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Macrostructural and microstructural discourse abilities in children with hearing impairment

Maria Jayaseelan[1]
MERF Institute of Speech and Hearing (P) Ltd, Chennai
Kowsika Devi Baskar[2]
MERF Institute of Speech and Hearing (P) Ltd, Chennai
Akshay Krishnan[3]
MERF Institute of Speech and Hearing (P) Ltd, Chennai

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Abstract

Hearing loss can hinder a child's growth of speech and language skills. Earlier research has emphasized that children with Hearing loss have hitches in narrative development relative to their hearing peers both in terms of macro-structure and with micro-structural devices. The present study aims at comparing the discourse abilities under macro and micro structural aspects in children with hearing Impairment (HI) who have been receiving instruction in English at school and Tamil as their mother tongue with age matched typically developing children (TDC). Picture description Narrative sample from a total of 20 children (10 HI and 10 TDC) were collected and the discourse abilities were calculated based on the protocol prepared. Macrostructure of the narrative is descriptively documented using qualitative analysis and the microstructure elements are documented using quantitative analysis. The results revealed significant difference in most of the discourse domains in which the children with Hearing impairment performed poorer than their age matched peers.

Keywords: Macrostructure, Microstructural Discourse, Picture Description, Narration, Hearing Impairment

1. Introduction

A complex system of cognitive and linguistic process that underlies everyday language use is termed 'Discourse'. Language can be witnessed and examined on various levels, one among of which is "language in use" (Frattali & Grafman, in press), or discourse. Discourse analysis or discourse studies, understood over analysis of language in its comprehensive sense (including face-to-face talk, non-verbal interaction, images, symbols and documents), is a general term for various methods to analyzing written, spoken or signed language use. It is typically measured using two factors such as macrostructure and microstructure of the discourse.

The macrostructure level includes exploring the ability to make an initiating event, the internal response to achieve the goal (attempt and cause), and the

[1] Ms. Maria J, Assistant Professor, MERF-ISH. Motivated towards the area of Child and Adult Language Assessment and Intervention to improve the impacted language abilities. Exploring more in discourse abilities in various clinical population. maria.aslp@gmail.com

[2] Ms. Kowsika Devi Baskar, MASLP Student, MERF-ISH, Emerging researcher in the field of Adult and Child language Disorders.

[3] Mr. Akshay Krishnan, MASLP Student, MERF-ISH, Upcoming researcher who is dedicated in providing his utmost contributions to the field of Speech and Language, to help further in developing the assessment and management processes in everyday clinical practice.

reaction (Stein & Glenn, 1979). It appraises speaker's skill to impart the central idea of the story and synthesize its core by stating the moral of the story. Macrostructures are global meanings of discourse, typically well-defined in terms of topic, gist, or upshot. Semantic macrostructures or topics define what is termed the global coherence of discourse. It refers to the overall coherence and organization of the narrative. Oral and written fictional narratives include a variety of elements that create a framework for a story. These elements are referred to as the macrostructure of the narrative (Hughes et al., 1997). Story grammar, one of the most well-known narrative macrostructure concepts, includes the elements of setting, initiating event, internal response, a plan or attempt to solve the initiating event, consequence, and resolution (Stein and Glenn, 1979). These components are frequently examined for their presence or absence in a story. Complex narratives comprise all of the elements and oftentimes, several of each element.

The microstructure level discourse investigates fine-grained features of narrative elements, comprising referential cohesion, lexical diversity, and sentence structure (e.g., Bloom et al, 1994). Microstructures are the local structures of words, clauses, sentences or turns in conversation. Macrostructures may be derived from microstructures by acts such as abstracting, which is, leaving out or to the point specific details. In other words, microstructures are the actually and directly 'expressed' structures of the discourse. It refers to measures of productivity and complexity at the sentence level. Narrative microstructure refers to linguistic features of language that are present in a narrative, such as: the length of the narrative in words and morphemes, the different types of words used—including words marking time and causal connections, and the inclusion of dialogue. These features fine-tune the stylistic presentation of the narrative (Hughes et al., 1997) and also the lexical diversity of the narrative.

There are four different types of discourse among which, narrative discourse plays an imperative role in the development of discourse, literacy, and socialization abilities (McCabe, 1996). It embraces the ability to communicate a story containing sequential information generally about a past or future event (Gleason, 2002), and is considered a keystone of children's language development. Narratives provide a rich linguistic context and have been used to evaluate the linguistic development of individuals with different health conditions that may be associated with language disorders. Children's emerging narrative ability is crucial for developing social skills (Miller, 1994) and has been shown to foretell later literacy skills (Griffin, Hemphill, Camp & Wolf, 2004; Roth, Speece & Cooper, 2002). Children with hearing impairment in spite of advances in hearing technologies, they continue to lack full auditory access to the spoken language that surrounds them, and so consequently persist with communication delays (Marschark & Spencer, 2015). Typically developing children, at about 22 months (Eisenberg, 1985; Sachs, 1982), initiate referring real past events, at first with much aid from adults. At 2 years, their narratives often contain negative past events, especially injuries (Miller & Sperry, 1988). Between 3 and 5 years of age, children communicate each other longer and more complex personal narratives, and progressively

respond to narratives from peers (Umiker-Sebeok, 1979). Narration functions as a predecessor for literacy development. Several contemporarily developing, higher-level language and cognitive skills are crucial to form cohesive, coherent, and structured narratives (Bamberg & Damrad-Frye, 1991). Reviews put forward that children with Hearing Impairment, regardless of spoken language delays, are able to convey the main elements of content and structure in narrative but have greater effort in using grammatical devices more dependent on finer linguistic and pragmatic abilities. In routine exchange of ideas, children as young as 2–3 years naturally retell stories or recount a sequence of events, and as they grow up children increasingly become able to deal with the discourse-pragmatic necessities that support narrative. Having this importance, narrative assessment is a must to be carried out and further treatment should be intended accordingly. Discourses of children with Developmental Language Disorders are impaired in terms of their language content. These children produce shorter, less cohesive stories that are syntactically simple and contain frequent errors of syntax, semantics, and morphology. With respect to the information content and information structure, some authors report a comparative lack of difficulty with discourse production by such children.

Norbury et al (2003) quoted in their article that children with specific language impairment and autistic disorder made more syntactic errors, and children with autism were significantly more likely to provide ambiguous references in the story. Alexandra et al (2010) showed that hearing-impaired children have abnormalities in all aspects of language: form, content, and use. The abnormalities seem to be related with these children's failure to convert oral language-speech, as described in the literature. He concluded that hearing-impaired speakers have inadequate narrative competence regarding the rate of proposition use, narrative scores, narrative cohesion, cohesion measurements and overall narrative scores.

Jones et al in 2016 reported that children with hearing impairment, regardless of the spoken language delays, were able to convey the main elements of content and structure in narrative, however, have greater trouble using grammatical devices more dependent on finer linguistic and pragmatic skills.

Discourse is any natural form of language embracing utterances or phrases (Wright and Capilouto 2012) and may be ‘the supreme elaborative linguistic activity’ (Ska et al. 2004: 302). Owing to the intricacy of discourse processing, quantifying discourse production in clinical population is essential

Narrative discourse should be a chief element of assessment and treatment programs for school-age children with language disorders. A narrative sample is a means of language development assessment. However, the available standardized data for Hearing Impaired population are limited. Here comes the need to compare the narrative performance between Hearing-impaired and normal-hearing children especially in Indian scenario.

The current study aimed at comparing the narrative discourse ability in terms of macrostructure and microstructure domains in children with Hearing Impairment fitted with appropriate amplification device and age matched typically developing children age ranging 4 years to 8 years.

2. Methodology

2.1. Participants

To document the *macrolinguistic* and *microlinguistic* discourse abilities in children with hearing impairment, a total of 20 children (10 children with congenital hearing impairment and 10 typically developing children) were included in the study. The children between the age ranges of 4 to 8 years participated in the experiment. The children were divided into two groups: Group I included hearing impaired children fitted with appropriate amplification devices with a minimum interventional age of 3 years and Group II included age matched typically developing children with no identified learning disability in both the groups. Children with multiple disabilities or other associated conditions and children intervened using sign language and other alternate mode of communication were excluded from the study.

2.2. Data collection and processing

'The Umbrella sequence picture card' (Appendix 1) and an audio recorder was used to collect picture description samples from children. The children were instructed to look at the picture and narrate a story in sequence. The children were comfortably seated in a distraction free environment and was shown the picture sequence and was explained about the picture and was instructed to tell a story using the picture sequences presented in front of them. The samples were audio recorded and the recorded samples were orthographically transcribed. The transcribed sample were subjected to macrostructural analysis and microstructural analysis which had three and seventeen subdomains respectively as listed in Table 1 and are explained following the table.

Table 1
Subdomains of macro and microstructure analysis

S.No.	Domains	Subdomains
1.	Macrostructure	i) Topic maintenance ii) Event sequencing iii) Explicitness (includes 3 analysis) • *Informativeness* • *Elaboration* • *Completeness*

2.	Microstructure	i)	Total number of words
		ii)	Total number of different words
		iii)	Total number of content words
		iv)	Total number of functional words
		v)	Number of bound morphemes
		vi)	Number of free morphemes
		vii)	Total number of morphemes
		viii)	Proportion of content words
		ix)	Proportion of functional words
		x)	Proportion of morphemes
		xi)	Complex structure per utterance
		xii)	Relevant pieces per utterance
		xiii)	Total number of mental state words
		xiv)	Mazes per utterance
		xv)	Number of pronouns
		xvi)	Number of ambiguous pronouns
		xvii)	Cohesion percentage

Topic Maintenance: Topic maintenance refers to how well are the utterances in a narrative relate to a central topic. Utterances may be connected to a central theme by expansion, continuation, or contradiction. Topic maintenance skills develop in preschool and are become proficient during the school years (Brinton & Fujiki, 1984; Ervin-Tripp, 1979; Foster, 1986). In contrast, utterances that do not maintain a topic may be irrelevant, tangential, vague, or ambiguous.

Event Sequencing: It represents the presentation of events in chronological or logical order. Generally, there should be a correspondence concerning the order of events produced by a speaker and the real-life ordering of events unless the narrator specifies to the listener that a violation of ordering will befall. Violated forms comprises leap-frogging sequences, characterized by an achronological arrangement of events and/or lapse of critical events (McCabe & Rollins, 1994). They weaken discourse coherence since a listener cannot keep track of events that have been described. Children below five years of age tend to construct leap-frogging types of narratives (Peterson & McCabe, 1983). By the age five they are able to sequence events chronologically and bit by bit order multiple events if their culture values this type of discourse (Peterson & McCabe, 1983).

Explicitness: It is the sense-making process of discourse coherence; it encompasses three traits of the completeness and elaboration of a narrative. The first dimension is called informativeness which describes whether a narrator represent sufficient information for a listener to make sense of a narrative. Exclusions of essential information compromise discourse coherence. The second dimension of explicitness includes some degree of elaboration. Elective details help make a text coherent. Unelaborated narratives will be hardly coherent; the listener will comprehend the gist of an experience but will be unable to fill in all of the details. Finally, a wholly explicit, coherent narrative encompasses all the basic narrative ingredients. It is essential that it is complete. Description, action, and evaluation are the

three key narrative components that are mandatory for a good narrative (Labov, 1972). Descriptions entail attributions of people and objects (e.g., "the little boy"). Actions denote to events (e.g., "He drenched in rain"). Evaluation states to the significance of an event for a speaker (e.g., "He felt sorry because he did not listen to his mother"). McCabe and Rollins (1994) explained in detail several kinds of evaluation seen in children's narratives (e.g., internal states, exclamations, repetitions, and negatives). Evaluation is vital because it apprises the listener of the speaker's state of mind about an event. The aspect of evaluation has interpersonal implications. Lacking the evaluation, a speaker may give the impression of being aloof and unfeeling. Without evaluation or description, the narrative will be unexciting to the listener. The development of explicitness emerges increasingly (Peterson & McCabe, 1983). Preschool children omit information that can be effortlessly retrieved by context or topic, such as setting information (Peterson & McCabe, 1983). Evaluation develops at two years of age and becomes more common in the narratives of older children (Miller & Sperry, 1988; Peterson & McCabe, 1983). A failure in explicitness may be due to a limited awareness of the communication requirements of the listener.

Total number of words: This is a productivity measure that facilitates comparison of the size of samples and / or cross individuals. It plays an important role and is one of the first steps in discourse analysis. This was calculated by transcribing the entire picture description sample and counting the number of utterances the child produced throughout the discourse.

Total number of different words: Various word types, like nouns, verbs, adjectives, and adverbs, carry significant and inimitable semantic information that distinguish them (Neville 2014). Based on previous research that production of modifiers manifested qualitative changes in language usage in language disorder (Sarno et al. 2005), it would be worth developing core lexicon lists for different word types as an exploratory purpose. The number of different words uttered delivers a more sensitive and informative appraisal of lexical diversity. This measure is every so often denoted to as a metric of productive vocabulary for the reason that it indicates how well children can integrate items in their lexicons into the language they produce (Pérez-Leroux et al. 2012). The number of different words the child produced was calculated. The word segments repeated were calculated as one word despite being uttered twice or thrice. This is further divided into content words and functional words.

Total number of content words: Content words hold semantic content and add to the meaning of the sentence. This comprises the nouns, verbs, adjectives and adverbs.

Total number of functional words: Functional words are words that exist to explain or create grammatical or structural relationships into the content words may fit. This includes articles, auxiliaries, demonstratives, quantifiers, prepositions, pronouns and conjunctions.

Total number of morphemes: A morpheme is the smallest meaningful part of a word. Morphemes, which constitute prefixes, suffixes and base words, are the smallest meaningful units of language. Morphemes are vital for phonics in both reading and spelling, and also in vocabulary and comprehension.

Number of free morphemes: Free morphemes can stand alone as a word and cannot be broken down further into other word elements.
Number of bound morphemes: A bound morpheme is a word element that cannot stand alone as a word.
Proportion of content words: This was calculated by dividing the total number of content words by the total number of words.
Proportion of functional words: This subdomain was measured by dividing the total number of function words by the total number of words.
Proportion of morphemes: This parameter was calculated by dividing the total number of morphemes by the total number of total words.
Complex structure per utterance: These are utterances which include passive constructions, relative clauses, complement clauses, adverbial clauses or infinite clauses embedded in a sentence. Children with language impairment, made less complex sentences than their age peers (Sarah, 2010). As children grow, research highpoints specific variances in use of complex syntax both over time and amid children with and without language impairments. As typically developing school-age children grow, their sentences show increased clause density (Loban, 1976), improved mean length of T-unit, and usage of relative clauses more frequently (Nippold, Hesketh, Duthie, & Mansfield, 2005).
Relevant pieces per utterance: It is the number of relevant pieces that can be broken from an utterance. E.g., '*The mother gave the umbrella*' – One relevant piece; '*The mother gave the umbrella to the boy who was leaving the house*'– Three pieces per utterance.
Total number of mental state words: Mental state talk is defined as that is the set of words used by children to attribute thoughts, feelings, emotions, and desires to people, when referring to either themselves or other people (Bretherton and Beegley, 1982).
Mazes per utterance: Elin et al (2002) reported that Linguistic non-fluencies known as mazes have been used to draw inferences about processing hitches associated with the production of language. In typically developing children, maze occurrence in general increases as the linguistic complexity increases, being greater in narrative than conversational contexts and in longer utterances. An identical tendency has been observed in children with SLI. The children with SLI used considerably more content mazes than the typically developing children. Loban (1976) described mazes as a chain of words (or initial parts of words), or free fragments which do not constitute a communication unit and which are not essential to the communication unit. Levelt (1989) classified mazes as revisions, filled pauses, or repetitions that occur as a result of uncertainty. Levelt (1989) reported that the production of mazes reveals the speaker's reaction to the demands of language.
Number of pronouns: A pronoun takes the place of a noun, but a pronoun must always refer clearly to its antecedent, which is the noun that the pronoun replaces. Documented by calculating the total number of pronoun referrals the child has uttered.
Number of ambiguous pronouns: If the antecedent of the pronoun is unclear, then the sentence will be unclear as well. An ambiguous pronoun occurs when more than one probable antecedent exists.

Cohesion percentage: It is the percentage of ambiguous pronouns used in comparison to total number of pronouns.

2.3. Data analysis

Macrostructural aspects were descriptively documented using qualitative analysis and the raw data obtained for microstructural aspects were entered in excel sheets and was subjected to statistical analysis using Mann-Whitney Test.

3. Findings

3.1. Macrostructural analysis

3.1.1. Topic Maintenance

Descriptions of superfluous routine events (e.g., scripts), allied information such as descriptions of plans, likes, dislikes, capabilities, and possibilities epitomize deviances in topic maintenance that are often found in specific language impaired children (Miranda, 1995). Some school-age children with language disorder add irrelevant material to the ends of their narratives (Merritt & Liles, 1987; Miranda, 1993, 1995). In the present study, in contrast to the results obtained from children with SLI, it was observed that in both the experimental and the control group majority of the utterances were appropriate and related to the topic.

3.1.2. Event sequencing

Event sequencing was also observed to be appropriate in both Hearing Impaired and typically developing children. It was observed that majority of events were organized in the chronological order of occurrence. However the previous research evidences that few children with language disorders will have trouble marking temporal ordering of events (Johnston, 1982; Liles, 1985a; Olley, 1989). They would have not become skilled at temporal terms or concepts (Lucas, 1980) or may not be talented to use them to signal the order of events in narratives. For example, past the age of four, children with SLI continue to produce incoherent leap-frogging narratives in which events are not presented sequentially and essential ones are omitted altogether (Miranda, 1993, 1995). In addition, they may repeat events as a stratagem to escape sequencing additional actions

3.1.3. Explicitness

(1). Among 10, 8 kid's discourse were found to have adequate **information**; this may be attributed to the fact that they have undergone early intervention comparatively. (2). Among 10, 6 kid's discourse was found to be **elaborative**. (3). All the 10 kid's **action and evaluation** skills has been found to be sparse; in typically developing children, it was found that they all had adequate information and their discourse was elaborative and complete. Earlier findings document that children with Specific Language Impairment, traumatic brain injury, and hearing impairment are likely to omit information that refer to individuals, plans, actions, internal states, and orientation (Biddle, McCabe, & Bliss, 1996; Liles, 1987; Merritt & Liles, 1987; Roth & Spekman, 1986; Sleight & Prinz, 1985; Yoshinaga-Itano, 1986). Narratives of children with language disorders might also lack

elaboration. Though the text can be understood, the deficiency of optional information makes it challenging for a listener to fulsomely understand the text.

3.2. Microstructural analysis

Among the seventeen subdomains significant difference were obtained in total number of utterances, number of different words, functional words, free morphemes, *total number of morphemes, number of complex utterances, relevant pieces per utterance, mazes per utterance, number of pronouns and cohesion* between the experimental group (Group I) and the control group (Group II). The p value is less than 0.05 for the above mentioned elements of microstructural discourse abilities. The typically developing peers outperformed the Hearing Impaired individuals except in mazes per utterances.

The above findings of the present study shall be supported by few pieces of evidence from the literature. Ruth et al (1996) revealed that the children with SLI also used significantly fewer different words than their age-equivalent counterparts. Children with language impairment, made less complex sentences than their age peers (Sarah, 2010). Comparing with typically developing peers in the same grade, school-age children with Specific Language Impairment used less complex sentences in conversation, and these complex sentences be likely to have scarcer clauses (Marinellie, 2004), and very less total words (Scott & Windsor, 2000) than their peers' complex sentences. Summer (2020) proposed that children with hearing impairment produced utterances containing complex syntax with limited errors and their complex syntax density is increasing with time. Elin et al (2002) reported that the children with SLI used considerably more content mazes than the typically developing children. Research has documented that more maze use may be reflective of language learning difficulty (Levelt, 1989; Levelt, 1999) and may often be measured a red flag for language impairment. The production of pronouns in spontaneous language was investigated by Gerard in 2008 in three groups of children with Developmental Language Disorders (DLD): children with Specific Language Impairment (SLI), children with hearing impairment (HI), and children with Down's syndrome (DS). The results were compared to the production of pronouns in typically developing children, matched on MLU. The number of pronouns used did not differ considerably between the groups. In the order of production of pronouns, more commonalities than variances were observed between the three Developmental Language Disorder groups and compared to normally developing peers. The number of errors in all the groups seemed to be very low and all groups presented a significant correlation between the increase in MLU and the production of pronouns. Masitha et al reported that the descriptive and narrative writing produced by the hearing-impaired students used very limited cohesive devices.

Other subdomains though showing a difference in the mean score and mean rank, does not show a significant difference in number of content words, number of bound morphemes, proportion of content words, proportion of functional words, proportion of morphemes, total number of mental state words and number of ambiguous pronouns. The Mean average, the mean

rank, and the significant values for each of the subdomains are tabulated in Table 2.

Table 2
Mean Average, Mean rank and Significant value of Microstructure Elements

S.No.	Subdomain	Mean Average		Mean Rank		Sig. Value
		Group I	Group II	Group I	Group II	
1.	Total number of words	45.1	65.7	7.75	13.25	0.037
2.	Total number of different words	23.1	34.2	7.70	13.30	0.034
3.	Total number of content words	16.8	23.3	8.00	13.00	0.057
4.	Total number of functional words	6.3	10.8	7.70	13.30	0.033
5.	Number of bound morphemes	4.6	5	9.05	11.95	0.271
6.	Number of free morphemes	25.1	37	7.80	13.20	0.041
7.	Total number of morphemes	29.7	42	7.90	13.10	0.049
8.	Proportion of content words	0.745	0.682	11.90	9.10	0.289
9.	Proportion of functional words	0.533	0.401	10.90	10.10	0.762
10.	Proportion of morphemes	1.23	1.252	8.70	12.30	0.173
11.	Complex structure per utterance	2.5	5.1	7.45	13.55	0.020
12.	Relevant pieces per utterance	7	12.1	7.40	13.60	0.019
13.	Total number of mental state words	0.6	2.5	10.00	11.00	0.676
14.	Mazes per utterance	5.1	2.3	14.40	6.60	0.003
15.	Number of pronouns	4.7	9.3	7.20	13.80	0.012
16.	Number of ambiguous pronouns	0.7	0.2	11.60	9.40	0.300
17.	Cohesion percentage	47	98	7.30	13.70	0.008

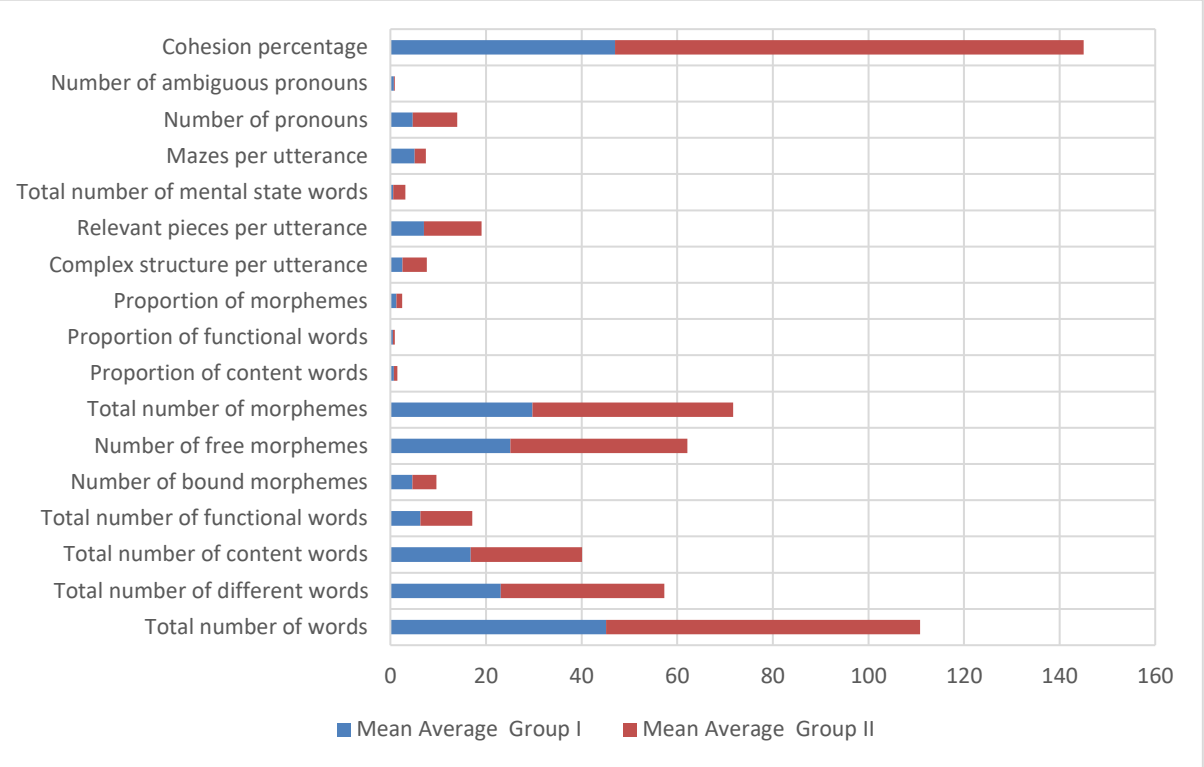

Figure 1. Mean Average of Group I (Hearing Impaired) and Group II (Normal Children)

4. Discussion and conclusion

It is comprehensible from this study that there is evident difference in discourse development between typically developing children and children with hearing impairment. The experimental group lacks majorly in explicitness and majority of the microstructural aspects of discourse. Other skills such as topic maintenance and event sequencing were developed adequately. On a qualitative comparison, macrostructures are comparatively better than the microstructural elements. There are variations within the experimental group. This arises due to other factors such as the age at which the child had sort intervention (early intervention), parental interaction at home, variation in the degree of hearing loss and other environmental factors.

Narration is one aspect which involves literacy knowledge that usually emerges during pre-school. It is essential for a child to effectively narrate that his early literacy skills should be developed adequately. Hearing impairment causes serious breakdown which makes the children to lag behind. So, it is important to provide appropriate intervention at the earliest evaluate narrative skills at early stage and to provide appropriate intervention.

Narrative is a virtuous way of assessing linguistic skill in older children with communication impairments. Core language abilities rather than pragmatic skill or diagnostic status are likely to have an effect narrative development.

Evident differences in discourse skills between typically developing children and children with hearing impairment have been documented in the present study. Narration serves as a precursor for literacy development and usually

emerges during preschool. Hearing impairment causes serious breakdown which makes children to lag behind. Therefore, it is important to evaluate narrative skills at early stage and providing appropriate intervention will enhance entry to mainstream.

5. Future directions

It is important to consider a large sample group across various age ranges and therefore as a future direction, it will be beneficial to consider a larger population analyzing both the macrostructural and microstructural aspects quantitatively.

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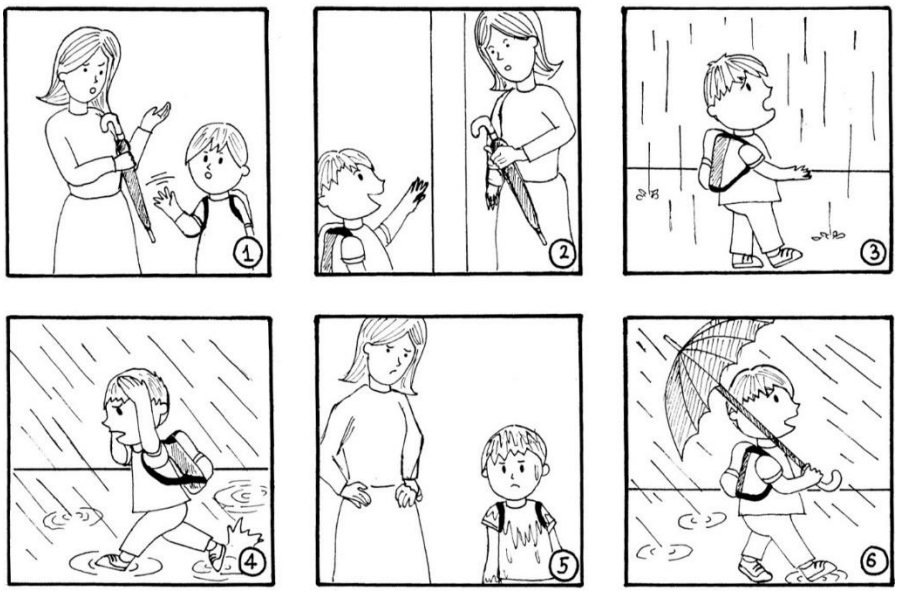
Appendix 1

The Umbrella Story



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