

Listening Text Story Comprehension and Story Recall in Children with Autism Spectrum Disorders (ASD); A Glean to Social Inferencing Skills

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Running Title: *Listening text comprehension and story recall in autism spectrum disorders*

Abstract: ***Introduction:** Comprehension of oral or written language involves complex process that requires the processing of both literal and inferential information and involves various components. However, children and adolescents with Autism Spectrum Disorders (ASD) without cognitive impairment showed lacunae in their ability to infer meaning from spoken or test messages due to the specific pragmatic deficits. Present study investigated how ASD children with normal language (ALN) comprehend literal and inferential information in oral text. **Method:** Ten children with ALN without cognitive impairment in the age range of 5-8 years and ten age matched typically developing (TD) children participated in the study. Both TD and ALN group underwent evaluation for language skills, non-verbal cognitive skills using Assessment of Language Development (ALD) and Raven's Colored Progressive Matrices - 2 (CPM -2). In addition, ASD symptomatology was ascertained through Child hood Autism rating Scale 2 (CARS-2). Clinical and control groups were evaluated as to their listening text comprehension and recall using stories. The listening text comprehension task necessitate the participants to answer questions about the literal content of the story, as well as questions involving two types of inferences: text-connecting and gap-filling. **Results:** The results of the study revealed that TD group outscored the clinical group on listening text comprehension involving inferential processing skills in both text connecting and gap filling task. However, ALN group performance in literal comprehension task was comparable to that of TD group. The results indicated that despite of having normal cognitive abilities and language children's skills, the poor performance in inferential processing task by ALN group is due to underlying socio-pragmatic deficit as well as lack of social inferencing skills. There exists a strong relationship between morpho syntactic skills, vocabulary and story recall. **Conclusion:** It is concluded that there is strong relation exist between inferential processing skills and pragmatic deficits in ALN group. Further conclusion can be drawn that comprehension aids recalls by enabling the listener to build a more stable mental representation of the story. The pragmatics deficits in ALN compromises these processes.*

Keywords: Inferential skills, Autism Spectrum Disorders, Story recall, Semantic Pragmatic deficit, listening comprehension

1. Introduction

The linguistic skills alone are not enough for successful communication. Successful communication requires skills that expand over the information given linguistically, because there are contextual and social factors that continuously contribute to our interpretation and expression of language (Gibbs & Colston, 2012; Leinonen, Letts & Smith, 2000). In many situations, utterances possibly have many interpretations, however the hearer automatically attempts to make use of relevant information only in utterance interpretation; this is called inferential comprehension. A troubled inferential comprehension skill can result in literal interpretation there by misunderstanding the intention of what is been said, heard or read (Grice, 1989). There is a close connection between the role of inference in pragmatic interpretation. Pragmatics is the study of language use especially focusing on how an individual utilize contextual information in the comprehension and expression as well as how the contextual factors interact with the linguistic meaning (Sperber & Wilson, 1995, 2012). Pragmatic skills are determined by one's ability to make inferences through adaptation to the linguistic and physical

context and demands. The ability to make inferences is as essential as language skills for effective communication (Leinonen, Ryder, Ellis & Hammond, 2003). Human communication, whether it is verbal or nonverbal is primarily a matter of inference and language is an add-on. Hence, we can clearly conclude that human communication is arguably inferential (Sperber & Wilson 2012). Leinonen et al., 2003; Perkins 2007 reported that social comprehension or inferential processing skills are largely embedded in comprehension. In addition, they stated that long and short-term memory, theory of mind, reasoning skills, lexical, syntactic knowledge, integration and thinking remain central to the comprehension process.

Children with language impairments have difficulty in reporting verbal inferences, however it remains unclear if the underlying cause is the limitations in language comprehension, inability to access world knowledge or integrating the information in a discourse (Botting & Adams, 2005; Karainski & Weismer, 2010; Dodwell & Bavin, 2008). Among the neurodevelopment disorders, children with Specific language impairment (SLI) and Autism Spectrum disorders (ASD) demonstrated

communication problem which are characterized by impairment in pragmatic aspects of language expression and comprehension (Landa, 2000). It is quite apparent that a difficulty in social communication increases the risk of peer discrimination and difficulties with integrating in to the society (Finke, 2016; Landa, 2000). Though the social pragmatic skills improve over time in individuals with ASD, difficulties in making inferences persist in adulthood despite of average verbal intelligence spared structural language development (Jolliffe & Baron Cohen, 1999a, 2000); Loukusa & Moilanen, 2009; Lonqvist et al., 2017; Rapin & Dunn, 2003.

Inferential processing skills in ASD

Autism spectrum disorders (ASD) is a pervasive developmental disorder characterized by impairment in social interaction and communication plus restricted repertoire of behaviors and interest (APA, 2013). Among the various skills, oral language competence majorly contributes to inferential comprehension (Ricketts, Johnes, Happe & Charman, 2013). Inferencing deficits in children with ASD is often contributed by theory-of- mind deficiencies, which may limit their ability to make inferences relating to the internal states that motivate fictional characters behaviors. Norbury & Nation (2011) studied influence of language phenotypes in adult ASD on text comprehension. Autism with normal language (ALN) and Autism with Language impairment (ALI) answered similar number of literal questions as their typically developing (TD) peers. The study demonstrated that ALI group were less accurate than their peers in answering questions related to inference processing. This demonstrated a disproportionate difficulty with inferencing skills. All the three groups who participated in the study were matched for their nonverbal cognitive abilities. ASD group selected did not differ in terms of symptomatology. Hence what can be inferred from the findings is that proficient language skills in children with ALN acted as a protective mechanism and in turn helped in reducing the impact of social deficits. The study identified oral language comprehension as the greatest predictor of variance in inferencing competence (31.7%) as compared to ASD status (10%).

Likewise, Jolliffe & Baron-Cohen, 1999; Saldana & Frith, 2007., conducted similar study in adult with ASD to assess bridging inferences. They asked the participants to read aloud pair of sentences which described a situation and their outcome. They also assessed the coherence of the connecting sentence. Taken together, the findings suggest that adults with autism demonstrate difficulties with inference processing than their nonautistic peers.

Relationship between text inferencing skills, autistic symptomatology and language phenotype was conducted by Lucas & Norbury, 2015 on a group of children in the age range of 7-12 years and the group comprises of TD, ASD and LI. Neale Analysis of reading Ability revised (Neale 1997) was administered and responses to literal and inferential questions were analyzed. The results indicated that inferential competence was predicted by oral language skills with autistic symptomatology although the contribution was not significant. The TD group outdone the ASD and LI group in inferencing task. Tirado & Saldana,

2016 researched on 21 participants with ASD without ID in the age range of 11-20 years and reported that the group displayed difficulty answering inferential questions about the same emotion from the read text. Additional studies established that language abilities support inferential processing and act as an important predictor than ASD phenotype. Similar results were reported by Bordner, Engelhardt, Minshew & Williams, 2015 in a sample of 96 children and adolescents in the age range of 10-16 years and adults in the age range of 17-45 years with ASD without ID and noted that even in individuals with well-developed meta linguistic skill demonstrated difficulties with inferences about social information. They also concluded that inference difficulties may not be a specific characteristic of individuals with ASD. A comparative study between typically developing children and children with ASD in the age range 5-10 years was done by Loukusa, Makinen, Gauffin, Ebelling & Leinonen, 2018. The study investigated contextual inference with and without theory -of-mind (TOM), relevant use of language, recognition of feelings, understanding of false beliefs by administering PRAGMA test, Social Interaction Deviance Composite Test (SIDC), TOM Subtest of Developmental Neuropsychological Assessment (NEPSY). The results indicated that children with ASD differed from TD in questions demanding context utilization. ASD group also displayed difficulties in explaining the utilization of context to arrive the correct answer. Studies on narrative retelling and inference skills and its relation with reading comprehension in children and adolescents with ASD indicated that these two skills are important for successful reading comprehension for individuals with ASD without intellectual disability (ID). Lexical semantical skills are the determinants of reading comprehension skills. Inferential skills were particular challenge for individuals with ASD, however better performance was observed as age advances. Furthermore, the findings pointed that narrative and inferential skills in addition to lexical semantic knowledge are potentially important to target to improve reading comprehension in children and adolescents with ASD without ID (McIntyre, Grimm, Solari, Zagic & Mundy, 2020).

When considering the trends of researches conducted in this area, it is evident that these studies focused exclusively on adolescents and adults with ASD who are capable of using language skills to compensate the social cognitive difficulties. In order to clearly understand the inferencing difficulties in ASD, it is necessary to carefully select a task that challenges their existing language resources. Hence, current study intentionally recruited participants in the age range of 5-8 years in contrary to the previous researches using the task that demand oral inferential comprehension skills. The study aims to investigate inferential processing skills of young children with Autism Spectrum Disorder with no language impairment (ALN) in comparison to typically developing peers through story comprehension & story recall.

2. Methods

Participants

Ten children with ASD with no language impairment (ALN) without cognitive impairment in the age range of 5-8 years

and ten age matched control group of typically developing children (TD) participated in the study. The clinical group was selected from the outpatient's population in department of NDS, NISH, Trivandrum. Age matched control group with no reported history of speech and language delay was recruited from the nearby school. The clinical group had a documented formal diagnosis of ASD based on Diagnostic Static Manual of Mental Disorders (5th ed.; DSM-V; American Psychiatric Association, 2013). Further, ASD symptoms were confirmed through Childhood Autism Rating Scale -2 (CARS-2) given by Schopler, Bourgondein, Wellman & Love, 2010. Language skills of clinical and control group was affirmed using Assessment of Language development (ALD) developed by Lakkanna, Venkatesh & Bhat, 2008. Children with ASD having age adequate receptive and expressive language skills on ALD was recruited for the study. All the participants in the control group demonstrated age adequate speech and language skills in ALD. To establish the participant's IQ and mental age, Raven's Colored Progressive Matrices (MPC) developed by Raven, Court & Raven, 1986 was used. All the participants with ASD in the current study met the inclusionary criteria of having a CARS score between 30-36 indicating mild-moderate degree of ASD. Further, all the participants in ASD group scored a nonverbal IQ score of 75 and above to meet the criteria. The typically developing (TD) control group selected for the study had IQ within the normal range and had no documented history of language delay are age matched with the ASD group.

3. Materials

Language Assessment:

Assessment of language development (ALD) in Malayalam (Lakkanna, Venkatesh & Bhat, 2008) was used to assess both receptive and expressive language skills of children. ALD is a standardized diagnostic tool in Indian population to measure language development in children from birth to 7.11 years. It covers both receptive and expressive language skills in the areas such as vocabulary, semantics, syntax, thinking and reasoning skills. ALD test results indicates whether the child's performance is reflective of a particular age level.

Non-verbal ability:

Raven's Colored Progressive Matrices (MPC) developed by Raven, Court & Raven, 1986 was utilized to determine the nonverbal intelligence of young children. It evaluates the degree to which children can think clearly. The test comprises of three sets of 12 items. The single raw score obtained is converted to percentile based on normative data from various groups.

Autism symptomatology:

Childhood autism rating scale – 2nd edition (CARS-2) Schopler, Bourgondein, Wellman & Love, 2010 is a 15-item behavior rating scale designed to detect and quantify symptoms of autism and to distinguish them from other developmental disabilities. CARS has a very good content and construct validity in Indian population.

Inferential processing task:

Inferential and literal comprehension was assessed using Malayalam adapted version of stories originally developed Bishop and Adams (1992); Slackman, Hudson (1984). Three short stories (Going on a holiday, the class room, My Friend) with 150 words in length were selected for the current study. Taking in to account of the primary aim of the study and subjects were poor readers, the examiner read the story aloud to the children. After each story examiner asked six questions: two literal, two involving text connecting inference and two involving gap filling inference. Stories were presented without accompanying pictures.

Procedure

The study was completed in two sessions, in the initial session was utilized to administer the prerequisite tests and in the second session the inferential processing skills were tested. In inferential processing task, after each story the question asked were in the same order the information seemed in the story. A series of graded prompts were given if children make an incorrect response. To specify, at the instances of incorrect response the relevant paragraph was re-read. In case of repeated failed response, the examiner re-read the relevant sentence or sentences with a hint saying that this part contained a clue and the question was repeated. The same procedure will be utilized for gap filling inferences. All correct responses yielded a score of two (2 points) and incorrect responses were scored as zero (0 points). The totaled score (gap filling and text composition) provided each child's comprehension score. In story recall task, questions were asked after each story was read to the child. The story recall task has been scored based on content and sequence. 4-point rating scale is adapted; 0-incorrect 1-with help, 2-partially correct, 3-correct.

Statistical analysis

The SPSS (version 16.0) was used. A descriptive statistical analysis was carried out.

4. Results and Discussion

a) Background Data

Table one shows data on age, nonverbal ability, receptive expressive language, autism symptomatology. The groups were matched on age and nonverbal ability. Language assessments of the control and clinical group demonstrated that the control groups were superior in performance than clinical group in higher language skills as expected.

Table 1: Depicts the participant ages and standard score

Measures	ALN	TD
Average Age	6.6	6.8
Nonverbal ability (Raven's)	107.70	110.83
Language skills (ALD)	RLA: 37.2	RLA: 43.2
	ELA: 35.8	ELA: 42.2
Autism Symptomatology (CARS)	33.4	-

*** Though the children in clinical group have peripheral age adequate language skills, they showed predominant morpho-syntactic difficulties, and significant pragmatic deficits. In comparison to aged matched control group, they had short mean length of utterances (MLU) Comprehension score

b) Literal Comprehension

There were no significant differences observed between the performance of experimental and control group for literal comprehension. The results revealed that ALN children did not differ from the controls in answering the literal questions. All the children with ALN in the present study scored between 8-12 with a mean of 10, and standard deviation +/- 2. This could be attributed to the factor that the literal; comprehension is generally not substantiated by contextual clues. The current study was in consistent with the study conducted by Norbay and Dorothy 2002, Letts and Leinonen 2001. Similarly, research conducted by Norbury & Nation (2011) exploring the autism symptomatology and text comprehension also demonstrated similar results.

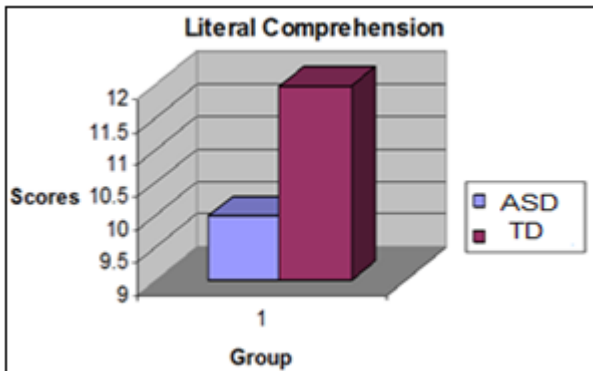


Figure 1: Depicts the mean score of ALN & TD group in the literal comprehension task

c) Inferential comprehension

The categorical examination of the data revealed that children with ALN were more likely to have specific inferential deficits. Error analysis suggested that all the children with ALN could make inferences but not relevant to the story content. This void in their performances could be attributed to the lack of bridging inferences skills (Jolliffe & Baron-Cohen, 1999; Saldana & Frith, 2007). There was significant difference in the performance of ALN compared to control group in task requiring inferential comprehension, with ALN having a mean score of 7.6 compared to 11.3 in controls. Though children with ALN is able to make inferences, the extent to which they utilized information about the content mostly related with their oral language competency. In addition to that, vocabulary knowledge is also an important catalyst in understanding the word meaning which turn facilitate the comprehension of the story itself rather the understanding of administered question (Bishop and Adams, 1992; Ellis & Weismer, 1985). This shows that children with ALN tend to perform like younger children with matched levels of story comprehension ability on inferential comprehension task. The results of the current study are aggregable with study on inferential text comprehension of children with ASD conducted by Nash & Snowling, 2006.

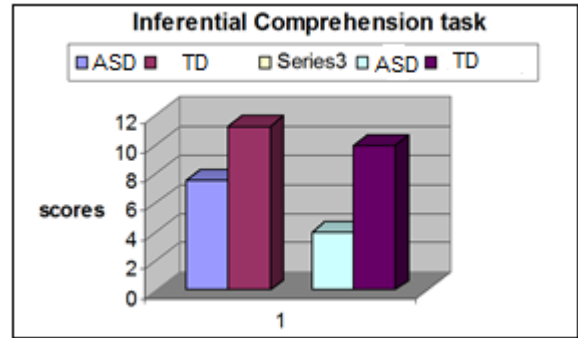


Figure 2: Shows performance of ALN& TD group on inferential comprehension task

d) Story Recall

Quantitative differences between children with ALN and language matched controls in story recall task (content & sequence) of the narratives. The control outscored the clinical group for this task in the present study. The clinical group demonstrated frequent problem in both context and sequence and required frequent prompts or cues for answering. Existence of strong relationship between story comprehension and recall was suggestive of this finding. Hence the conclusion drawn was comprehension aids recalls by enabling the listener to build a more stable mental representation of the story. The pragmatics deficits in ALN compromise these processes (Norbay & Bishop, (2002); Diehl, Benetto, Young, (2006).

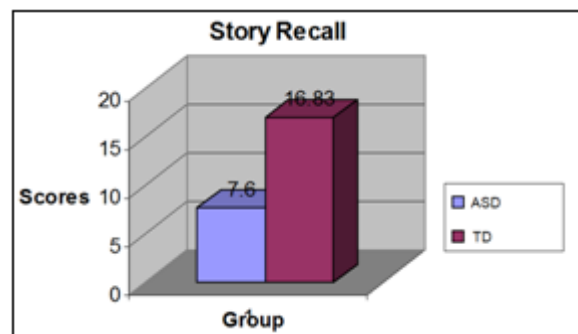


Figure 3: Shows the performance of ALN & TD group in story recall

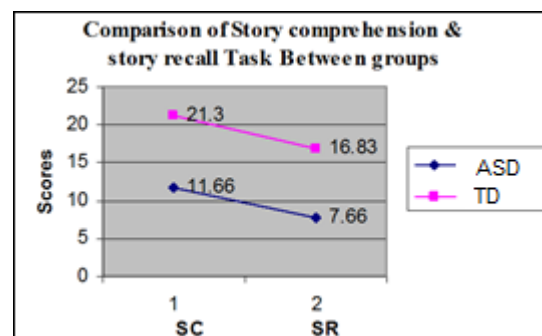


Figure 4: Shows the correlation between the story comprehension and recall in both the groups

5. Summary and Conclusion

In summary the present study showed that children with ASN experienced problem with inferential ability, performing significantly worse on inferential questions than literal questions compared to the controls. Analysis of the

relationship demonstrated that inferential comprehension is related to language comprehension as well as to story recall. Those who have better comprehension tend to have better recall. Hence the present study suggests that while performing an assessment on inferential comprehension of ASD, both text-connecting and gap-filling must be taken in to account, since they appear to measure different aspects of language comprehension. More over the analysis of atypical responses could be developed which can have a potential to be a valuable tool for this purpose.

We have no conflict of interest to disclose

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