AN INVESTIGATION OF JOINT ATTENTION

SKILLS IN PRE-SCHOOL AGED

HEARING-IMPAIRED CHILDREN

LISA QUIGLEY

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Submitted in partial fulfilment of the MSc in Speech and Language
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Department of Human Communication Science
University College London

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ABSTRACT

Background: Previous research examining joint attention and theory of mind indicates that hearing-impaired children are delayed in their development of these skills and that hearing-impaired children of hearing parents appear to be most disadvantaged. This study aims to contribute to previous research by investigating the development of joint attentional behaviours in pre-school aged hearing-impaired children in relation to hearing children of the same chronological age and children of the same language age.

Method: Structured tests were used to explore abilities of three groups of children – hearing-impaired, age-matched and language-matched. Joint attentional responses were monitored and used as a measure of ability in tests of social orientation, social referencing, shared attention and gaze following.

Results: No statistical differences were found between the hearing-impaired children and the age-matched children, nor between the hearing-impaired and language-matched children. However, trends were visible to show hearing-impaired children performing at a lower level than the age-matched children, and in some cases, also at a lower level than the language-matched children. In other instances the hearing-impaired children performed better than the other two groups.

Conclusion: These results suggest that joint attention may not be a necessary 'pre-cursor' for the development of theory of mind in hearing-impaired children. Further investigations with these children to investigate their theory of mind abilities later on may provide additional insight into the development of such skills in this group of children. Methodological limitations could have affected the significance of the results obtained, as could the small size of the sample, and the results should be viewed with this in mind.

INTRODUCTION

There is extensive research in the areas of joint attention and theory of mind, and what these mean to a child's development of social and linguistic skills. There are many different viewpoints as to how the two skills link together, as steps in a single stage of development or as separate entities, one requiring the other in order to progress. The role of hearing has also been extensively investigated, focus being on the pathway of development of joint attention and theory of mind skills of hearing-impaired children in relation to typical development. This study aims to provide further evidence in the debate by investigating joint attention skills of hearing-impaired children in comparison with typically developing children of the same age, and younger children at the same level of language development.

Typical Development of Joint Attention

Most research in this area has previously focused on two ideas. Firstly, that infants around the age of one year are able to follow, or direct an adult's attention to an outside entity. Secondly, that in the second year of life, children are able to extend the amount of time they participate in joint attention, and begin to acquire linguistic skills (Tomasello; 1995). It has therefore been hypothesised that joint attention is a "pre-cursor" to acquiring theories of mind.

Carpenter, Nagell & Tomasello (1998; p2) state that joint attention can be viewed as the "capstone" of the process which begins with newborn infants interacting with adults and progresses to infants participating in triadic social interactions with people and objects. They explain that as well as an end-point, joint attention is a beginning point for later stages of development, providing a foundation for communication involving reference to the outside world and to the minds of others.

The term *joint attention* has often been used to encompass a number of skills (Carpenter et al. (1998)). The first is sharing attention, where a child and adult look at the same object, and the child looks from the object to the adult's face. The

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second is following attention, either by following gaze or pointing gesture to an object, or by imitating actions on an object. At this stage, infants are beginning to illustrate a basic understanding about other people as intentional agents. The final skill is to direct others' attention to outside objects through intentional communication, indicated by the child directing their communication towards another person, alternating their gaze between an object and the person. All these skills involve the 'referential triangle' of child, adult and a third entity to which attention is directed and shared.

Tomasello (1995; p107) explains further that in joint attention, the child coordinates attention to an object and the adult, and at the same time, the adult is directing their attention to the same object and the child. A joint attentional interaction occurs because both participants are sharing an intentional relation to the world (Hobson, 1989).

There is controversy surrounding the age at which children first acquire joint attention behaviours. Scaife and Bruner (1975) suggested that children of six months of age are able to engage in joint attention. However, Corkum & Moore (cited in Moore & Dunham, 1995) provide evidence to suggest that six and seven month old infants are unable to follow an adult's gaze. The definitions of joint attentional behaviours in these two studies may differ, however, which could result in the conflict of results. Corkum & Moore's research also found that at eight and nine months, infants can be conditioned to follow gaze to an interesting sight (in Moore & Dunham; 1995). However, Tomasello (in Moore & Dunham; 1995) argues that before nine months of age there is very little spontaneous alternation of gaze between an adult and an object, and when this does occur, they rarely check back on the adult's attentional focus. This might suggest that prior to nine months of age, adult-infant simultaneous looking is not confirmation that the infant understands others as intentional agents, but is simply a case of onlooking, alternating attention, or the result of a learned response that there is something worth looking at in the direction of the adult's gaze.

Between nine and eighteen months, behaviours begin to suggest infants are developing an understanding of other people. Around one year of age, infants are able to follow an adult's gaze to an object and check the adult's attentional focus by looking back (Butterworth, 1991). Bakeman & Adamson (1984) have further illustrated that at the same age, infants are able to participate in extended periods of co-ordinated joint attention with their mothers. 'Co-ordinated joint attention' refers to a situation where the infant is actively coordinating visual attention to the object of interest and an adult, as opposed to adult and child looking at the same object, with the child showing no awareness of the adult's presence/participation. It is also at around this age that infants begin to point to or show objects to an adult, alternating their attention between the object and adult (Bates, 1976), illustrating their development through the stages of joint attention skills discussed by Carpenter et al. (1998) previously.

Bakeman & Adamson's research (1984) shows that an infants participation in sustained periods of co-ordinated joint attention increases over the next several months until, by the age of 18 months, joint attention skills to people and objects are well consolidated. It is also around this age that linguistic skills begin to take shape. Tomasello (1995; p115) explains that a child's understanding of others as intentional agents comes out in their attempts to learn language by "tuning into the attentional focus of others (comprehension) and in their attempts to use language in order to get others to tune into their attentional focus (production)." To acquire new words, Tomasello (1995) believes that the child must participate in a state of joint attention with the adult, which may require shifting their own attention to match that of the adult's, thus demonstrating they have an understanding of different points of view.

Theory of mind

According to Tomasello et al. (in Moore & Dunham, 1995; p104), infants undergo a 'revolution' at one year of age, in their understanding of others as intentional agents, in the same way they begin to understand mental states i.e. thoughts and

beliefs, in their fourth year. This is the concept of theory of mind, described by Lundy (2002; p41) as "the understanding of one's own and others' minds and awareness of the relation between people's minds and the world."

Whether joint attention is, as suspected by many, a 'precursor' to theory of mind, or whether the two skills are steps towards a greater goal of communication, it makes sense for the two to be discussed together, in relation to how their development in hearing-impaired children compares with typically developing children.

Joint Attention & Theory of Mind in Hearing-Impaired Children

There has been much controversy in recent years over the issue of how hearing-impairment affects development of joint attention and theory of mind. In reviewing this literature, the term 'hearing-impaired' is used to describe a severe-profound hearing loss, and does not relate to the mode of communication adopted by the child. It must be taken into consideration in reviewing literature in this area that the heterogeneity of the hearing-impaired population is enormous. For this reason, findings of research must often be interpreted within fairly constrained parameters.

Quittner, Smith, Osberger, Mitchell & Katz, (1994) believe that auditory input and communication are essential for the development of language, cognition, and behaviour. They hypothesise that hearing-impaired children will be delayed in their development of visual attention, behaviour control and theory of mind due to disturbances in their auditory input. Clark (1989) reiterates this, stating that hearing-impaired children have fewer opportunities for natural, meaningful interactions in the way of conversation and consequently, will not acquire the same extent of conversational pragmatic skills as hearing children.

Spencer & Waxman (1995) studied the engagement states of hearing-impaired and hearing children with their mothers at 9, 12 and 18 months. They found no differences at any age, suggesting that hearing-impaired children follow the same pathway of development as hearing children prior to 18 months of age. The same

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study found that hearing-impaired 18-month-olds had less language than hearing children, contradicting Baldwin's (1995) conclusion that language is instrumental in drawing children into, and maintaining them in joint attention. If hearing-impaired and hearing children spend the same amounts of time in joint attention until 18 months of age, it would be expected that there would be no difference in their development of language at this point.

Prezbindowski, Adamson & Lederberg (1998) studied attention regulation among people, objects and symbols in 20-24 month old hearing-impaired and hearing children with hearing mothers. They found that hearing-impaired children spend less time in symbol-infused joint attention than hearing children and significantly more time in co-ordinated joint attention. 'Symbol-infused' joint attention develops following co-ordinated joint attention (Adamson & Chance; 1998) and involves attending to and integrating symbols into play with adults and objects which form the basis of co-ordinated joint attention. Prezindowski et al. (1998) concluded that the amount of time children spend in episodes of joint attention increases during the second year, regardless of whether they infuse symbols into their interactions with others. This finding suggests that language is not necessary for the emergence and maintenance of joint attention skills as suggested by Spencer and Waxman (1995). They also found that hearing-impaired children spend significantly less time in episodes of joint attention (of all types) than hearing children. This may imply that despite the fact language does not appear necessary for developing joint attention, it is likely that by the time a hearing-impaired child reaches the age of three, joint attention may not provide as strong a context for learning language as it does for hearing children.

Similar delays have been observed much later in development. Mitchell and Quittner (1996) compared visual attention in hearing-impaired children aged between 6 and 13 years with hearing children. They found that hearing-impaired children performed worse.

Prezindowski et al. (1998) concluded that hearing-impaired and hearing children

share the same developmental pathway for joint attention until the approximate age of two, where their pathways diverge, "when symbol-infused joint attention becomes one of the primary states of parent-child interaction for hearing children and their hearing parents, but not for hearing-impaired children and their hearing parents." (Prezindowski et al.; 1998; p385)

Swisher (1992) believes the reason joint attention is harder to achieve with hearing-impaired infants is that hearing children simultaneously hear what their mothers say and see the items being referred to. Hearing-impaired children need to manage two visual stimuli simultaneously. They must attend to the object and the mother's face/signs. They must also learn to monitor for incoming messages to ensure they are in a position to intercept them.

If hearing-impaired children experience a delay in their development of joint attention, it is likely that they will also encounter delays in their theory of mind development. Peterson and Siegal (1995) tested a sample of Australian hearing-impaired children aged 8 to 13 years on a test of false-belief. Typically developing children are able to pass this test at the age of 4 to 5 years. This sample of hearing-impaired children failed the test. Russell, Hosie, Gray, Scott & Hunter (1998) have confirmed these findings, testing theory of mind skills in hearing-impaired children aged between 4 and 16 years. They concluded that performance on tests of false-belief are age-related and that hearing-impaired children raised in a spoken language environments are likely to exhibit a developmental delay in theory of mind acquisition as a result of restricted early opportunities for learning about mental states.

Peterson & Siegal (1999) also carried out a study comparing the effect of modality of language production, i.e. oral hearing-impaired children vs signing hearing-impaired children on theory of mind ability. They found that oral hearing-impaired children performed at the same level as hearing children, suggesting that lack of hearing is not directly responsible for any delays encountered in theory of mind skills, but that language acquisition plays a more important role. De Villiers and de

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Villiers (2000) did find a positive correlation between language and theory of mind performance. However, De Villiers and Pyers (2000) found that oral hearing-impaired children have a theory of mind delay of approximately 3 to 4 years with respect to hearing children.

This raises important questions regarding the mode of communication hearing-impaired children are brought up to use, and what effect this has on communication between parent and child and development of early skills of joint attention and theory of mind.

Parental hearing status

Peterson & Siegal (1995) were the first to report that hearing-impaired children of hearing parents are delayed in their theory of mind, indicated by failure to pass a false-belief test. There are many theories as to why this may be the case. Harris, Clibbens, Chasen & Tibbits (1989) explain that when a hearing parent speaks to their hearing child, they are able to talk about the child's focus of attention without requiring the child to be looking at them. When a parent communicates with a hearing-impaired child, it is necessary for the child to be visually aware of both parent and object of focus. If the parent looks at the object of reference whilst speaking to a hearing-impaired child, or if the child is unaware that the adult is speaking, numerous vital opportunities can be missed by the child to intercept language (Gallaway & Woll; 1994). Furthermore, according to Vaccari and Marschark (1997), most hearing parents do not have sufficient knowledge of sign language to provide their hearing-impaired children with the optimal social interactions.

Meadow-Orlans & Spencer (1996) examined co-ordinated joint attention in infants and their mothers during play. They found that the mother's hearing status was significant to the level of co-ordinated joint attention at 9, 12 and 18 months. Similarly to Peterson & Siegal's (1995) results, hearing-impaired babies of hearing mothers performed the worst in all three age levels. They also found that hearing-

impaired infants of hearing-impaired mothers spent significantly more time in co-ordinated joint attention than hearing-impaired babies of hearing mothers or hearing babies of hearing-impaired mothers.

Marschark, Green, Hindmarsh, & Walker (2000) provide conflicting evidence. They investigated theory of mind in hearing-impaired children aged 9 to 15 years with hearing parents through the production of narratives. They found that there was no difference between hearing-impaired and age-matched hearing children. Marschark et al. concluded that hearing-impaired children from hearing families have an understanding of mental states and possess theory of mind. This research relied on only one activity, and so the results should be treated with caution.

Peterson & Siegal (1998, 1999) state that hearing-impaired children with hearing-impaired parents perform at the same level as hearing pre-schoolers on tests of theory of mind. This could be due to the fact that where hearing children are able to link auditory information with a referent, hearing-impaired children require more visual information, and hearing-impaired parents, being aware of this, are able to adopt strategies to promote a link between sign and referent instead (Harris et al.; 1989).

Further to Peterson & Siegal's findings and in support of Meadow-Orlans & Spencer's research (1996), Courtin (2000) has found that signing hearing-impaired children with hearing-impaired parents performed *better* than hearing children on false belief tasks. Courtin believes that as the perspective presented when signing is that of the signer, the listener must alter their visual perspective to understand the message. Signing hearing-impaired children could be expected to develop a theory of mind earlier than those who speak because of their extensive exposure to perspective taking. Those hearing-impaired children who sign are able to monitor changes at a representational level. Peterson and Siegal (1995) however, believe that it is language which affects performance on tests of false-belief, causing a change at the communicative level, leading to better understanding of mental

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states and therefore false beliefs, through conversation and social interactions.

Bruner and Feldman (1993) draw a comparison between the delay in theory of mind encountered by hearing-impaired children and that experienced by children with autism. They explain that "autism's triad of impairments in language, imagination and socialisation are likely to inhibit maximum participation in conversations with others". In the same way, oral or hearing-impaired children of hearing parents are likely to experience the same problems due to their inability and lack of opportunity in the early years to learn about and discuss mental states. The possible implication, as Russell et al. (1998) describes, is that hearing-impaired children are likely to face problems in social situations, in addition to those stemming from difficulties with speech and language.

Besides the effect of hearing status of the child's parents, the measures taken to compensate for their hearing loss has also been researched in relation to development of joint attention and theory of mind skills.

Cochlear implants vs hearing aids

It has generally been seen that hearing-impaired children tend to perform worse on tests of joint attention and theory of mind than hearing children. Quittner et al. (1994) have, however, found that older hearing-impaired children who use cochlear implants are able to 'catch up' to the performance level of hearing children of the same age and show significant improvements in their visual attention and also in their oral language. An additional study carried out by Smith, Quittner, Osberger, & Miyamoto (1998) found that hearing-impaired children with cochlear implants performed better than hearing-impaired children with hearing aids in tests of joint visual attention. Performance in this study was related to parental reports of responsiveness to environmental sounds, providing potential further evidence that reduced auditory input can affect development of joint attention.

Peterson (2004) tested theory of mind using false belief tasks with children aged 4

to 12 years, including oral hearing-impaired children with implants and hearing aids, children with autism and younger hearing children. The results showed that hearing-impaired children with cochlear implants are as delayed in theory of mind development as children with hearing aids. It is surprising that cochlear implants have a beneficial effect on joint attention skills, but do not appear to have the same benefit for development of theory of mind. However, many variables need to be considered in order to properly evaluate this area, for example, the age of onset of hearing-impairedness relative to age of implantation, aided thresholds, the child's pattern of use of aids and cochlear implants, rehabilitation/intervention history, and many others. Peterson (2004) also found that hearing-impaired children did not perform better than children with autism, reiterating the point made previously by Bruner and Feldman (1993). Hearing children scored significantly better than all other groups.

Focus of this study

This study aims to investigate the joint attention skills of pre-school aged hearing-impaired children, in comparison with hearing children of the same age, and also with younger children matched for language age. It will examine a number of areas of co-ordinated joint attention, social referencing, shared interest and gaze following.

Previous research has shown that hearing-impaired children with hearing parents are likely to show the most significant delays in joint attention and theory of mind abilities. As all the subjects in this study have hearing parents, it is hypothesised that the hearing-impaired children will perform worse in all areas than the hearing children of the same age. As the pattern of development of joint attention has been seen to diverge at 18 months of age, it is hypothesised that the hearing-impaired subjects will perform worse than their younger language-matched peers. However, as language is thought to have a bearing upon the development of joint attention skills, it is possible that the hearing-impaired children could perform at the same level as the younger, language-matched subjects in this study.

The hearing-impaired subjects use a mixture of devices to compensate for their hearing loss, some cochlear implants, the others digital hearing aids. Given that previous studies have found that cochlear implantation improves development of joint attention and oral language use, it is hypothesised that those subjects with cochlear implants will perform better than those with digital hearing aids, but worse than their age-matched hearing peers.

The subjects taking part in this study are all pre-school aged children who would be expected, if following a typical pathway of development, to be proficient in activities involving joint attention. Tests of theory of mind are not included in the current study as the majority of the children are too young for these tests to be useful and relevant.

METHOD

Design

This study is of a between-subjects design, with three independent groups – hearing-impaired children, hearing children matched for chronological age, and hearing children matched for language age. The dependent variable was the score obtained by each child for individual tasks.

Participants

Thirty-three children participated in the study, ranging in age from 1 year 2 months to 5 years 9 months. All had parental permission to be included in the study.

Fourteen hearing-impaired children attending the same unit for hearing-impaired children in a mainstream school participated. The children spend a significant proportion of the school day integrating with hearing children in both nursery and reception classes. Eleven hearing-impaired children participating in the study wore digital hearing aids, and three have cochlear implants. They are all from families with hearing parents, who communicate with their children using a mixture of sign and speech.

Twelve hearing children attending the same school as the hearing-impaired children and placed in the same nursery participated. A Mann-Whitney test confirmed that these children were adequately matched with the hearing-impaired children for age (U-63, p=0.43).

Seven younger hearing children from a different nursery, matched for language age took part. Language age was established for all children in the study using the Derbyshire Rapid Screening Test (Appendix 1) which provided a measure of word level comprehension. Due to the small number of participants in group three, no statistical analysis was carried out to establish an effective match for language

level, but the results of the screening test illustrated that the hearing-impaired children were approximately matched with the younger children in this respect. Table 1 provides descriptive information about the chronological ages of all three groups and Table 2 provides details of the language age test results.

Group	Mean Age (years : months)	Standard Deviation (months)	Age Range (years : months)
Hearing-impaired	4:3	8.6	3:6 – 5:9
Age-matched	3:11	3.5	3:2 – 4:2
Language-matched	2:4	11.2	1:2 – 3:1

Table 1 Descriptive ages for individual groups

Group	Mean Word Level
Hearing-impaired (n = 13)	1.38
Age-matched (n = 10)	3.60
Language-matched (n = 5)	1.40

Table 2 Mean word level for individual groups

(Due to time constraints, not all children were able to be tested, as seen in the numbers provided)

Materials

A video camera recorded the procedures, to allow for qualitative analysis.

A wind up mechanical toy was used (a pair of shoes which walked when activated), as directed by the Early Social Communication Scales, ESCS (Hogan & Mundy 1996) to elicit joint attention in tasks involving social orientation and blocking and teasing. A timer was also used in the social orientation task.

For the Joint Attention task, a box containing six coloured plastic eggs was used. Each egg contained a miniature object – a man, a hat, a candle, a tiger, a bag and a ring. The task required six larger objects which corresponded to the miniature

objects inside the eggs – a puppet, a hat, a candle, a picture of a tiger, a large bag and a ring.

Procedure

Subjects were tested in an allocated area within their nursery. Two adults were present, one to carry out the test, one to record the results (alternating roles). The child was seated on the floor, opposite the experimenter. The observing adult recorded as much of the child's face as possible, as well as the adult's side profile, to enable joint attentional behaviours to be observed following the session.

Four tasks were carried out, based on previous experiments testing joint attentional behaviours. They were carried out in the same order as they are presented below, for each subject.

1)   Social Orientation Task

The social orientation task was adapted from the Early Social Communication Scales, ESCS (Mundy & Hogan, 1996), designed to initiate joint attention in the form of eye contact to initiate shared attention to an object (Mundy & Hogan, 1996). This task was carried out first to gain the child's attention and establish a rapport between tester and subject.

The experimenter wound up the toy and placed it on the floor within the child's reach. The toy was wound up three times during the test, and the task timed for one minute. The experimenter remained quiet but attentive to the child, providing opportunity for the child to initiate joint attention should they wish. If the child did establish joint attention, the tester used either a verbal response ('Yes, I see') or non-verbal response (nodding or smiling) in acknowledgement.

Variation in the social interactions of the children prevented this procedure and the experimenter's responses from being standardised, but all testers made every attempt to adhere to the guidelines. Scoring for this task involved counting the

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number of times the child initiated interaction with the adult using eye contact. Scoring took place during the test by the observing adult, and later confirmed by observation of the video.

2)   Joint Attention Task

Prior to the task, the six large objects corresponding to the miniature pieces were placed around the room behind and to the sides of the child's position. No objects were placed behind the tester, to ensure the direction of the adult's gaze was obvious.

The tester placed the egg box on the floor within sight of the child, but out of reach. The egg box was opened, and the adult engaged the child by use of eye contact and 'interested' facial expression. No speech was used to ensure there was no advantage for the hearing children. The tester picked up one egg and shook it for five seconds, away from their face, whilst monitoring the child's gaze switch between the egg and the tester. The egg was then opened, without verbal interaction, and the contents shown to the child. The child's gaze was monitored to see if they looked towards the tester after the egg was opened. If the child took the miniature object from the egg, they were allowed to play with it for a short time, then encouraged to return it. With the object returned, the tester obtained the child's attention by saying their name or touching their arm, and said 'I brought my ring/candle (object corresponding to the miniature) today' and looked towards that object. If the child did not follow the tester's gaze, their attention was regained (if necessary) and the comment was repeated, accompanied by a point in the direction of the object. No other comments/requests were made. This procedure was repeated for each egg individually.

<u>Scoring</u>

Measuring gaze switch:

Look towards tester whilst the tester was shaking egg	1
Look towards tester after egg was opened	1
No look in either of the above conditions	0

Measuring gaze monitoring:

Look following tester's gaze switch and verbal statement	2
Look following tester's point and repeated statement	1
No look in either of the above conditions	0

Maximum total score for joint attention   **4 per egg**

= 24

3)   Blocking task

A mechanical toy was given to the child. The tester watched the child play for a short time, then gently covered the child's hand with their own for five seconds, preventing any activity. This was repeated three times at varying intervals and each time, the child's gaze was monitored. If the child looked at the tester in response to the block, one point was awarded. The maximum score for this task was three.

4)   Teasing task

The child was allowed to continue play with the toy. When the child reached for the toy, the tester removed it from their reach and placed it out of sight behind their back. This was repeated three times and the child's reaction monitored. One point was awarded if the child looked at the tester in response to the toy's removal. A maximum score of three was available for this task.

For the blocking and teasing tasks, joint attention was considered present if there

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was evidence of eye contact and social referencing. If the child looked at any area of the upper orbital region of the tester's face (as opposed to the lower portion of the face), this was considered eye contact. Social referencing was recorded as present if the child alternated their gaze between the active object and the tester's upper face. These two tests were administered last as it was thought they would be more effective once rapport had been established between the tester and subject.

Inter-rater Reliability

Both testers observed each individual's video tape separately and recorded the results. Their written results were then compared. The level of agreement between the two scorers was found to be 100%.

RESULTS

1) Social Orientation Task

The number of times eye contact was made with the tester was recorded for each subject. Table 3 provides a summary of the results and Figure 1 compares the results for each group.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	2.5	3.0	1.09	0	4
Age-matched	2.9	3.0	1.44	1	5
Language-matched	4.0	3.0	1.73	3	7

Table 3 Frequency of looks made for each group in the social orientation task
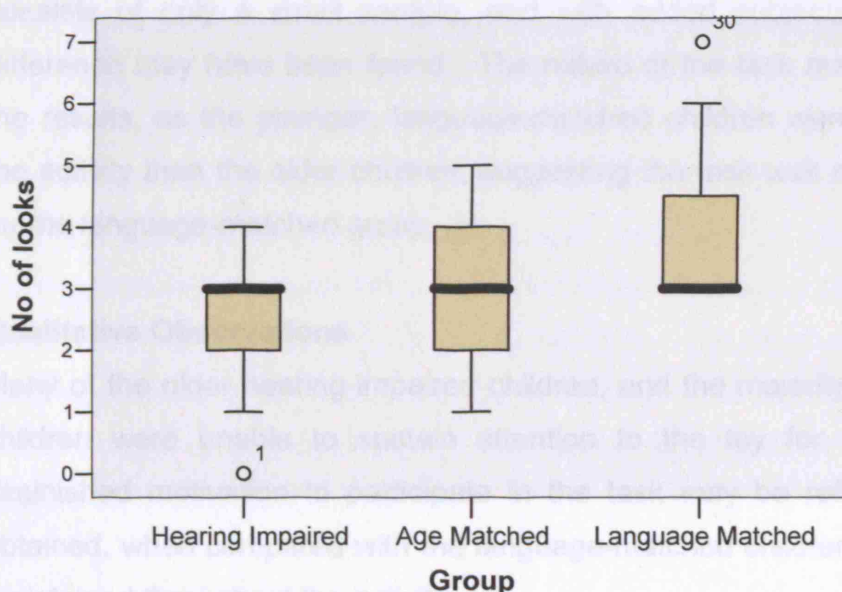

Figure 1 Box Plot comparing frequency of looks for each group in social orientation task

A Shapiro-Wilks test showed that the data for the hearing-impaired and age-matched groups were normally distributed allowing an independent sample T-test to be used for analysis, whilst the data for the language-matched group was not normally distributed, meaning a non-parametric test, Mann-Whitney, was used.

A two-tailed independent sample T-test, comparing the results of the social orientation test for the hearing-impaired and age-matched groups showed no significant difference in the frequency of looks between these two groups (t = -0.84, df = 24, p = 0.41). This result contradicted the original hypothesis that the age-matched children would score more highly than the hearing-impaired children. This would suggest that hearing ability has no bearing on social orientation.

A Mann-Whitney test to compare the results for the hearing-impaired and language-matched children showed no significant difference between the frequency of looks made by the children in these groups (U = 25.0, p = 0.05). However, as the p value lies on the border of showing a significant difference, it could be suggested that there is a tendency for the language-matched children to look more frequently in this task than the hearing-impaired children. Visual analysis of the box plot in Figure 1 supports this. The language-matched group consists of only a small sample, and with added subjects, a more significant difference may have been found. The nature of the task may also have affected the results, as the younger, language-matched children were more motivated by the activity than the older children, suggesting the task was more age-appropriate for the language-matched group.

Qualitative Observations

Many of the older hearing-impaired children, and the majority of the age-matched children were unable to sustain attention to the toy for a full minute. Their diminished motivation to participate in the task may be reflected in the results obtained, when compared with the language-matched children whose interest was maintained throughout the activity.

2) Egg Task

The individual tasks which comprised the 'Egg task' will be analysed individually in the following sections, however the combined scores were analysed to establish

whether there was a difference overall, when comparing the hearing-impaired children with the language-matched and age-matched children. The maximum score available for this task was 24. Table 4 provides a summary of the overall results.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	19.5	20.5	3.80	12	24
Age-matched	21.3	22.0	2.96	13	24
Language-matched	19.4	18.0	2.30	18	24

Table 4 Total scores obtained for the combined aspects of the Egg task, for all groups

The data for all individual tasks within the Egg task was found to be not normally distributed, and so a Mann-Whitney test was used to analyse all data. In the case of the overall Egg task scores, no significant difference was found in the number of looks made by the hearing-impaired and the age-matched children, $U = 62.0$, $p = 0.25$. Similarly, no significant difference was found between the hearing-impaired and language-matched children, $U = 44.5$, $p = 0.74$. These results contradict the original expectation that the hearing-impaired children would not perform as well as their age-matched peers, however, it was surprising to find that the language-matched children, despite there being no overall difference, had a higher minimum score than the older, hearing-impaired children. The small size of the sample of language-matched children could have affected this result, or this may be an indication that language is playing some part in the children's abilities to participate in activities involving joint attention.

Qualitative Observations

Child JOL (hearing-impaired) attended without hearing aids. Despite the fact the tasks were conducted in a manner which ensured that hearing provided no significant advantage, the absence of hearing aids, considering they would normally be worn at school, could have been a factor in this child's poor score.

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2a)   Social Referencing

The social referencing task measured how many looks to the tester were made when the eggs were shaken, with a maximum score of 6. Table 5 summarises the results, and Figure 2 compares the groups.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	5.1	6.0	1.23	2	6
Age-matched	5.6	6.0	1.00	3	6
Language-matched	5.4	6.0	0.98	4	6

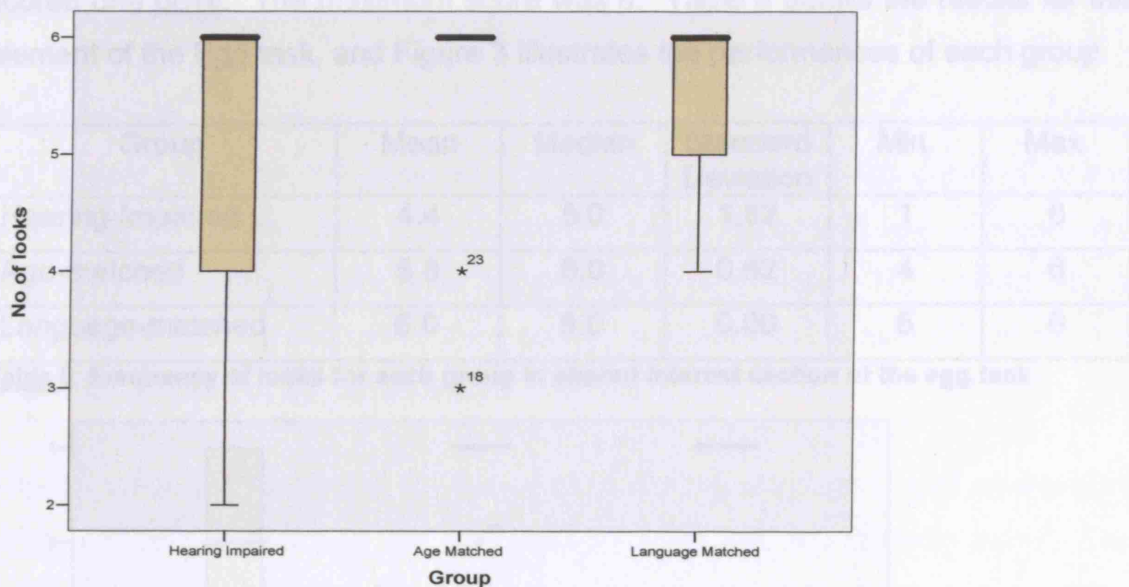**Table 5** Frequency of looks for each group in social referencing section of the egg task

Figure 2 Box Plot comparing social referencing data for each group

Statistical analysis indicated no significant difference between the frequency of looks made in social referencing by the hearing-impaired children and by the language-matched children, $U = 43.0$, $p = 0.61$. There was also no significant difference between the results of the hearing-impaired group and the language-matched group, $U = 64.5$, $p = 0.22$. However, there are two outliers visible within the age-matched group, and if these were removed, it is possible that a significant difference would have been found between this and the hearing-impaired group.

Qualitative Observations

Child JOL affects the results for the hearing-impaired group, scoring the lowest in the group. This may be due to the fact that this child participated without hearing aids, in which case the results for the hearing-impaired group could have looked more like those for the language-matched group. However, it is also possible that this child genuinely lacks awareness of the tester in this task.

2b)   <u>Shared interest</u>

In this activity, the child's gaze was monitored as the tester opened the egg to reveal a small object. If they looked at the tester, sharing interest in the object they scored one point. The maximum score was 6. Table 6 details the results for this element of the Egg task, and Figure 3 illustrates the performances of each group.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	4.4	5.0	1.82	1	6
Age-matched	5.8	6.0	0.62	4	6
Language-matched	6.0	6.0	0.00	6	6

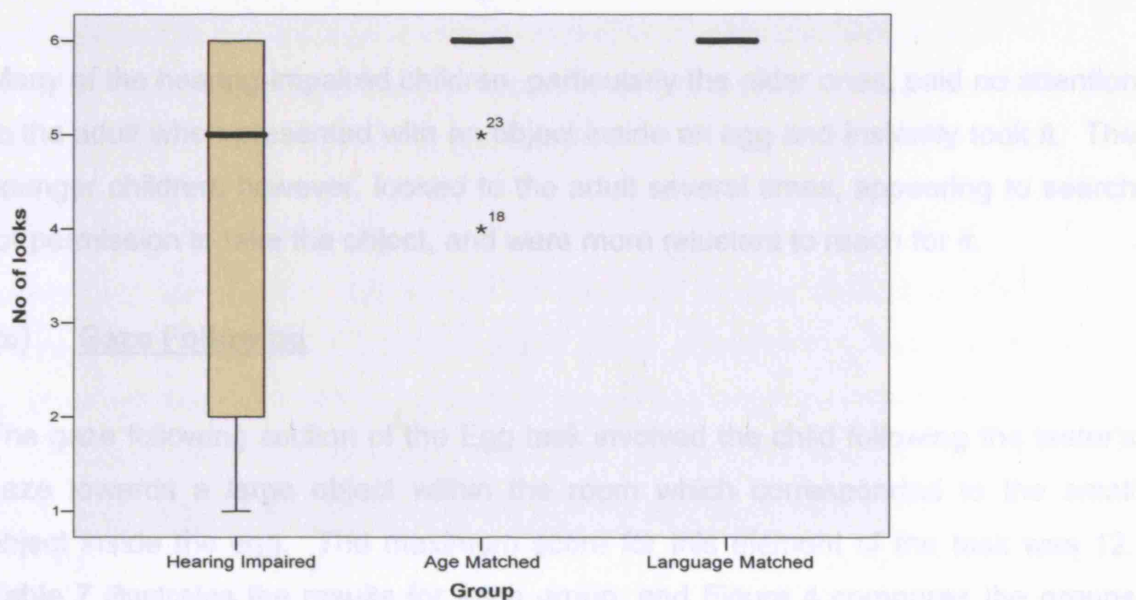**Table 6** Frequency of looks for each group in shared interest section of the egg task

Figure 3 Box Plot comparing shared interest data for each group

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Analysis revealed a significant difference between the performance in sharing interest of the hearing-impaired children and the age-matched children, U = 41.5, p = 0.015. There was also found to be a significant difference between the hearing-impaired group and the language-matched group, U = 17.5, p= 0.009. In both cases, the hearing children performed significantly better than their hearing-impaired peers, demonstrating more instances of shared interest with the tester. This supports the hypothesis that the hearing children would perform better in activities testing joint attention skills. This could suggest that hearing status, rather than stage in development affects a child's awareness of the use of eye contact to share interest in an object, as the younger children, at the same stage in their development of language as their hearing-impaired peers performed significantly better in this task.

Qualitative Observations

JOL scored only 2 on this task, and again, consideration of the affect of lack of hearing aids must be taken into account. The other children who achieved low scores on this task were the older hearing-impaired children. The appropriacy of this particular task for children of this age may be questionable, and should also be taken into account when considering the results.

Many of the hearing-impaired children, particularly the older ones, paid no attention to the adult when presented with an object inside an egg and instantly took it. The younger children, however, looked to the adult several times, appearing to search for permission to take the object, and were more reluctant to reach for it.

2c)   Gaze Following

The gaze following section of the Egg task involved the child following the tester's gaze towards a large object within the room which corresponded to the small object inside the egg. The maximum score for this element of the task was 12. Table 7 illustrates the results for each group, and Figure 4 compares the groups performances.

Group	Mean	Median	Standard Deviation	Mini.	Max.
Hearing-Impaired	10.0	9.5	1.47	8	12
Age-matched	9.9	10.0	1.93	6	12
Language-matched	8.1	8.5	1.91	6	12

Table 7 Frequency of looks for each group in gaze following section of the egg task
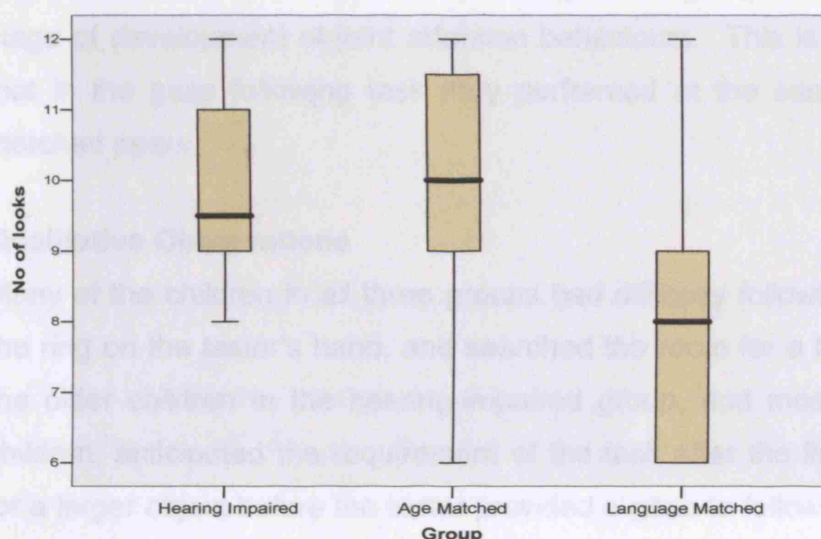

Figure 4 Box Plot comparing following gaze data for each group

A Mann-Whitney test showed there was no significant difference between the hearing-impaired and the age-matched children's abilities to follow gaze, U = 80, p = 0.84. However, a significant difference was found between the results for the hearing-impaired group and the language-matched, younger children, U = 22.5, p = 0.04.

Surprisingly, considering the results of the task testing shared attention, the hearing-impaired children followed gaze more consistently than the younger language-matched children. The sample size of the language-matched group was significantly smaller than the other two groups, perhaps affecting the significance of this finding. Also to be noted is that only one language-matched child (TB) scored full marks. This child has a language age at the 4-word level, which is higher than the other children in the group, possibly affecting the performance. Furthermore, two of the children in the same group are only fourteen months old. Children begin

to follow gaze and pointing gestures at approximately twelve months (Scaife & Bruner, 1975) so it is not unreasonable to expect these children to follow gaze less often than the other children in the group.

It is possible that the hearing-impaired children's lack shared interest in an object with the tester has no relation to their stage of language development, nor to their stage of development of joint attention behaviours. This is supported by the fact that in the gaze following task they performed at the same level as their age-matched peers.

Qualitative Observations

Many of the children in all three groups had difficulty following the adult's gaze to the ring on the tester's hand, and searched the room for a larger object. Many of the older children in the hearing-impaired group, and most of the age-matched children, anticipated the requirement of the task after the first egg, and searched for a larger object before the tester provided a gaze to follow. Despite the fact that the testers made every effort to obtain the child's attention before they could locate the object, this could have affected the results as the child may not be considered to be following gaze if they already knew the object's location, making these actions very difficult to score.

3)   Blocking

The blocking task was carried out three times for each child, and the number of times they looked at the tester was recorded. Table 8 provides a summary of the results. Figure 5 shows a box plot comparing the results obtained for each group.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	2.0	2.5	1.24	0	3
Age-matched	2.3	2.0	0.75	1	3
Language-matched	0.9	1.0	1.07	0	3

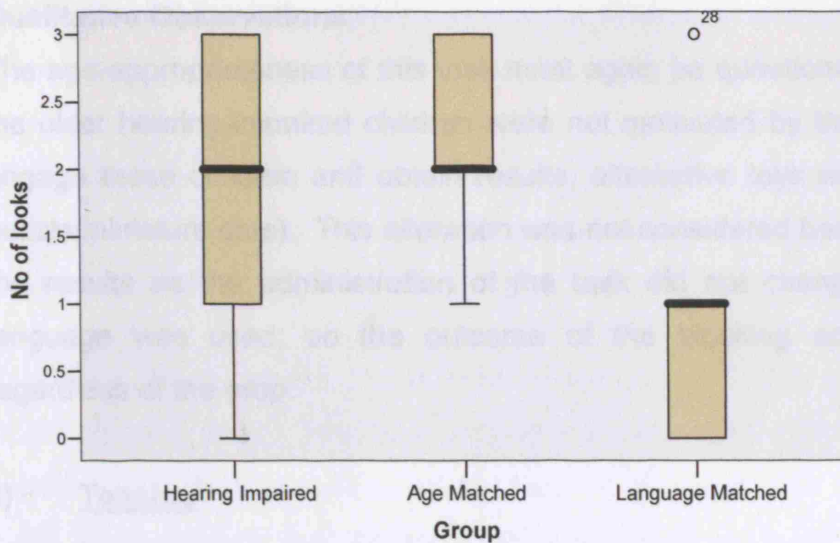Table 8 Frequency of looks for each group in the blocking task

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Figure 5 Box Plot comparing data for each group in blocking task

A Shapiro-Wilks test confirmed that the data for this test was not normally distributed, for all groups. The Mann-Whitney test used to analyse the data indicated no significant difference between the hearing-impaired and age-matched groups in the frequency of their use of eye contact in the blocking task, $U = 81.0$, $p = 0.87$. There was also no difference between the performances of the hearing-impaired and language-matched children in this test, $U = 25.5$, $p = 0.07$. Visual analysis of the box plot in Figure 5 suggests that if the outlier in the language-matched group (child TB) were removed, a significant difference may exist, but as previously mentioned, the sample size of this group may have a bearing on this.

With the outlier removed, the result for the blocking task would appear to mirror the result for the gaze following task, with the hearing-impaired children performing better than the language-matched children. This contradicts the original hypothesis that the hearing-impaired children would perform more poorly on these tasks due to delayed development of joint attention behaviours. These results would again imply that the hearing-impaired children are at the same stage in their development of joint attention as their age-matched peers, suggesting an alternative hypothesis must be formed.

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Qualitative Observations

The age-appropriateness of this task must again be questioned, as the majority of the older hearing-impaired children were not motivated by the wind up toys. To engage these children and obtain results, alternative toys were used (i.e. jigsaw puzzle/miniature cars). This alteration was not considered harmful to the validity of the results as the administration of the task did not change, i.e. no additional language was used, so the outcome of the blocking action was the same regardless of the prop.

4) Teasing

The teasing task was also carried out three times for each child, and the number of times they looked at the tester recorded. Table 9 summarises the results. Figure 6 compares each group's results.

Group	Mean	Median	Standard Deviation	Min.	Max.
Hearing-Impaired	2.9	3.0	0.27	2.0	3.0
Age-matched	2.2	2.0	0.72	1.0	3.0
Language-matched	1.3	1.0	1.11	0.0	3.0

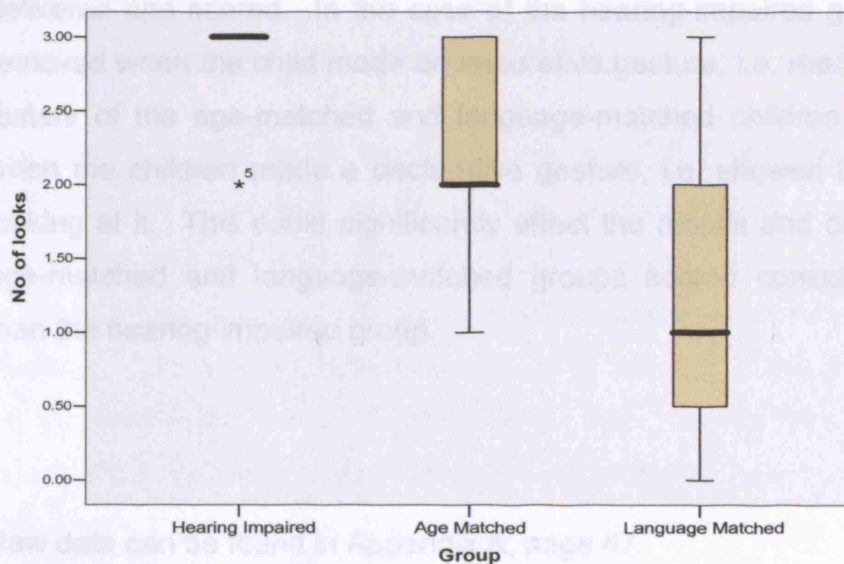Table 9 Frequency of looks for each group in the teasing task

Figure 6 Box Plot comparing data for each group in teasing task

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A Mann-Whitney test revealed a significant difference in the frequency of looks in response to a teasing action between the hearing-impaired children and the age-matched children, $U = 33.0$, $p = 0.002$. There was also found to be a highly significant difference between the hearing-impaired and language-matched groups, $U = 8.5$, $p = 0.000$. In both cases the hearing-impaired children performed better than the children in the other two groups.

These results contradict the original hypothesis that the age-matched children would perform better than the hearing-impaired children, and that the hearing-impaired and language-matched children would perform at a similar level. This could again suggest that language development is not a factor which affects this aspect of joint attention, and that hearing status and chronological age may be more significant. However, child TB in the language-matched group, with a language age at a 4-word level, scored highly, in contrast to the other children in the group, which could imply that stage in language development does play a part.

Qualitative Observations

There is one crucial discrepancy in the administration of the activity which requires consideration. Three different pairs of testers collected results and on examination of the video data it was found that there was a difference in the way the test was delivered and scored. In the case of the hearing-impaired group, the object was removed when the child made an imperative gesture, i.e. reached for the toy. The testers of the age-matched and language-matched children removed the object when the children made a declarative gesture, i.e. showed interest in the toy by looking at it. This could significantly affect the results and could explain why the age-matched and language-matched groups scored considerably lower scores than the hearing-impaired group.

Raw data can be found in Appendix A, page 47.

DISCUSSION

This study aimed to establish whether or not there is any difference in the joint attention behaviours of hearing-impaired children in comparison with hearing children of the same age and younger children of the same language age. Based on the conclusions of previous research carried out in the area, it was hypothesised that hearing children would perform better on tests of joint attention than their hearing-impaired peers. Quittner et al. (1994a) have stated that auditory input is essential for the development of language, cognition and behaviour. With this in mind, it was hypothesised that hearing-impaired children would show delays in joint attention behaviours, in comparison with hearing children of the same age. Furthermore, Baldwin (1995) has concluded that language is instrumental in the development of joint attention as it is required to draw the child in, and maintain their attention. Our hypothesis was that the hearing-impaired children in this sample would perform at the same level as the younger language-matched children. One further hypothesis was made in this study, that children with cochlear implants would perform better on tests of joint attention than those wearing hearing aids, following examination of research suggesting that this is the case (Smith et al., 1998)

Hearing-impaired vs age-matched children

The results of this study were not able to confirm the hypothesis that hearing children tend to perform better on tests of joint attention than hearing-impaired children of the same chronological age. No significant differences were found between these two groups in tasks involving social orientation, gaze following and blocking. This was surprising, particularly in the case of the gaze following activity, as Prezbindowski et al. (1998) found that hearing-impaired children spend significantly less time in episodes of joint attention than hearing children of the same age. It could be thought that by the age of 3 to 4 years as the children in this sample are, hearing-impaired children may have 'caught up' with the hearing children in their joint attentional skills. However, Mitchell and Quittner (1996) found

that hearing-impaired children are still delayed in visual attention at the ages of 6 to 13 years. It must be noted, however, that Prezbindowski et al. (1998) tested joint attention during natural free play activities. Our study used very structured tests, without the involvement of language which reduces the level to which this can be compared with Prezbindowski et al.'s research. If as Baldwin (1995) believes, language is integral to drawing a child into joint attention, it could be the case that the hearing children in this sample did not look as often as they would in a natural situation due to the lack of use of verbal language throughout the activities.

No significant difference was found in the social referencing task. However, if the outliers in the age-matched group were removed, it is likely that a significant difference would have been evident. This goes a little way to reinforcing the hypothesis that hearing-impaired children tend to perform worse on tests of joint attention, perhaps illustrating a delay in joint attention behaviours in hearing-impaired children.

Interestingly, the child in the age-matched group with the lowest score on this activity is one of the oldest in the group. This child's language is at the one word level. This could show that language is an influential factor in the development of skills in social referencing. However, older hearing-impaired children with the same language level performed better in this task, contradicting this idea.

Also in support of the hypothesis is the significant difference which was found in the shared interest task. Age-matched children performed better than hearing-impaired children. As language-matched children also out-perform the hearing-impaired subjects on this test, it would appear that language does not play an important part in this aspect of joint attention. It would appear that the hearing-impaired children are delayed beyond the younger age of the language-matched subjects for some other reason than their delayed language skills. Carpenter et al. (1998) explained that joint attention involves three levels of behaviour, firstly sharing attention, secondly following attention and lastly directing attention. This result would suggest that the hearing-impaired subjects in this study remain

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delayed at the sharing attention stage which is surprising considering no significant difference was found between the hearing-impaired and age-matched groups in the task examining gaze following. It could be that hearing-impaired children are delayed in their desire to share attention with an adult. It could also be the case that due to their hearing impairment they require either verbal or physical reminders that the adult is there, and that they are paying attention to the same object. As Harris et al. (1989) explain, hearing-impaired children need to be visually aware of both adult and object of focus. As the tasks in this study did not involve any language use at all, this may have been particularly difficult for the hearing-impaired subjects, as well as the fact that the adult was unfamiliar to them.

A very surprising outcome of the study is the highly significant difference found in the teasing task. The hearing-impaired children performed significantly better on this task than the age-matched children. This contradicts the original hypothesis, as according to previous research, hearing-impaired children would have been expected to perform worse than their age-matched peers. There were many methodological issues which could have affected the outcome of this particular task, and these will be discussed later.

Hearing-impaired vs language-matched children

The original hypothesis that hearing-impaired children would perform worse on tasks of joint attention than younger language-matched children was also not entirely confirmed.

No significant differences were found on the tasks of social orientation. This confirms the idea that hearing-impaired children are delayed in their skills of joint attention, and suggests that level of language comprehension is a significant factor in determining the development of joint attention behaviours, as previously suggested by Spencer & Waxman (1995).

As previously seen with the age-matched group, no significant difference was

found between the hearing-impaired and language-matched groups in the test of social referencing, however visual analysis of the box plot (figure 2) indicates that a trend appears to exist; younger children looking more often in the task than the hearing-impaired children. If a greater number of subjects were tested in the language-matched group, it is highly probable that a more significant result would have been obtained. This trend, and the superior performance of the language-matched children over the hearing-impaired children on a task involving shared interest supports the original hypothesis that hearing-impaired children would perform worse than language-matched children. The language-matched children are able to share attention, as described by Carpenter et al. (1998), and yet the hearing-impaired children appear to be delayed at this basic stage of joint attention. Prezindowski et al. (1998) found that hearing-impaired and hearing children follow the same pathway of development of joint attention skills until the age of two, where the pathways divide. They concluded that by the age of three, it is unlikely that joint attention provides the same strong context for language learning as it does for hearing children. In this case it would appear that language comprehension has not guaranteed the same level of development in the hearing-impaired children as it has the language-matched children, supporting Prezindowski et al.'s results.

The results of the gaze following task indicate no significant differences between the hearing-impaired and language-matched children, however, again, visual analysis of the box plot (figure 4) indicates that with a larger sample there is a potential difference, with the hearing-impaired children performing marginally better. If this were the case, the original hypothesis would be contradicted. It could also be an indication that the hearing-impaired children are further progressed than previously thought, in terms of their stage of development of joint attention behaviour. This would suggest that they are able to follow attention, and are more advanced in their skills of joint attention than their language-matched peers. Such a result would imply that language is in fact not as important as previously suggested and that chronological age is more significant.

Similarly, statistical analysis of the results of the blocking test indicated no significant difference, but with the outlier removed, it is likely a difference would have been found, with the hearing-impaired children scoring more highly than the language-matched subjects. This mirrors the result of the gaze following task, and could suggest that chronological age is the key factor here. The younger children appear to remain focused on the object only, with no regard for the participation of the adult, whilst the older children (hearing-impaired and hearing) take this into account. This was not the case for the hearing-impaired children on the social orientation task, but this task was different, being less structured in nature, perhaps accounting for the difference in performance. The outlier in the language-matched group (child TB) is the child with the highest language age, above the range of the rest of the group. This child scored full marks on all the tests. This could suggest that there is some language influence involved as this child is still much younger than the hearing-impaired children, and not the oldest of the language-matched group.

In the teasing element of the study, the hearing-impaired subjects scored more highly than their language-matched peers. This result again contradicts the original hypothesis, and it is possible that language is the defining factor in this case again for reasons already discussed, as seen by the fact that child TB scored full marks. However, there was a difference between the scores of the age-matched and language-matched groups, leading to the possibility that the factor is purely developmental, as Prezbindowski et al. (1998) believe. As previously mentioned, there are many methodological factors which could have affected the results in this aspect of the test, and these will be discussed later.

Cochlear implants vs hearing aids

The final hypothesis in this study was that within the hearing-impaired group, children with cochlear implants would perform better on tests of joint attention than children with conventional hearing aids. Evidence to confirm/reject this hypothesis is limited, as there are only three children in the sample who have cochlear

implants. The performances of these three children varied. One child scored one of the lowest scores of the hearing-impaired group. The other two scored two of the highest marks for the group. One of these children is amongst the younger of the group, so her high score is quite surprising, possibly supplying evidence that cochlear implantation benefits joint attention behaviours, however this is only one child and not enough to base firm evidence on. The general focus of this study was to compare the performance of hearing-impaired children with that of age-matched and language-matched children. The comparison of children with cochlear implants and hearing aids is useful additional information. However there are few children with cochlear implants in the sample, and many variables that could not be controlled for, for example, onset of hearing loss, unaided and aided thresholds, age of implantation and hearing aid use prior to implantation. This makes it very difficult to make accurate comment about the performance of the children with cochlear implants in this study.

Strengths and Limitations of this study

One strength of this study is the battery of tests that was used. Given the age of the children and their attention levels, the battery was quick and easy to administer, ensuring results were obtained for the maximum number of subjects in the time allocated, and also ensuring that the children's attention was not lost.

This study is unique in its sample as the hearing-impaired children and age-matched children are all members of the same class. This means that teaching methods and mode of communication in class are unlikely to be factors affecting the results, as they are consistent for all subjects.

The most obvious limitation of this study is the small sample number. With a larger sample it is suspected that more significant results would have been obtained.

Despite inter-rater reliability being 100%, the fact that three different pairs of testers were involved could have significantly affected the results. As previously

mentioned, in the teasing task, joint attentional skills were measured following an imperative gesture in the hearing-impaired group, and following a declarative gesture in the age-matched and language-matched groups. Given that this could dramatically affect the results obtained, the data for the teasing test should be viewed with caution.

The environment the testing took place in was within the children's nursery, and was often noisy, with other children distracting the subjects during testing. This may have affected the results as the environment was unpredictable, and different for each child, according to the time of day, activities going on in the nursery etc. Alongside this, testing was not carried out at the same time of day for each subject, which could have an effect on the children's performances, depending on their levels of attention and motivation.

Most research previously carried out in this area has focused on children interacting with familiar adults, usually parents. Due to time constraints, testing began with no prior interaction with the children, so the testers were entirely unfamiliar adults. This could also have affected the performance.

Another limitation is the measure used to establish language age. Considering language age was used to group subjects, this particular measure may not be considered sensitive enough and could affect the differences found between the groups. Subject TB could be an example of this, and further language testing may indicate that this child is not a suitable language-matched subject.

Also a limitation is the age appropriacy of the tests carried out. Many of the older children were not motivated by the tasks, or the toys used, and as previously discussed, were able to predict the expectation of the task, making it difficult to score. This could detract from the reliability of the results obtained.

In the case of the blocking and teasing tasks, only three measures were taken. This limits the scope for differences to be visible as there is not a wide enough

range of results possible. If more measures were taken, more significant results may have been found. However, given the age of the children in the study, and their attention span, this may not have been possible.

Despite these limitations, this study provides interesting results in the field of development of joint attention, and raises further questions which, with more work could provide more depth to the subject.

Further research

Firstly, there is controversy concerning the difference in development of joint attention and theory of mind caused by parental hearing status. Meadow-Orlans & Spencer (1996), Peterson & Siegal (1995) and others have found that the mother's hearing status is significant, hearing-impaired children of hearing mothers being most heavily disadvantaged. The hearing-impaired subjects in this study all have hearing mothers. It would be useful to extend the sample to include hearing-impaired children of hearing-impaired mothers, and also hearing children of hearing-impaired mothers. It could also be interesting to group subjects according to their mode of communication, i.e. sign, spoken language, or bilingual.

The fact that language may affect the joint attention behaviours of young children has been acknowledged in this study, however it would be interesting to establish whether there is any difference between the joint attention behaviours of children according to their home language and looking further into cultural differences if any should exist in this area of development.

The age of the majority of the subjects in this study prevented any testing of theory of mind abilities to be carried out. According to Tomasello (1995), joint attention and theory of mind are related in terms of development. As the results of this study do not entirely support a conclusion that hearing-impaired children are delayed in joint attention skills, it would be useful to carry out further testing with these children to investigate their performance on theory of mind tasks.

The older hearing-impaired children were difficult to test on measures of joint attention as they were able to predict the expectation of the task and were not motivated by the activities. It would be useful to measure their theory of mind abilities to see if they have reached a level beyond that of joint attention. In addition to this, it would be interesting to include some measure of directing attention, to provide a clear picture of these children's level of joint attention (Carpenter et al. (1998)) .

Prezindowski et al. (1998) found that hearing-impaired children spend more time in co-ordinated joint attention, whilst hearing children of the same age spend more time in symbol-infused joint attention. This study only investigates episodes of co-ordinated joint attention. It would also be interesting to include a measure of symbol-infused attention, as this could give more detailed information about the stage at which each child is at, and any differences which appear between groups.

Conclusion

The aim of this study was to compare the joint attention skills of hearing-impaired children with hearing children of the same chronological age and younger children of the same language-age.

The hypotheses that the hearing-impaired children would perform worse on tests of joint attention than age-matched and language-matched children could not be confirmed, however interesting evidence was found both in support and in contradiction of this hypothesis.

The small sample size prevents generalisation being made, however the general finding according to statistical evidence is that hearing-impairment does not hinder a child's development of joint attention skills.

TOTAL WORD COUNT: 9,892

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APPENDICES

a) **Raw Data**

b) **Derbyshire Rapid Screening Test**

RAW DATA

	Child	Grp	CA	LA	SO	ET	Shake	Open	Object	Block	Tease
1	FB	1	53	1	0	15	4	2	9	0	3
2	AB	1	45	1	1	21	6	6	9	3	3
3	MC	1	44	1	3	23	6	6	11	2	3
4	ME	1	53	2	3	23	6	5	12	0	3
5	KK	1	46	1	3	24	6	6	12	3	2
6	JOL	1	45		2	12	2	2	8	3	3
7	JO	1	52	1	2	23	6	6	11	3	3
8	JW	1	41	1	3	18	4	5	9	3	3
9	MA	1	59	1	4	14	4	1	9	2	3
10	EG	1	52	5	2	22	5	6	11	0	3
11	KG	1	66	1	3	17	6	2	9	1	3
12	TL	1	47	1	4	20	6	4	10	3	3
13	KO	1	69	1	2	22	5	5	12	2	3
14	LS	1	61	1	3	19	6	5	8	3	3
15	KEZ	2	50	3	3	21	6	6	9	3	3
16	BL	2	48	1	2	19	6	6	7	3	3
17	MP	2	49	1	3	21	6	6	9	3	3
18	HS	2	50	1	1	13	3	4	6	2	2
19	BC	2	45		3	23	6	6	11	3	2
20	CC	2	46	5	1	22	6	6	10	1	2
21	DC	2	50	5	5	24	6	6	12	2	2
22	DHL	2	49	5	5	24	6	6	12	3	2
23	RJ	2	48	5	2	21	4	5	12	2	1
24	SS	2	50	5	5	22	6	6	10	2	3
25	BW	2	45	5	2	23	6	6	11	2	2
26	HSW	2	38		3	22	6	6	10	1	1
27	SA	3	37	2	3	18	4	6	8	0	1
28	TB	3	36	4	6	24	6	6	12	3	3
29	JW	3	37	0	3	18	6	6	6	0	0
30	KG	3	14		7	18	6	6	6	1	1
31	RO	3	31		3	21	6	6	9	1	2
32	TJ	3	28	1	3	18	6	6	6	1	2
33	JWF	3	14	0	3	19	4	6	9	0	0

Group 1   Hearing-impaired children
      2   Age-matched hearing children
      3   Language-matched hearing children

CA   Chronological age (months)
LA   Language age (word level)
SO   Number of looks in social orientation task (in one minute)
ET   Combined score for all components of the egg task (maximum 24)
Shake   Number of looks for social referencing component of egg task (maximum 6)
Open   Number of looks for shared interest component of egg task (maximum 6)
Object   Number of looks for gaze following component of egg task (maximum 12)
Block   Number of looks for blocking task (maximum 3)
Tease   Number of looks for teasing task (maximum 3)

DERBYSHIRE RAPID SCREENING TEST

(Taken from Knowles, W. & Masidlober, M. (1982) <u>Derbyshire Language Scheme</u> Derby:
Derbyshire County Council)

Name: **DOB:**   **Age:**

1. <u>Real Objects</u>
   Show me/Give me the...
   a)   Cup / Spoon / Brick   /3
   b)   Key / Fork / Pencin   /3

2. <u>Pictures of Actions</u>
   Who's/Give me the one/which one's...
   a)   Eating / Sleeping / Washing   /3
   b)   Drinking / Brushing / Sitting down

3. <u>2WL</u>
   Brick, spoon, doll, knife (near child)   (replace in original position)
   Box, plate, cup (6" away)
   a)   Put the spoon in the cup
   b)   Put the brick on the plate
   b)   Put the doll in the box

   Alternative:
   Equipment: doll, teddy bear, toy chair, bed, table
   a)   Put dolly on the bed
   b)   Put teddy on the table
   c)   Put teddy on the chair

4) <u>3WL</u>
   a)   Put the knife under the plate
   b)   Put the brick in the cup
   c)   Put the spoon under the box

   Alternative:
   Equipment: doll, teddy bear, bed, box (upside down), table
   a)   Put the doll under the table
   b)   Put the teddy on the bed
   c)   Put the teddy under the box

5) <u>4WL</u>
   Equipment: same as item 3 plus pencil

   <u>Demonstrate</u>
   a)   Put the doll in the box
   b)   Put the spoon in the box
   c)   Put the doll and the spoon in the box
   <u>Request</u>: (give as single unit)
   d)   Put the spoon and the knife on the plate
   e)   Give me the cup, the box and the doll
   f)   Put the pencil in the box and the knife in the cup
   g)   Put the brick under the box and give me the plate