote the understanding that interlocutors have contrasting perspectives and motives. Second, conversation could provide incidental exposure to lies and mistakes. Third, conversation could include explicit metalinguistic talk about lying (or being mistaken) and the intentions behind it (Morgan et al., 2014).

When the DHH children in Group 1 were matched for receptive vocabulary with typically hearing children, the observed discrepancy between groups disappeared. Children's scores on the vocabulary measure can be seen as a proxy measure for the richness of previous language exposure, albeit a crude one. Previous studies have consistently found that vocabulary comprehension is a predictor of false belief test performance in DHH and typically hearing children (e.g., Schick et al., 2007). The present study suggests the same is true for the ability to distinguish lies and mistakes. This is consistent with studies of pragmatic ability in typically and atypically developing children, where formal and pragmatic language skills are observed to be correlated (e.g., Matthews, Biney, & Abbot-Smith, 2018; Norbury, 2014). It is important to note that 11 of the 26 DHH children in Group 1 did not have cochlear implants, rather bilateral hearing aids. It stands to reason that this group could be particularly limited in terms of access to conversational interaction and their language acquisition. However, although cochlear implants offer increased access to sound, they do not necessarily ensure language abilities will be within normal limits (see Vlastarakos et al., 2010 for a metaanalytic review of infants with cochlear implants and their outcomes). Nor do cochlear implants ensure typical pragmatic development. Most et al. (2010) found no differences in pragmatic abilities between children with cochlear implants and children with hearing aids in childhood. In the current study, the majority of children who did have cochlear implants did not receive these early. It is possible that early implanted children may perform better on the task given their early increased access to language; however, findings from Rinaldi et al. (2013) suggest that even early implanted children have poor basic pragmatic skills in the first years of life. Therefore, we ran a *t*-test comparing children with hearing aids to children with cochlear implants on their language scores (BPVS II scores) and there was no significant difference ($t(24) = -0.01$, $p = .995$, means (SD) = 70.36 (10.86) and 70.40 (16.40), respectively).

It is interesting to note that only 1 DHH child failed at least one control question (who was excluded as a result but otherwise would have been included in Group 1) concerning each bear's knowledge state. These control questions required some social-cognitive skill, namely being aware that seeing leads to knowing and conversely not seeing results in ignorance (an ability that typically develops around 3 years of age; Hogrefe, Wimmer, & Perner, 1986; Pratt & Bryant, 1990). This emphasizes that more complex reasoning about others' communicative intentions does not follow as a matter of course (O'Reilly et al. 2014). That is, being aware of others' mental states and using this awareness to make inferences about communicative intentions are separable abilities.

A more detailed measure of children's communicative experiences with their parents would have provided a clearer profile of each group's access to conversational interaction. Future studies could ask parents via a questionnaire how often they communicate with their children about people's beliefs, intentions and speech acts such as jokes, mistakes, lies, and sarcasm. They could also ask about communication in the home more broadly (the modalities used and the parents' self-assessed fluency). The present study reported the signing skills of deaf parents (i.e., fluent BSL) but details of the children in DHH Group 1 were restricted to sign or oral and not if, and how often parents used SSE and/or TC.

In the present study, the DHH children in Group 2 were reported by teachers to have age-appropriate language. This would not necessarily be the case for all DHH children who use BSL as their first language. However, for the 10 children in this study, both parents were deaf, most had deaf siblings and all used BSL fluently at school, suggesting early access to a fluent language model. Although a small group, these children performed at the same level as typically hearing children of the same chronological age, suggesting that they might demonstrate a similar developmental trajectory to their typically hearing peers. However, the sample size was small and most children tested were over 7 years of age. A larger group of children covering a broader range of ages would, therefore, be necessary to draw strong conclusions about developmental trajectories.

The significant delays in pragmatic development present in the larger DHH group highlights that there is a substantial risk of communicative delays for DHH children who are delayed in their language abilities and likely experience somewhat limited access to language in the early years. Such delays can have negative consequences for real-world social wellbeing (Peterson, Slaughter, Moore, & Wellman, 2016). There is therefore a need to consider how best to support children's development. Although some research on supporting communication skills has been reported (Holzinger, Fellinger, & Beitel, 2011; Moeller, 2000; Rees *et al.* 2015; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998), the field would benefit from more evidence to inform practitioners about how to support DHH children's wider social-cognitive and pragmatic development.

In sum, mean scores for 26 DHH children indicated that they had experienced limited access to conversation (based on observed vocabulary delay). As a group, mean task scores also pointed to a delay in their ability to distinguish lies from mistakes. Delayed pragmatic development can have profound consequences for interactions with others and the current findings along with a growing body of longitudinal and experimental studies suggest that DHH children who, for various reasons, have reduced access to early conversational interaction would be particularly vulnerable to this. Future research should consider the viability of interventions to promote conversational interaction for DHH children and test whether such interventions are effective in promoting three areas of development: mental state understanding, formal language, and pragmatics.

Funding

The work of GM was funded by the Economic and Social Research Council (Grant 620-28-600 Deafness, Cognition and Language Research Centre). The work of CK was funded by a University of Sheffield Faculty of Science Scholarship and Funds for Women Graduates (Foundation Main Grant).

Conflicts of interest

No conflicts of interest were reported.

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