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Understanding of Pretend Emotions in Children who are Deaf and Hard of Hearing

Abstract

Children who are deaf and hard of hearing (DHH) and born to hearing parents have delays in their social-cognitive development and in particular in their Theory of Mind (ToM). These delays are often attributed to the difficulties they encounter in acquiring age-appropriate linguistic and communicative skills. The present study asks whether this developmental delay extends to problems with understanding pretend emotions and if linguistic difficulties are related to this area. A total of 173 children (82 DHH and 91 hearing) between 3 and 8 years of age received a set of emotion and language measures. Results showed that children who are DHH were delayed in understanding pretend emotions and this was strongly related to their difficulties with expressive vocabulary and pragmatics. In summary, children who are DHH and have experienced reduced access to language and communicative interaction have a restricted understanding of the communicative intentions of emotional expressions. These delays may have implications for their social relationships with surrounding family and other children.

Literature Review

Theory of Mind (ToM) describes a set of social-cognitive abilities used to predict and understand others' minds (Premack & Woodruff, 1978; Wellman, 2014). ToM is important as it enables people to function in complex human social networks and correlates with children's social skills in peer interactions (e.g., Peterson, Slaughter, Moore, & Wellman, 2016). The present study focuses on ToM and more specifically explores if children who are DHH are delayed in their understanding of pretend emotions (i.e. understanding that

emotions may be displayed for playful purposes and be outwardly different to inner reality). The previous literature would suggest emotion understanding is an area which could be at risk of such developmental delays in children who are DHH (Rieffe, 2012). The current study also investigated how language development is related to the understanding of pretend emotions in children who are DHH.

ToM and Emotion Understanding

ToM development occurs over several years and begins during the earliest meaningful social-communicative routines that lead to joint-attention during parent-child interaction in the first 12 months (Ninio & Bruner, 1978; Bruner, 1985). Evidence suggests that an implicit sensitivity to more complex mental states (such as understanding false beliefs and their emotional consequences) using non-verbal tasks can be detected in the second year of life (Onishi & Baillargeon, 2005; Baillargeon, Scott, & He, 2010; Scott, 2017). For example, Walle and Campos (2014) suggested that by 19 months infants may have an implicit understanding of pretend emotions.

However, the more difficult ability to explicitly reason about other people's cognitions (meta-representation) takes considerably longer to develop (Wellman, 2018). This has been documented as developing during the pre-school and middle childhood period (3-6 years - for reviews see: Flavell, 2004; Wellman, 2014). Within this later-acquired set of complex cognitions (such as the understanding of diverse desires, perceptual and perspectival understanding, or false belief understanding) is the ability to understand emotions. For instance, Wellman and Liu (2004) include emotion understanding on their ToM development scale.

Emotion understanding may have an impact on social relationships. For example, understanding of emotions has been linked to social acceptance or popularity, as it may

facilitate prosocial behaviour (e.g., cooperative play) and reduce antisocial behaviour (e.g., bullying) (Harris, de Rosnay, & Pons, 2016). Emotion understanding has been divided into nine different components, including the following: emotion recognition (e.g.., labelling facial emotions), understanding the causes of emotions (e.g. understanding how a child feels when receiving a gift), emotion regulation (e.g., stopping thinking about a threatening event), and understanding that emotions can be hidden (e.g. pretending you like a gift) (see Pons, Harris, & de Rosnay, 2004). Understanding hidden emotions implies an appreciation that internal feelings and external expression may differ. This has typically been studied using deception situations, and research suggests these tasks can be difficult for children before the age of six years (Harris, Donnelly, Guz, & Pitt-Watson, 1986). Children might hide emotions for reasons other than deceiving their observers. This is the case of pretend play situations, where children may express sadness for playful purposes while in reality they are feeling happy, for example. The current study focuses on this final aspect.

It has been argued that understanding pretend emotions is important as it is necessary for children to participate in pretend play contexts and to comprehend and predict other children's behaviour in these situations (for example, realizing that another child is not really sad when pretending to cry (Mizokawa, 2011; Sidera, Serrat, Rostan, & Sanz-Torrent, 2011). Furthermore, poor ToM skills have been suggested to impact negatively on learning activities that are mediated socially, such as reading comprehension (see Holmer, Heimann & Rudner, 2016), so pretend emotion understanding may have an impact beyond predicting people's behaviour.

Pretend Emotion Understanding

Peterson and Wellman (2009) suggest that the understanding of pretence reflects an appreciation of how other people understand mental states (i.e. desires, intentions and

beliefs). In this respect, how children develop their understanding of pretend emotions is important because it helps them identify reliable individuals and establish positive and trusting relationships with others (Saarni, Campos, Camras, & Witherington, 2006).

The literature suggests that the explicit understanding of pretend emotions (e.g., understanding that a child is crying because it is a part of a game and not because he or she is actually sad) is difficult before the age of 4 years, and develops between the ages of 4-6 years (Mizokawa, 2011; Peterson & Wellman, 2009). However, grasping the implications of pretend emotions for the beliefs of observers (people can be deceived about the real emotions of a pretender) continues to be difficult after the age of 6 (Sidera, Amadó, & Serrat, 2013). This developmental progression led us to conduct a comparison of three age groups in the present study. However previous studies evaluating hearing children's understanding of pretend emotions used narratives with pictures with a high linguistic load (Mizokawa, 2011; Sidera et al., 2013). This method is not appropriate for children who are DHH, as evaluations of ToM and emotion understanding require a technique with lower linguistic demands such as silent videos. Therefore, this is the method we will use in the present study.

Language and ToM in children with hearing loss

Much research in the development of ToM and related emotion understanding pinpoints the influence of language on these related concepts (Astington & Baird, 2005; Milligan, Astington, & Dack, 2007). For this reason the main focus of the current study is the understanding of pretend emotions among children who are DHH and how language development influences pretend emotion understanding. The role of audiological variables will not be considered as these are beyond the scope of the present research.

There are several emotions that can be studied in this area but sadness, anger and happiness are the first labels acquired by children (Widen & Russell 2003; Maassarani,

Gosselin, Montembeault, & Gagnon, 2014). In terms of understanding false emotion though, happiness was discarded because previous research showed that children have more difficulty differentiating internal from external feelings in pretend play situations where the protagonists were pretending to be happy while being in fact sad (see Sidera et al., 2011). The reason for this might be that children are reluctant to accept that others feel sad while pretending to be happy. On the contrary, children are more likely to accept that during play people who are pretending to be angry or sad are in fact happy.

While some children who are DHH develop language skills commensurate with their hearing peers, there are very large individual differences and variability in outcomes (Pisoni, Kronenberger, Harris & Moberly, 2018). Children who are DHH display delays in comparison to hearing children on different measures of language ability, including language comprehension, grammar, vocabulary and verb morphology (Chilosi et al., 2013; Geers, Nicholas, & Sedey, 2003; Laugen, Jacobsen, Rieffe, & Wichstrøm, 2016; Le Normand, Ouellet, & Cohen, 2003). Furthermore, development among children who are DHH is characterized by slower and more variable language trajectories (Geers, Nicholas, Tobey, & Davidson, 2016; Niparko et al., 2010). At the same time, many ToM studies conducted on this population have highlighted the link between ToM and language development (J. de Villiers, 2005; Morgan & Kegl, 2006). With the proposed link between ToM and language development, linguistic difficulties of children who are DHH may impact on their understanding of pretend emotions.

Indeed, a range of research studies have explored the difficulties that children who are DHH have with understanding emotions; for example, children who are DHH have a delay in recognizing emotions from facial expressions, but performance is strongly related to verbal ability (Dyck, Farrugia, Sochet, & Holmes-Brown, 2004; Sidera, Amadó, & Martínez, 2017). Dyck et al. (2004) used the Emotion Recognition Scales to measure emotion recognition and

understanding ability, and found that children and adolescents who were DHH, equalled or exceeded the performance of hearing peers when matched on verbal ability. This emphasised the links between skills in the linguistic and emotion understanding domains. Vocabulary (and especially words related to mental states e.g. 'think' and 'know') and grammar development have been found to correlate with the mastery of ToM understanding in hearing children (de Villiers & Pyers, 2002; Slade & Ruffman, 2005), and also in children who are DHH, even when using nonverbal ToM tasks (Levrez, Bourdin, Le Driant, d'Arc, & Vandromme, 2012). However, some authors have suggested that delays in ToM, including emotion understanding documented for children who are DHH, are not only due to formal aspects of language such as vocabulary, but also to delays in early communication abilities that grow out of social interactions and conversations (Peterson, Wellman, & Slaughter, 2012; Rieffe, 2012; Morgan et al., 2014; but see: Dyck et al., 2004). In Morgan et al. (2014), hearing parents of children who are DHH when describing still photos of individuals interacting used far fewer connected turns in conversations with their 24 month olds than matched hearing parents with hearing toddlers. The ability to engage in connected turns is linked to pragmatic development and it has been reported that many children who are DHH have difficulties with this component of language (see Toe, Paatsch, & Szarkowski, 2019). Furthermore, in Morgan et al. children who were DHH also experienced a more restricted number of explanations for mental states and emotions from their parents than hearing peers. In a related study, Gola (2012) used a video-based training methodology (with hearing children) to study the effect of the interactional style (overheard or interactive) of mental-state verbs presented in conversations. She found that children improved their false belief understanding even in situations where mental state utterances where not directed to them. Considering these results, she argued that the ToM difficulties of children who are DHH born to hearing parents could be linked to fewer opportunities to overhear conversations. Taken

together these previous studies suggest that some children who are DHH as well as having poorer linguistic development may experience restricted access to conversations or environments where social-emotional concepts are being discussed. One important issue here is that children who are DHH are extremely heterogeneous, and not all children who are DHH experience restricted access to these types of conversations (Schick, Marschark & Spencer; 2005).

Approximately 5% of children who are DHH are born to DHH parents and normally but not always communicate in a sign language from infancy onwards, thus becoming native signers. Apart from early access to language it is also plausible that parents who are deaf are able to link emotionally earlier with their deaf infants. The role of maternal sensitivity on ToM has been explored extensively in hearing children (Cutting & Dunn, 1999). Woolfe, Want and Siegal (2002) looked at the development of ToM by using a non-verbal measure of false-belief understanding. Using non-verbal materials meant all children who are DHH were able to access the task equally. Woolfe et al. (2002) showed that native signers passed tasks at the same age as hearing controls (between 4-5 years) and significantly earlier than children who are DHH with hearing parents. Such an advantage for native signers suggests that having successful early communication and full access to language can lead to successful ToM development. In the current study experimental stimuli were also non-verbal following the rationale for the Woolfe et al (2002) work.

While early access to language might be associated with ToM gains, some studies suggest that children who are DHH with a language level similar to that of hearing children still show ToM delays. For example, in the study by Netten et al. (2017), children with moderate hearing loss (MHL) demonstrated difficulties in some aspects of ToM despite being within the normal range on standardized tests of spoken language. Similarly, Ketelaar, Rieffe, Wiefferink and Frijns (2012) found that children who are DHH with CIs were delayed in

ToM even after controlling for verbal ability, and despite having received an implant before the age of 2 years on average. Ketelaar, et al, (2012) argued this delay was linked to the CI's reduced processing of background language interaction (overheard speech). In the current study all the children were educated orally and attended mainstream schools with hearing peers. There are very few studies of the impact of schooling environment on ToM development. However, Meristo et al. (2007) reported that children who were educated in mainstream schools where spoken language was used and often relied on lipreading had poorer performance on ToM tasks compared with their hearing peers and native signing children. Meristo et al (2007) argued that oral only communication decreased conversational exchanges about others' mental states. All of these studies support the view that it is not only language proficiency but also early communicative experiences that matter for the development of ToM.

Language and Pretend Emotions

One important social context where children learn about the use and function of pretend emotions is in their play situations e.g. role play or acting out fairy tales. There are no studies investigating whether children who are DHH are delayed in their understanding that emotions expressed in pretend play contexts are different from real emotions. However, this is a possibility, as children who are DHH born to hearing parents have been found to engage less in pretend play than hearing children (Spencer, Deyo, & Grindstaff, 1990). The pretend play of children who are DHH has also been documented to be less developed and less abstract (Brown, Rickards, & Bortoli, 2001). Furthermore, difficulties have been observed in children who are DHH's understanding of social pretence (Peterson & Wellman, 2009). Reduced access to conversation in the case of children who are DHH might mean they may struggle to realize that the mental states of people who share pretend play activities may

differ from those who do not (e.g., if two children pretend to paint a red toy car blue, a child who arrives later will not know what they are pretending). Another suggestion that pretend emotions will be difficult for them is that in general the pretend play of children who are DHH has been connected with their language levels (e.g., Augusto & Martínez de Antoñana, 1998). Although less studied than false belief, the capacity to understand pretend emotions correlates in hearing children with linguistic skills such as vocabulary and the syntax of complementation i.e. 'Sally thinks that the marble is in the basket' (Sidera, Serrat, & Amadó, 2014). Apart from formal aspects of language, pragmatics has also been proposed as important for ToM development (see Cardillo, Garcia, Mammarella, & Cornoldi, 2018). Whether language delays in children who are DHH are also connected to understanding pretend emotions is not yet clear and will be addressed in the current study.

In summary, children who are DHH show delays in a set of linked skills: language development, pretend play and ToM. It is not known if pretend emotion understanding is also at risk in children who are DHH and how language development is linked to children's development of this domain. Hence, in the present study the following questions were explored:

a) How do children who are DHH understand pretend emotions?

b) In what ways are expressive vocabulary and linguistic-communicative skills linked to this understanding?

Materials and Methods

Participants

The initial sample comprised 173 children (89 boys and 84 girls), made up of children who are DHH (n=82) and an age and non-verbal IQ (NVIQ) matched sample of hearing children

(n=91). The characteristics of this sample of 82 children who were DHH (38 girls and 44 boys) were: mean age = 72.09 months; *SD* = 17.63; range = 41 to 107 months. The 91 hearing children (46 girls and 45 boys) were matched for age and NVIQ: mean age: 72.74 months; *SD* = 18.86; range: 39 to 107 months. . The participants were divided into 3 age groups for comparison.

To discard the possibility that difficulty with pretend emotion understanding could be due to difficulties in recognizing facial emotions a control task was used. Children who did not recognise angry or sad faces in the emotion recognition task were not included in the study. Children who did not pass the pretend actions task were also excluded from the final sample (see Material section). This control task was introduced to ensure that the possible difficulties that children had with understanding pretend emotions were not due to a general difficulty with distinguishing pretence vs. reality.

After applying these criteria, the final sample consisted of 129 children (54 children who were DHH and 75 hearing children). In Table 1 the sample characteristics are described. Hearing and children who were DHH were compared for non-verbal cognitive ability and age, and no significant differences were found between the two groups either in the whole final sample or when considering the three age groups separately ($p > .05$ in all cases).

Insert Table 1 here

The hearing group was recruited from 4 different state schools in Catalonia (in North-East Spain). Three of these schools had children who are DHH among their student populations and so both groups had broadly similar social and educational experiences. Children who are DHH were recruited through the different speech and language therapy services that work in the schools. Only children whose parents gave written permission were given the tasks. No children were reported to have cognitive delays.

All children who are DHH had bilateral hearing loss and were educated in mainstream oral schools with the support of speech therapists and teachers specialized in audition and spoken language, as is the prevailing tradition in this area of Spain. Therefore, all children in the study were assessed in spoken language. Of the 54 children in the final DHH sample, 24 had a DHH relative (no data were obtained concerning this variable for 2 children because they were adopted). In 8 cases, one or both parents were deaf, but due to strict oral language interventions in this geographical area of Spain none of the children in the sample were reported to use Catalan Sign Language, which was verified during testing.

In the final sample, the mean age of hearing loss detection was 20.48 months (*SD* = 19.3; range = 0 to 75 months). The mean age of hearing loss onset was 0.3 years (*SD* = 0.91), ranging from birth to 4 years. A total of 44 were reported to have had hearing loss at birth or acquired hearing loss during their first year of life. Table 2 shows the sample characteristics in terms of audiological variables.

Insert Table 2 here

Material

A total of 5 experimental tasks were carried out with the children. Furthermore, two questionnaires were filled out by speech therapists for the DHH group, and by teachers for the hearing children. In order of administration, the tests were as follows:

1. Expressive verbal ability. The Naming vocabulary subscale of the British Ability Scales 2 (henceforth, BAS 2; Elliott, Smith, & McCulloch, 1996; Spanish version by Arribas & Corral, 2011) was used to measure children's expressive language. This task has norms for the age-range used in our study. Children are shown a series of individual drawings and asked to label them. For our analyses, Ability Scores from the test were used. These scores are a

transformation of the raw scores that considers the level of difficulty of the specific set of items responded to correctly by each child (see Elliott et al., 1996).

2. Pretend actions task. To ensure children understood the difference between pretence and reality a control task involving action was first used. This was an adaptation of the task used by Rosen, Schwebel, & Singer (1997), judged to be suitable for children who are DHH after extensive piloting. Before the task started there was a warm-up phase. The experimenter carried out 2 real actions and 2 pretend actions using the terms "real" ("de veritat", in Catalan) and "pretend" ("de mentida", in Catalan). After each action, the children were asked whether the action was real or pretend, and were given corrective feedback.

After the warm-up, a test of real versus pretend actions was carried out. Four videos were used. In 2 of them, a girl performed real actions (combing her hair or eating a banana). In the other two videos, the same girl performed the same actions in a pretend way (combing her hair without a comb or eating a toy banana). The order of presentation of the videos was counterbalanced in a Latin-square design. After watching each of the videos, participants were asked the test question: "*Is the girl really combing her hair or is she just pretending to comb her hair?" or "Is the girl really eating a banana or is she just pretending to eat a banana?"* One point was given for each correct answer, meaning the score in this task ranged from 0-4. Children who responded correctly to at least 75 % of the videos (3 or 4 points) were included in the final sample, whereas children with a lower score (0, 1 or 2) were excluded.

3. Emotion recognition task. A test of facial emotion recognition was included as a control task to ensure that both hearing and children who are DHH recognized the facial emotions involved in the Pretend emotions task (anger and sadness) at the same level. This task was based on the Test of Emotion Comprehension (Pons & Harris, 2000) and had six standard drawings of a girl representing the basic emotions (happy, sad, scared, angry,

surprised and disgusted). The drawings were placed on a table in front of the children in two lines and the experimenter labelled each of the emotions (a Latin-square design was used which counterbalances the order of presentation of the different emotions). The children were asked to point to the correct facial expression after the question "*Could you point to the girl looking happy, etc."* After each question, the experimenter said "Okay", and asked for the label of the following drawing. The task included six different emotions but, for the purposes of the present study, only scores for sad and angry were used. Children were judged as giving a correct response if they pointed to the correct face and incorrect if they pointed elsewhere or did not respond. Only children who correctly judged the emotions of anger and sadness were included in the final sample.

4. Pretend emotions task. Sidera et al. (2013) used written stories with drawings to study children's understanding of pretend emotions. In previous work on ToM-related concepts in hearing children with developmental language disorder, researchers have used similar non-verbal assessments (e.g., Miller, 2001). Non-verbal tests of ToM are appropriate for children with language delays (both hearing and DHH) because they are freed up from the linguistic processing of the stimuli and can more easily reason about the ToM concepts inherent in these tasks. This approach has revealed that children who are DHH can express their underlying ToM understanding more than in a verbally loaded task (Woolfe et al., 2002; Morgan & Kegl, 2006). Following these authors, the current study created a novel task with silent videos instead of drawings in order to reduce the amount of language the children who are DHH were required to understand.

The pretend emotions task was divided into a warm-up and a test phase. In the warm-up phase, children were shown the angry and sad drawings from the Emotion recognition task and asked about how the girl felt in each of the drawings (*"Can you tell me how this girl feels"?*). If children did not respond correctly, they were given the correct label for each of

the two faces. In the test phase, children were shown 8 silent videos of children acting out real or pretend emotions. The order of presentation was counterbalanced following a Latin-square design. The emotions expressed by the main character were: real anger, real sadness, pretend anger or pretend sadness (2 videos of each type were used). In the real videos, the main character had a reason to feel angry or sad. They expressed anger because another child did something annoying to them (i.e. pushed them to the ground or ripped a drawing of theirs). The anger emotion was expressed towards the camera, so the child who provoked the anger was not visible at that time. In the real sadness videos, the main characters appeared alone and expressed sadness because something unfortunate had happened to them (i.e. a glass of water had spilt on their drawing and spoilt it, or a balloon had popped while they were playing with it). In the pretend videos, the main characters were pretend playing with another child. In the pretend anger videos, the children pretended that a doll had misbehaved (i.e. by throwing some pretend food on the floor or by knocking down a tower of blocks), and the main character was depicted expressing pretend anger towards the doll. In the pretend sadness videos, one of the characters pretended to be a baby who did not want to eat or sit down in their chair and the other child was an angry mother, so the baby pretended to be sad. At the end of each video, the emotional expression of the main character was shown in a freeze frame.

At this point, the test question and a justification question were asked in this order:

Test question: *"*Is the child really *angry / sad* or is she pretending to be *angry / sad*?"

Justification*: "*Why do you think she *is angry / sad (or pretending to be angry / sad)*?"

Participants were not asked to guess the emotions of the protagonists. Thus, for the anger stories, the experimenter used the word "angry" in the previous questions, and for the sadness stories the word "sad". Therefore, participants were only asked about whether they thought these emotions were real or pretend. Although real and pretend videos were used, both types

of videos tap into the same conceptual ability, which is the capacity to understand that emotions may have a pretend purpose.

Children received 1 point for each correct answer in the test questions, meaning the total score for this task (sum of pretend emotions) ranged from 0 to 8 (justifications were not considered in the score).

5. Non-verbal cognitive ability. Children's abilities for spatial problem-solution and analysis were assessed using the standardised Spanish version of the Pattern Construction subtest of the BAS 2 (Arribas & Corral, 2011). This subtest is appropriate for the age range of the children in current study and is strongly related to general cognitive ability. Previous research has already used this subtest to accurately measure NVIQ in children who are DHH (e.g., Kyle & Harris, 2011). The ability scores were used in our analyses. In order to do this, the raw scores are transformed to take into account the specific set of items responded to by each child.

Language assessment. The Language Proficiency Profile LPP-2 (Bebko & McKinnon, 1993) was filled out by the classroom teachers (for the hearing sample) and speech and language therapists (for the children who are DHH). This is a scale originally designed to evaluate the language and communicative skills of children who are DHH and covers the semantic and pragmatic features that are shared by different languages. It has been reported to be useful as a measure of overall language development in children who are DHH (Bebko, Calderon, & Treder, 2003). The LPP-2 has five sub-scales: Form, Content, Reference, Cohesion and Use of Language. The maximum Total score with this scale is 112. However, since some teachers and speech therapists left some items blank (87 children had one or more blank items; mean of items left blank = 2.07; *SD* = 3.20), a percentage of points obtained from the possible score was calculated (both for the whole scale and for each of the

sub-scales) and taken as the measure of the child's linguistic-communicative skills (instead of the direct score of the test, which is the usual measure).

Demographic questionnaire. A questionnaire was used to gather background information about the child (date of birth, siblings, school enrolment and existence of learning difficulties). This included, if applicable, details about their hearing loss (cause, age of hearing loss onset, age of hearing loss detection, degree of hearing loss, use of hearing devices, relatives with hearing loss, and communicative systems used by the child). Information was also collected about the parents (education, mother tongue, and language used with the child). This questionnaire was filled out by teachers for the hearing children and speech therapists for children who were DHH.

Procedure

All children were tested in spoken Catalan in a quiet room of their own schools. Individual tasks were untimed but were all administered in one session that lasted between 35 to 55 minutes. The tasks were administered to the children who are DHH in the presence of their speech therapist, who rarely participated in the sessions, only when the experimenter needed help to understand the children's answers. Five different experimenters participated in data collection.

For the purposes of data analyses, the children were divided into 3 age groups: a) 3- and 4-year-olds; b) 5- and 6-year-olds; and c) 7- and 8-year-olds. This division was employed based on the literature which argues for a developmental progression in the understanding of pretend emotions between a young group with difficulties, a middle group in the process of acquiring this, and an older group who had already mastered these concepts (see Sidera et al., 2013). Data were analysed using IBM SPSS version 23. Since the data used in our analyses did not follow normal distributions, non-parametric tests were carried out. A description of

the type of tests carried out is provided next, as well as how effect sizes were calculated (for significant statistical values).

The Mann-Whitney test was used to compare results between the DHH and the hearing children for different variables: Pretend emotions, expressive vocabulary and linguistic-communicative skills. The effect size estimate *r* for Mann-Whitney's U comparisons was calculated using the formula $r = Z/\sqrt{N}$ (Rosenthal, 1991; cited in Field, 2009). The Wilcoxon signed-rank test was used to compare children's scores on the pretend emotions task between anger and sadness stories. The one-sample Wilcoxon signed-rank test was used in order to test whether scores on the pretend emotions task at different ages exceeded chance levels. The effect sizes estimate *r* for the Wilcoxon signed-rank test was calculated using the same formula as for Mann Whitney's U comparisons (see Field, 2009). Spearman's correlations were used to study the relationship between the understanding of pretend emotions and quantitative variables. Spearman's R^2 allowed us to interpret how much of the variability was shared by two variables by multiplying the Spearman score by 100 (see Field, 2009). This value was then used to measure the effect size of correlations. The Kruskal-Wallis test was used to compare the effects of the degree of loss and type of aids on different variables.

Results

No significant differences were found among the different groups of hearing loss (moderate, severe and profound groups were considered here, as the mild group only had 1 participant) for any of the following variables: age, NVIQ, expressive vocabulary, linguistic-communicative skills, or score in the pretend emotions task ($p > .05$ in all cases). When the above mentioned comparisons were made in each age group, all comparisons remained not

significant ($p > .05$). The lack of any differences between hearing loss categories meant we did not consider this variable further in the results.

Pretend Emotions in children who are DHH

Turning to the main area of study the results of the Pretend emotions task were analysed to learn whether children who are DHH show a delay in understanding pretend emotions. In this task videos of children expressing real emotions and videos expressing pretend emotions were used. The scores between the two types of videos (real videos and pretend videos) in each group of children (hearing and those who were DHH) were compared and no significant differences were found ($p > .05$). Therefore, it was decided to maintain a total score of the Pretend emotions task and not analyse the results of each type of videos (real or pretend) separately.

On the analysis of pretend emotions the results of hearing children and children who are DHH were compared first. Next, the two emotions involved in the Pretend emotions task (anger and sadness) were considered separately. Finally, differences between children who are DHH and hearing children in each of the three age groups were analysed, in order to study whether the possible delay changes in older children.

The mean scores for the Pretend emotions task were 6.53 (SD = 1.46) for hearing children and 5.57 (SD = 1.65) for the DHH group (maximum score: 8 points). This difference was found to be significant (Mann-Whitney's U = 1353.000; $p < .005$). The effect size was calculated as follows: $r = -3.289/\sqrt{129} = -.29$.

When analysing the results of the two emotions involved in the Pretend emotions task (see Table 3), children were significantly better in the case of sadness rather than anger. Since this difference was observed in both hearing and children who are DHH, and the study was

interested in differences between groups and not between emotions, the two types of emotion were merged in the following analyses.

Insert Table 3 here

Results of the Pretend emotions task in each of the three age groups are shown in Figure 1. Analysis revealed significant differences between hearing and children who are DHH in the group aged 5-6 years ($U = 239.000$; $p = .007$; $r = -.36$) and in the group aged 7-8 years ($U = 165.500$; $p = .012$; $r = -.36$), but not for 3-4 year-olds ($U = 50.000$; $p = .286$). Children's scores were compared to chance expectation (4 points was taken as chance level because the Pretend emotions task involved 8 two way responses). The 3-4 year old group did not obtain scores above chance (children who are DHH: $Z = .649$ $p = .516$; hearing children: $Z = 1.935$, $p = .053$). Conversely, older children scored above chance (5-6 children who are DHH: $Z = 3.320$, $p = .001$, $r = .39$; 5-6 hearing children: $Z = 4.915$, $p < .001$, $r = .87$; 7-8 children who are DHH $Z = 3.559$, $p < .001$, $r = .80$; 7-8 hearing children: $Z = 4.647$, $p < .001$, $r = .88$).

Insert Figure 1 here

Language and pretend emotion understanding

Table 4 compares children's scores (as a function of their hearing status) for the language development variables (Expressive vocabulary and LPP-2 scores). Statistically significant differences were observed between the hearing and the children who are DHH in both of the language tests. In order to better define the length of delays in language development of children who are DHH, Z-scores based on the participants of the study were calculated for the hearing and DHH groups. For the DHH group, the mean Z-scores were -.43 for expressive vocabulary and -.21 for LPP-2, whereas for the hearing group mean Z-scores were .31 for expressive vocabulary and .15 for LPP-2.

Insert Table 4 here

DHH and hearing children's scores for the language variables in each age group (see Table 5) were compared. Statistically significant differences were found between hearing and children who are DHH in both vocabulary and LPP-2 variables in the group of 5- and 6-year-olds. In the group of 7- and 8-year-olds significant differences were found only in expressive vocabulary. No significant differences existed in the group of 3- and 4-year-olds.

Insert Table 5 here

Partial correlations (controlling for age) between children's understanding of pretend emotions with the language variables were calculated (see Table 6). The language variables correlated significantly with pretend emotion understanding only in the DHH group. Specifically for the LPP-2, all sub-scales correlated significantly (Spearman, controlling age) with pretend emotion understanding, being the *Use of language* the aspect more related to it (Form: $r_s = .577$; $p < .001$; $R^2 = .33$; Content: $r_s = .459$; $p = .001$; $R^2 = .21$; Reference: $r_s = .468$; $p < .001$; $R^2 = .22$; Cohesion: $r_s = .462$; $p = .001$; $R^2 = .21$; Use: $r_s = .603$; $p < .001$; $R^2 = .36$).

Insert Table 6 here

Discussion

As a first objective this study looked at a possible delay in the ability to understand pretend emotions in children who are DHH. Our results indicate that, for pretend emotions, children who are DHH with moderate, profound and severe hearing loss are delayed in their understanding compared with hearing peers. This difficulty in children who are DHH continued in the 7 - 8 years group. A second objective was to elucidate whether language development was linked to this understanding. In this regard, it was found that pretend emotion understanding difficulties were related to linguistic skills.

Pretend Emotions in children who are DHH

In interpreting our results, it is important to consider several alternative possibilities. Firstly, difficulties in the facial recognition of emotions does not seem a likely explanation, as only children who recognised the expressions of anger and sadness were included in the sample. Moreover, only children who passed the pretend actions task were included in the analyses i.e. they could use the words 'real' and 'pretend' correctly when linked to actions. This also reduces the possibility that the labelling demands in the pretend emotions task were responsible for the difficulties encountered by children who are DHH. Arguably, since the pretend emotion videos contained contextual markers for pretence (for example, a doll or toy food), children could have responded correctly to the task without really understanding pretend emotions. But if this were the case, children who are DHH could have used this context at least to the same extent as hearing children (or even more, in which case the present study would have underestimated the difference in pretend emotion understanding between hearing children and children who are DHH). The main explanation that remains is that the cognitive reasoning required in the Pretend emotions task lies behind the difficulties encountered by the DHH group. This is related to explicitly applying the pretence-reality distinction in the field of emotions.

We did not find differences in the understanding of pretend emotions between hearing children and children who are DHH in the youngest group. This is most likely explained by the task being too difficult for all the children at these ages, as any of the two groups scored above chance. Previous literature found that 4-year-olds start to distinguish real from pretend emotions when narratives are used (see Sidera et al., 2013). Including 3-year-olds in the current study possibly influenced the low scores of the youngest group, although

methodological differences between the two studies (using silent videos vs. narratives with pictures) could also have an effect.

As with false belief understanding, recent research has proposed that before children acquire concepts explicitly they do so in an implicit way (see Low & Perner, 2012; although some authors have criticised this methodology: Kulke, von Duhn, Schneider, & Rakoczy, 2018). Efforts are being made to try to understand how the transition from implicit to explicit knowledge occurs and the role of language or experience in this transition (San Juan & Astington, 2012; Schuwerk, Vuori, & Sodian, 2015). Walle and Campos (2014) suggested that children before the age of 2 could have an implicit understanding of pretend emotions. As the present study shows difficulties in the explicit understanding of pretend emotions by children who are DHH, future research could investigate possible difficulties in their implicit understanding of pretend emotions.

Language and pretend emotion understanding

The second objective was to look at the relationship between language and emotion understanding development. The direct evaluation of language development in our study was based on expressive vocabulary. Vocabulary is used in many studies as an indicator of wider language abilities as it predicts a range of outcomes including other language abilities (Marchman & Fernald, 2008), literacy (Biemiller, 2003), and social and behavioural skills (Dawson & Williams, 2008). Previous findings have highlighted the role of language development on wider ToM skills in the DHH group (e.g. Moeller & Schick, 2006; Morgan, et al., 2014) and to the emotion domain (Rieffe, 2012). The current study extends this link in children who are DHH and showed that language was very strongly related to their ability to reason about pretend emotions.

At a theoretical level, language could influence emotion understanding in different ways. First of all, language labels may help children to focus their attention on specific aspects of the situation, and thus, help them to grasp information related to the emotions involved in the scenarios (Doherty, 2009). Secondly, according to the representational perspective (Lindquist, Satpute, & Gendron, 2015) language plays a very important role in the formation of emotional categories. An emotional label such as "sad", would allow children to compare this label for different emotional manifestations (in different people), feelings (in themselves) or situations, and thus allow children to distinguish between this concept and similar concepts (e.g., anger). From this viewpoint, there is a causal relationship between language and emotional representation. In other words, language acts as a guide for the conceptualisation of emotions as well as a labelling of emotional experiences. Finally, the conversational hypothesis suggests that ToM and emotion understanding does not only depend on formal aspects of language but also on early communicative interactions. In this framework the experience of reasoning about emotions comes from social interactions and participation in conversations (Morgan et al., 2014; Peterson, Wellman, & Slaughter, 2012; Rieffe, 2012). Early access to conversational interactions emphasises that others have different perspectives linked to misunderstandings and scenarios involving other people's mental states such as beliefs, thoughts, feelings and intentions (e.g., Astington & Baird, 2005; Morisseau, Davies, & Matthews, 2013). Children who are DHH typically have a reduced early participation in explicit talk about emotions in others and fewer opportunities to overhear indirect conversations (Gola, 2012). Ketelaar, et al., (2012) also pinpointed that children who are DHH have less indirect exposure to overheard speech because CIs are less able to process language interactions in background noise.

Implications of the current study

The main clinical implication of the current study relates to the importance of children who are DHH being able to interpret the communicative intentions of other children's emotional expressions. Although our study did not evaluate children who are DHH in natural interactions, their difficulties in interpreting whether negative emotional expressions are playful or not might have an impact on how well they adjust their behaviour in social contexts (see Walle & Campos, 2014). The experimental simulation of pretend emotions used in the present study was a simple version of a social interaction common in wider life, which could be much more complex. Understanding and predicting the behaviour of others involves interpreting subtle signals (Ma & Lillard, 2006), for example deciding whether a smile implies complicit or mock play. In this sense, differences in children who are DHH's capacity to detect pretend emotional expressions could lead to greater difficulties when intentions are less obvious than in the case of pretence. This seems reasonable when considering that difficulties with more advanced complex mental states have been reported for children who are DHH (see Peterson, Wellman & Liu, 2005) and in DHH adults who experienced late language exposure (O'Reilly, Peterson, & Wellman, 2014)

Although clinical interventions in this area are lacking, some authors have suggested that rehabilitation programmes should attempt to improve how DHH parents communicate with their young children regarding mental states (see Ketelaar et al., 2012). In this sense, parents and teachers of children who are DHH could attempt to improve children's socio-cognitive skills, such as emotion understanding by training them in specific conversational routines, such as those suggested by Paatsch and Toe (2016). These authors identify the key pragmatic skills where school-aged DHH children who use spoken language need additional practice and support. An appropriate training intervention in pragmatics and in the social use of language may have a crucial positive influence both for hearing children and those who are DHH. Furthermore, teachers in mainstream or special education classrooms should bear in

mind the particularities of children who are DHH, as individual differences in socio-cognitive development might influence children's learning, as well as their social relationships (Knoors & Marschark, 2014). For this reason, activities which focus on emotion understanding, and in particular, of pretend emotion understanding, should be promoted. This can include: activities which focus on the causes and consequences of emotions in conversations, discussing why people hide or pretend emotions, involving children in activities related to emotion simulation (e.g. drama and role play) or debating when it is convenient to express or not express certain emotions (i.e. in films and novels).

One limitation of our study is related to the fact that in both the pretend and real videos of the pretend emotions task the video task used actors, instead of people showing emotions in real situations. However, there is no reason to believe that this might have influenced decisions differently for the DHH and hearing children. Another possible limitation is that the current study only focused on two negative emotions. Future research should also include a range of different pretend emotional states. Additionally, the current research did not take into account the role of audiological variables in the understanding of pretend emotions, which should be studied in future studies. Finally, the scorers of the LPP-2 were different for the DHH and hearing children, the former being speech therapists and the latter teachers. Conceivably, this aspect may have biased our results.

In conclusion, our study shows for the first time that delays in understanding pretend emotions exist in children who have reduced access to language and communicative interaction due to the barrier of hearing loss. These differences could stem from their previous experiences of social interaction as well as reduced vocabulary and grammatical development. This supports the view that not only formal language but also early communication has a crucial influence in the development of this important aspect of social

cognition. Therefore, it is vital that parents and teachers benefit from specific training programs focusing on naturalistic conversational interaction.

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Figure 1. Scores for the Sum of pretend emotions task as a function of age group and hearing status.

Note: The children's scores ranged from 0 to 8, and 4 was chance level.

Table 1. Descriptive statistics of the three age groups in the final sample.

	Hearing			**DHH**		
	Sex	**Age in months Mean (SD)**	**Non-verbal cognitive ability score Mean (SD)**	**Sex**	**Age in months Mean (SD)**	**Non-verbal cognitive ability score Mean (SD)**
3- and 4-year-olds	7 girls & 8 boys	50.00 (SD = 4.97)	91.80 (SD = 27.92)	5 girls & 4 boys	48.00 (SD = 5.00)	90.22 (SD = 29.32)
5- and 6-year-olds	18 girls & 14 boys	71.66 (SD = 7.52)	147.19 (SD = 24.74)	13 girls & 12 boys	71.32 (SD = 8.05)	146.4 (SD = 31.79)
7- and 8-year-olds	14 girls & 14 boys	93.25 (SD = 7.62)	164.32 (SD = 20.93)	9 girls & 11 boys	92.75 (SD = 7.05)	161.15 (SD = 35.37)

Table 2. Type of aids, degree of hearing loss, and age at hearing aid fitting according to age group.

	Type of hearing aids	**Degree of loss (in the better ear)**	**Age at hearing aid fitting**
3- and 4-year-olds	Never had hearing aids	Moderate: 1	--
	Children with only hearing aids	Moderate: 2	Mean: 13.00 months (*SD* = 2.82)
		Severe: 2	Mean: 17.5 months (*SD* = 9.19)
	Children with cochlear implant	Profound: 4	Mean: 11.25 months (*SD* = 2.87)
5- and 6-year-olds	Never had hearing aids	Moderate: 1	--
	Children with only hearing aids	Mild: 1	Age: 16 months
		Moderate: 10	Mean: 38.40 months (*SD* = 18.37)
		Severe: 3	Mean: 31.00 months (*SD* = 19.97)
		Profound: 2	Mean: 23.00 months (*SD* = 16.97)
	Children with cochlear implant	Profound: 8	Mean: 21.38 months (*SD* = 11.87)
7- and 8-year-olds	Children with only hearing aids	Moderate: 6	Mean: 61.17 months (*SD* = 15.47)
		Severe: 3	Mean: 28.00 months (*SD* = 21.07)
		Profound: 1	Mean: 8 months
	Children with cochlear implant*	Severe: 2	Mean: 27.5 (*SD* = 19.09)
		Profound: 8	Mean: 22.63 months (*SD* = 10.663)

Note: *Includes a child with BAHA implant; some children with cochlear had hearing aids before the implant. The degree of hearing loss was classified following the International Bureau for Audiophonology - BIAP (1996; recommendation BIAP 02/1 bis) guidelines, which consider losses from 21 to 40 dB as mild, from 41 to 70 dB as moderate, from 71 to 90 as severe, and from 91 to 119 as profound .

Table 3. Means (and SD) in the sum of pretend emotions task as a function of type of emotion and hearing status.

	Hearing	**DHH**	Group comparison (Mann-Whitney)
Sadness stories	3.48 (.79)	3.02 (.94)	$U = 1454.000$; $p = .003$; $r = -.26$
Anger stories	3.04 (0.95)	2.56 (1.04)	$U = 1489.000$; $p = .008$; $r = -.24$
Comparison between emotions (Wilcoxon)	$Z = -3.658$; $p < .001$; $r = -.42$	$Z = -2..913$; $p = .004$; $r = -.40$	

Note: Range = 0-4

Table 4. Means (and SD) and comparison of groups in the variables related to language.

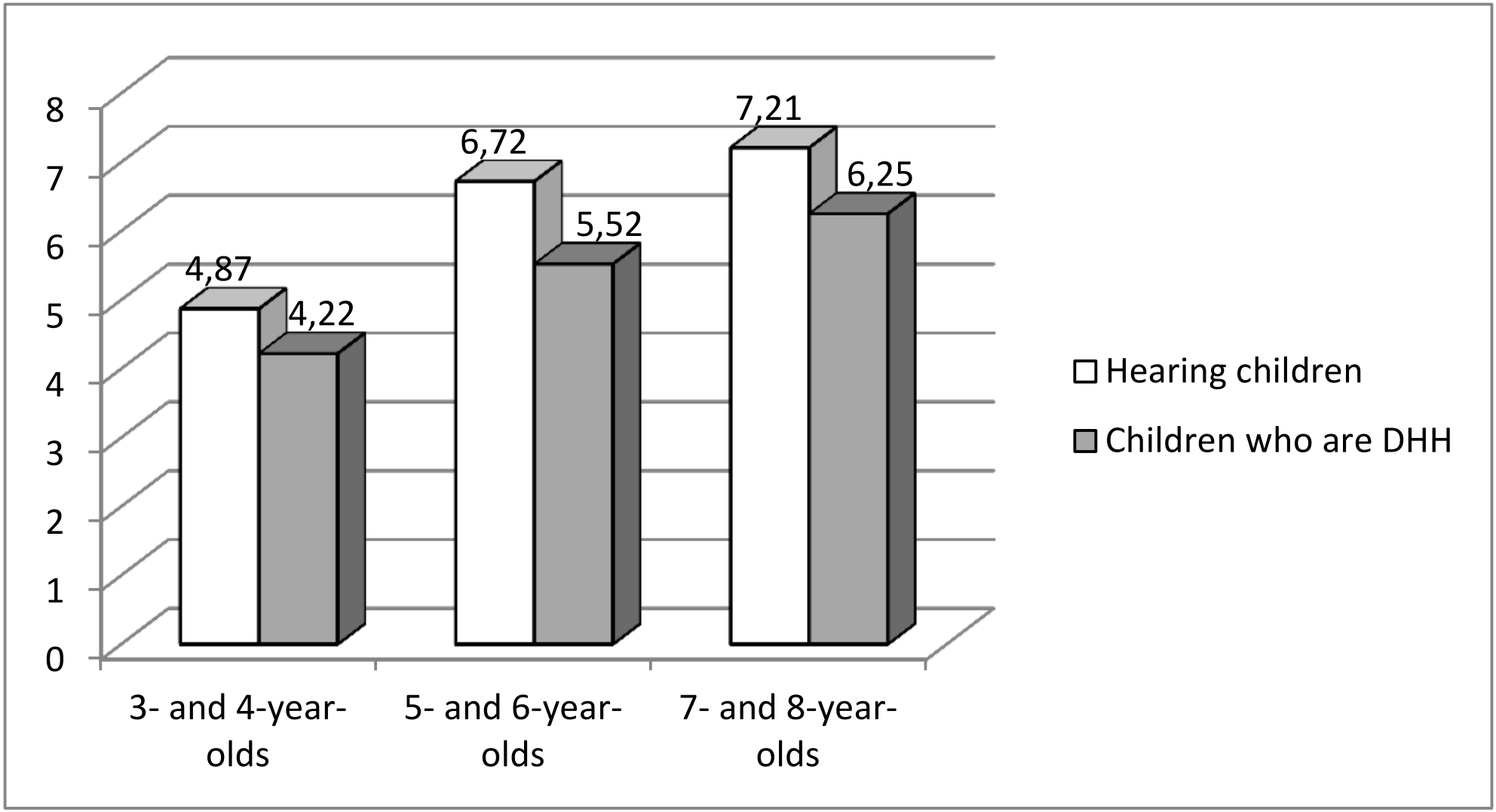
	Hearing	**DHH**	**Group Comparison** Mann-Whitney
Expressive vocabulary (aptitude score)	121.81 (14.7)	109.43 (16.45)	$U = 1077.000$; $p < .001$; $r = - 0.39$
Linguistic-Communicative skills (Range = 0-100)	85.79 (15.65)	79.92 (16.58)	$U = 1512.000$; $p = .020$; $r = - 0.30$

Table 5. Means (and SD) and comparison of groups in the variables related to language, separated by age groups

		Hearing	**DHH**	**Comparison**
				Mann-Whitney
Expressive	Young	107.27 (17.45)	106.89 (9.49)	$U = 54.500$; $p = .435$
vocabulary	Medium	122.58 (11.91)	107.00 (17.51)	$U = 173.000$; $p < .001$*; $r = -.47$
	Old	128.75 (10.03)	113.6 (17.33)	$U = 129.000$; p = .002*; $r = -.46$
Linguistic-Communicative	Young	69.86 (20.71)	66.58 (20.21)	$U = 58.000$; $p = .571$
skills	Medium	89.87 (11.54)	81.07 (15.66)	$U = 253.000$; $p = .030$*; $r = -.29$
Range 0-100	Old	89.65 (10.92)	84.54 (13.24)	$U = 210.000$; $p = .143$

Table 6. Spearman partial correlations (controlling age) between understanding of pretend emotions with language and non-verbal cognitive ability.

		Linguistic-Communicative skills	Expressive vocabulary	Non-verbal cognitive ability
Understanding pretend emotions	*DHH children*	$r_s = .616$ $p < .001$ $R^2 = .38$	$r_s = .456$ $p = .001$ $R^2 = .21$	$r_s = .439$ $p = .001$ $R^2 = .19$
	Hearing children	$r_s = .045$ $p = .703$	$r_s = .152$ $p = .200$	$r_s = .172$ $p = .146$


8
7
6
5
4
3
2
1
0
4,87
4,22
6,72
5,52
7,21
6,25
3- and 4-year-olds
5- and 6-year-olds
7- and 8-year-olds
Hearing children
Children who are DHH