

## Language and Theory of Mind in Children with Hearing Impairment - A Preliminary Study

Meera S. S.<sup>1</sup>, Thulasi Prasad<sup>2</sup> & Rashmi. J. Bhat<sup>3</sup>

### Abstract

*Theory of Mind (ToM) is the ability to understand another person's mind. Presence of a sound ToM is necessary for a mature understanding of all social situations and relationships. A poor or an absence of ToM in an individual can lead to a breakdown in communication. Language is an important tool by which ToM skills are expressed and thus used. Children with hearing impairment (HI) represent a group who show a delay in the development of ToM. The present study investigated ToM abilities in children with HI. The study involved 10 typically developing children as the comparison group and 10 children with HI as the clinical group. The Theory of Mind Scale (Wellman & Liu, 2004) was administered on all the children. The performance of the children with HI did not match the comparison group children, despite being matched for their language age. The mothers of the children with hearing impairment reported lack of or minimal use of mental state language while conversing with their children. The acquisition of ToM, it may be said then, is not just governed by language age, as generally accepted, but it is a result of language age, hearing age, chronological age as well as the use of higher mental state language during conversations with the child. It is recommended that the use of mental state language must be included as a part of the prescribed aural habilitation program.*

**Key words:** *Mental state language, Early conversation.*

Human beings are the highest evolved animal species in terms of communication skills. Human communication defined in the simplest form is social interaction among people. Thus, it can be considered as a form of social behavior. Communication through the verbal mode is uniquely human. It is language that makes us efficient at communication. Language may be defined either as a system of symbols and codes used in communication or as a form of social behavior shaped and maintained by a verbal community (Hegde, 1995). Language can be subdivided into phonologic, morphological, syntactic, semantic and pragmatic components. These areas of language have been studied in great detail in both children with and without communication disorders. The pragmatics of language is the study of the rules that govern the use of language in social situations. Pragmatics is an important part of every human being because it is this aspect that explains what we do with our language, how we modify what we say based on the context, what is our intention when we say something and likewise what opinion might the other person hold if this is what is said (Hegde, 1995).

Theory of Mind (ToM) forms an important aspect of the pragmatics of language. Presence of a sound

ToM is necessary for mature understanding of social situations and relationships. ToM is the ability to attribute mental states (beliefs, intents, desires, pretending, knowledge, etc) to oneself and to others, and also to understand that others have beliefs, desires and intentions that are different from one's own (Premack & Woodruff, 1978). The presence of ToM facilitates better human communication by allowing one to predict, understand and explain other people's behavior.

Most literature about ToM has been with respect to children with Autism Spectrum Disorders (ASD), where a core cognitive feature is in the difficulty in understanding another person's perspective. It presents as a universal commonality in these children. Another group of children who show a deficit in this area are the children with Hearing Impairment (HI). Research in this area is more recent and is less than two decades old.

Normal children develop the ToM by around 4-5 years of age (Garfield, Peterson & Perry, 2001; Peterson & Siegal, 1995). It is known that children with HI acquire ToM with a delay of 3-4 years (de Villers & Pyers, 2000). Also, it is a well-documented phenomenon that children's performance on standard ToM tasks, such as the false belief tasks, improves with age (Wellman, Cross & Watson, 2001).

Early identification of HI, advances in hearing aids and related technologies and early access to quality intervention programs have resulted in higher levels of linguistic competency at faster rates (Ling,

1. Department of Speech Pathology and Audiology NIMHANS, Bangalore.

2. All India Institute of Speech and Hearing, Mysore.

3. Dr. S. R. Chandrasekhar Institute of Speech & Hearing Bangalore.

Table 1. Demographic data of participants

Groups	Age range			Gender		Hearing level	Mean hearing age (in years)
	CA (Years, months)	LA	Mean age (In years)	M	F		
Clinical Group	4.5 to 9.2	3.11 to 5.11	6.03	5	5	Severe and profound HL	3.13
Comparison Group	4.1 to 5.11	3.11 to 5.11	5.1	5	5	Within normal limits	NA

HL: Hearing Loss, Y: Years, NA: Not Applicable, LA: Language Age, CA: Chronological Age, LA: Language Age, M: Male, F: Female

2002). However ToM development and its influence on linguistic competency in the hearing impaired population has not been considered until recently (Rommel, Bettger & Weinberg, 2001). Areas of syntax, morphology, semantics and also pragmatic deficits have been studied in children with HI and have been popular areas of research. However, the area of ToM is less frequently studied in these children and even less or hardly used during intervention.

Children with HI have an atypical language development with a delay in the acquisition of the ToM (Peterson & Seigal, 2000). Due to sensory deprivation in the formative years, they tend to lose out on a range of information that would otherwise help the child develop mental state attributes and also facilitate ToM acquisition. An important way a child becomes aware of another person's mental state is through interpersonal communication. Thus, it is important to

provide children with HI, a different form and content of language input in the early years, which is not merely concrete language, but language that involves mental state attributes (references to beliefs, desires, emotions, etc.) and a language referring to thoughts of another person in a given physical context. There is strong evidence that exposure to mental state language, facilitates a child's acquisition of ToM (Adrian, Clement & Villanueva, 2007).

At present there is a dearth of information and experimental evidence involving the development of ToM in Indian children with HI. Research in this area is essential considering the cultural differences between our population and that of the Western community. Thus, the present study, which is a preliminary investigation, aims at establishing if there is a delay in the acquisition of ToM in children with HI in the Indian scenario.

Table 2. Details of the matching of language age of participants in the two groups.

Test administered	Language age	HI Number (%)	Normal hearing Number (%)	p value
RLA	2	2 (22)	3 (33)	0.865♦
	3	6 (67)	5 (56)	
	4	1 (11)	-	
ALD	2	3 (33)	4 (44)	0.565♦
	3	5 (56)	5 (56)	
	4	4 (44)	5 (56)	
CRLA	3	4 (44)	4 (44)	0.574♦
	4	1 (11)	-	
SECS	2	7 (78)	6 (67)	1.000♦
	3	2 (22)	3 (33)	

♦ Not significant

1= Language age (LA) between 2 years to 2 years 11 months; 2= LA between 3 years – 3 years 11 months; 3= LA between 4 years to 4 years 11 months; 4= LA between 5 years to 5 years 11 months.

ALD: Assessment of Language Development; CELA: Combined Expressive Language Age ; CRLA: Combined Receptive Language Age; ELA: Expressive Language Age; HI: Hearing Impaired; RLA: Receptive Language Age; SECS: Scales for Early Communication Skills for hearing impaired children

## Method

### Participants

This is a cross sectional two group or standard group comparison design which involved participants from a middle socio economic status. The two groups were matched for 'receptive and expressive language age' (See Table 2) and 'gender' (5 males and 5 females in each group). Participants for the study were chosen based on simple random sampling from a school setting, between the age ranges of 4 to 10 years. They were divided into 2 groups, namely, a group of participants with HI (clinical group) and a group of participants with normal hearing (comparison group).

The clinical group was a total of 10 participants who use Hearing aids. All the participants were chosen such that their language age was between 3 years 11 months to 5 years 11 months based on two developmental language tests namely the 'Assessment of Language Development' (Lakkanna, Venkatesh & Bhat, 2008), and the 'Scales of Early Communication Skills for Hearing-Impaired Children' (Moog & Geers, 1975). These participants were selected from a school for hearing impaired, which trains the mother and the child with HI. An aural-oral method is used as the mode of communication. All the participants in the clinical group had bilateral severe or profound hearing loss, identified before the age of 3 years. The participants are born to parents who can hear. All the participants used verbal mode of communication and spoke in Kannada. These participants have been part of the specified formal training program for at least 1 year. Participants diagnosed with cognitive, behavioral disorders and any other medical diagnoses (epilepsy) were excluded from the study. The comparison group comprised a total of 10 participants with normal hearing, between the age ranges of 4-6 years. All participants were assessed for their language age (3 years 11 months to 5 years 11 months) based on the above mentioned language tests. They were matched for gender with the clinical group (See table 1). All participants were selected from a regular school.

### Materials

The 'Theory of mind scale' (Wellman & Liu, 2004) was modified with permission and used to evaluate the performance of the participants on the ToM task (Appendix 1). The following are the sub-tests from the 'Theory of Mind scale' that were administered to each participant in Kannada. 1) Diverse Desires 2) Diverse Beliefs 3) Knowledge Access 4) Contents False Belief and 5) Real-Apparent Emotion. The subtests were arranged in increasing complexity

(a scalogram). The sub-tests comprised both target and control questions, to check if the participants had comprehended the task. Participants were given a score of 1, if they answered the target question and scored 0, if they did not. Each participant could get a score between 0-5. The control questions were not scored. However, to get a score of 1 for each of the target question, the child had to answer the control question correctly. This was done to eliminate a guessed response for the target question. Since this test is a scalogram a child who, for example, got a score of '4', indicated that he/she had responded correctly to the first 4 subtests and not the 5th subtest. Similarly a score of '2/5', indicated that the child had answered the first 2 subtests accurately.

The 'Assessment of Language Development' (ALD) and 'Scales of Early Communication Skills for Hearing-Impaired Children' (SECS) were used to evaluate the children's language. Both tests assess a child's receptive and expressive language skills. While the ALD assesses a child's language skills from birth to 7 years 11 months, the SECS assess a child's language skills from 2 years to 8 years. The SECS is especially designed to evaluate the language skills of the children with HI. It includes a section on non-verbal communication for both receptive and expressive language skills. The item receives a '+' rating if the child demonstrates the skill enough to indicate that he is capable of performing at that level. An item receives a rating of '±' if the child has demonstrated the skill on one occasion and a rating of '-' if the child has not demonstrated the skill or it has occurred only by accident. One point is assigned to each skill which is consistent and ½ point to a skill not consistent. The participant does not get a score, if skill is absent or has occurred by accident. These points were added to obtain the raw scores. These raw score values are utilized to obtain the percentile and standard scores and later the language age. Similarly in the ALD test, a participant receives 1 point for a correct response and no points for incorrect responses. The total score gives the raw score which was then utilized to compare with the criteria for a particular age level.

### Procedure

Parental consent was obtained for all the participants. The child's assent was obtained whenever possible. The mother of every participant was interviewed about the participant's demographic data before the participant was assessed. In addition the mothers of the participants were interviewed regarding the use of Mental State Language (MSL) with their wards. The participants were tested in a noise free and distraction free room to the best possible extent. Each participant

Table 3. Comparison of performance on the “ToM scale” among the two study groups.

	HI	Normal hearing
Mean (SD)	2.6 (1.3)	5 (0.0)
Median	2.5	5
Range	1-5	5-5

**HI: Hearing Impaired**

was tested individually. The participants within the comparison group were tested first, followed by the participants within the clinical group. Each participant was assessed using the ALD and the SECS. On meeting the inclusion criteria for each group, the participants were assessed on the ToM sub-tests.

language age with the comparison group i.e., 3 years 11 months to 5years 11 months, their performance on the ToM tasks did not match the comparison group. The participants in the clinical group performed correctly on subtests (1) i.e., Diverse Desires and subtest (2) i.e., Diverse Beliefs. Only five participants passed the subtest (3) i.e., Knowledge access, two children passed the subtest (4) i.e., Contents False Belief, while only one participant passed all 5 subtests (See Table 4).

**Results**

Table 3 shows the mean, median and range of scores for the two groups. Since the sample size chosen was small (n=10 in each group) and the data did not follow normal distribution, all the data in the present study were analyzed based on the Mann- Whitney U test, a non-parametric equivalent of the Student’s t-test, which compares 2 independent groups. The results revealed that there was a significant difference in the performance of participants in the two groups, on the ToM scale (p=0.001).

Purely, on the basis of an observation in the performance trend of all the 10 participants in the clinical group (See Table 4), older children and those with greater hearing age performed better than their younger counterparts with lesser hearing age. Thus, this trend shows a delay in the acquisition of ToM within the hearing impaired population.

All the participants in the comparison group passed all the 5 subtests of the ToM scale. Though the participants in the clinical group were matched for their

Also, on enquiry, the mothers of the participants in the clinical group reported lack of or minimal use of mental state language when conversing with them. They reported use of concrete words and words which could be communicated through gestures only.

Table 4. Chronological age, hearing age and test results of the children with HI (clinical group).

Subjects Clinical group	Chronological age (in years, months)	Hearing age (in years, Months)	Theory of Mind Scale Subtests				
			1	2	3	4	5
1	4, 5	2, 5	+	+	-	-	-
2	4, 10	3	+	+	-	-	-
3	4, 11	2	+	+	-	-	-
4	5	1, 5	+	+	-	-	-
5	5, 7	3, 2	+	+	+	-	-
6	6, 4	2	+	+	-	-	-
7	6, 5	3, 5	+	+	+	-	-
8	6, 9	3, 5	+	+	+	+	-
9	7, 9	5, 9	+	+	+	-	-
10	9, 2	4, 2	+	+	+	+	+

“+” : Pass, “-” : Fail

## Discussion

One would have expected that children with HI who were language age matched to the comparison group, would perform at the same level in ToM tasks as the normal children. However, the present study showed that the performance of the two groups on the ToM tasks was different. Children with HI performed poorer even though some of them were older than children with normal hearing. This shows a delay in the acquisition of ToM within the hearing impaired population.

The delay in the acquisition of the ToM in children with HI can be attributed to the lack of early conversation ("early conversation hypothesis") and minimal use of mental state language during communication.

Peterson and Siegal, (1995) postulated the 'early conversation hypothesis' to explain ToM deficits in children with HI. They state that, early conversational experiences with the family who also incorporated mental state language into their utterances, facilitate the development of ToM. The hearing loss limits the child from over hearing what his/her parents talk about other people's motives/ actions or beliefs. They do not get to hear others talking about their own thoughts, feelings and how they share the same. Thus, paucity of early inter personal communication about mental processes at home, is likely to account for the observed delays in the ToM in children of hearing parents (Courtin, 2000). All ten children in this study have had deprivation of early conversation as indicated by their hearing age.

More the involvement in mental state conversations at home, more does it facilitate children to develop and succeed in ToM tasks (Dunn, Brown, Slomkowski, Tesla & Youngblade, 1991). In a study by Collins, (1969, as cited by Peterson & Seigal, 1995) a child with HI loses out on this input because majority of the mothers use concrete words (e.g. table, banana) to communicate with their children and hardly any abstract words (e.g. imagine, wonder). Mothers in our study have reported negligible use of mental state language during interaction with their children.

Since chronological age showed a positive correlation it seems that these children develop the ToM by observation. As they grow their experiences vary. Probably this visual experience and observation enhances ToM development.

It is observed that deaf children from deaf families converse with their parents in sign language about memories, thoughts and ideas just as frequently as hearing children converse verbally with their hearing parents about such topics (Meadow, Greenberg, Erting & Carmichael, 1981) and thus do not show a delay in the acquisition of ToM. In the present study all children were born to hearing parents.

Children with HI can be trained in acquiring the ToM to communicate better. In turn better interpersonal communication leads to improved quality of life for the individual with HI. Speech Language Pathologists must ensure that therapy focused on ToM is provided to the children with HI. It is also important that we create awareness among the parents of children with HI on the benefits of involving mental state language in their daily interaction with the child.

The limitation of this study lies in the small sample size chosen and also that the subjects for the study have been obtained from only one school. The language abilities of each child could have been established in more detail, in terms of the components of language. The parental interview on use of mental state language has not been quantified. An in-depth study attempting to differentially control variables such as language age, chronological age, and hearing age is needed.

## Conclusion

It might be expected that all the children with HI, whose language age is matched with the comparison group, would perform on the ToM tasks at the same level, which is clearly not the case. There was a significant difference in the performances between the two groups on ToM tasks. Older children and those with a greater hearing age seemed to perform better than their younger counterparts. This leads to the conclusion that the acquisition of ToM is not just governed by language age, as generally accepted, but it is a concerted result of language age, hearing age, chronological age as well as the use of higher mental state language during conversations with the child. Since ToM acquisition enhances social functioning, children must be trained in this area as a part of the prescribed aural habilitation program. There is no published literature in this aspect of use of mental state language in children with HI in the Indian context. A more detailed assessment protocol including the ToM aspects must be developed followed by a good training module, which includes mental state language inputs.

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**Address for Correspondance :** Meera .S.S, #858, 8-B main, 17-cross, ISRO layout, Bangalore- 560078  
Email : ssmeeras@gmail.com

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## Appendix 1

## Theory of Mind Scale

This Wellman and Liu scale (Wellman & Liu, 2004) cited in an article by Rommel & Peters, (2008) has been modified with permission.

Theory of Mind Scale: A five-item version of Wellman and Liu's (2004) scale was modified (with permission) and administered in the following order. The scoring procedures including asking control questions to check for comprehension and memory were as given in the Wellman and Liu script.

(1) Diverse Desires: This tests the child's

understanding that different people may have different desires. The child is asked which of two foods (carrot or chocolate) he/she would want for a snack. Then the child is told that a character (Shiva) prefers the other food (e.g., carrot if the child prefers chocolate). Then the child is asked which food Shiva will pick for his snack. The child is scored as correct if he/she chooses the food that Shiva wants, rather than the food that the child wants.

(2) Diverse Beliefs: This tests the child's

understanding that different people can have different beliefs. The child is told that a character (Rani) wants to find her cat, and asked to guess in which of the two locations (trees or house) the cat is hiding. Then the child is told that Rani thinks the cat is in the other location (e.g., trees if the child thinks house). Then the child is asked where Rani will look for the cat. The child is scored as correct if he/she chose the location where Rani believes the cat is, rather than the location where the child believes the cat is (note: the true location of the cat is unknown).

(3) Knowledge Access: This tests the child's understanding that perceptual access leads to knowledge. The child is asked to guess what is inside an unlabeled cardboard box. Then the child is shown that the box actually contains a small toy elephant. Then the child is told that a character (Mani) has never seen inside the box, and asked if Mani knows what is inside. The child is scored as correct if he/she responds that Mani does not know, even though the child has seen inside and does know.

(4) Contents False Belief: This tests the child's understanding that people may hold false beliefs. The child is shown a Cadbury chocolate box and asked what is inside. Then the child is shown that the box actually contains a 1 rupee coin. Then the child is told that a character (Mahesh) has never seen inside the box, and asked what Mahesh thinks is inside. The child is scored as correct if he/she responds that Mahesh thinks there are chocolates inside, even though the child knows the that belief is false.

(5) Real-Apparent Emotion: This tests the child's understanding that people's facial expressions may not match how they feel inside. The child is told a story about a boy (Venu) who is being teased by some other children but does not want the other children to know that he is upset. The child is shown drawings of a happy face, a sad face, and a neutral face and asked to indicate how Venu really feels and how he tries to look on his face. The child is scored as correct if he/she indicates that Venu feels more negative than he looks.