PRESYMBOLIC DYADIC COMMUNICATION BEHAVIOURS IN TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH INTELLECTUAL IMPAIRMENTS (0.6-1.6 YEARS): A COMPARATIVE STUDY

A Doctoral Thesis

Submitted for the degree of Doctor of Philosophy (Ph. D)

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CERTIFICATE

This is to certify that the thesis entitled **'Presymbolic Dyadic Communication Behaviours in Typically Developing Children and Children with Intellectual Impairments (0.6 years to 1.6 years): A Comparative Study'** submitted by Ms. Yashaswini R for the degree of Doctor of Philosophy in Speech-Language Pathology to the University of Mysore was carried out at the All India Institute of Speech and Hearing, Mysuru.

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This is to certify that the thesis entitled **‘‘Presymbolic Dyadic Communication Behaviours in Typically Developing Children and Children with Intellectual Impairments (0.6 years to 1.6 years): A Comparative Study’** submitted by Ms. Yashaswini R, for the degree of Doctor of Philosophy Speech-Language Pathology to the University of Mysore was carried out at the All India Institute of Speech and Hearing, Mysuru, under my guidance. I further declare that the results of this work have not been previously submitted for any other degree.

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DECLARATION

I declare that this thesis entitled "**Presymbolic Dyadic Communication Behaviours in Typically Developing Children and Children with Intellectual Impairments (0.6 years to 1.6 years): A Comparative Study"** which is submitted for the award of the degree of Doctor of Philosophy in Speech-Language Pathology to the University of Mysore, is the result of work carried out by me at the All India Institute of Speech and Hearing, Mysuru, under the guidance of Dr. R. Manjula., Former Professor of Speech-Pathology, All India Institute of Speech and Hearing, Mysuru. I further declare that the results of this work have not been previously submitted for any other degree.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Presymbolic skills constitutes a significant portion of children's early communication repertoire and serves as a foundation for learning symbolic forms of expressions and language. This study aimed to investigate the presymbolic communication behaviours in Typically developing children (TD), and two clinical groups which included Children with intellectual disability due to Down syndrome (DS) and Children with intellectual disability due to Developmental disabilities (DD, whose mental age (MA) was matched with that of TD children. Each of the three groups included two age groups (>6 to ≤ 12 months Vs. >12 to ≤18 months). The study also aimed to investigate the Mother's communication behaviours which occurred in dyadic communication context of free play using specified toys with the child. Fifty four mother-child dyads were included in the study (Eighteen dyads of typically developing (TD) children and their mothers; eighteen dyads of children with developmental disability (DD) and their mothers and eighteen dyads of children with Down syndrome (DS) and their mothers. The interaction between mother-child dyads were video recorded. The videos were edited, segmented, coded and annotated using ELAN software. Annotations done for eye gaze orientation, gestures, vocal behaviours of the children; maternal gestures and child-directed speech for the mothers were grouped under the subcategories. The percentage occurrence of the following in children were analyzed: (a) Eye gaze orientation (Single, dual and triadic eye gaze orientation) (b) Gestures [(Preintentional presymbolic (PIPS) gestures (comprising of alerting behaviours, mother assisted actions, toy exploration and toy manipulation) Intentional presymbolic (IPS) gestures (comprising of deictic gestures) and Intentional symbolic (IS) gestures (comprising of conventional and representational gestures) (subcategories of gestures)] and (c) Vocal behaviours

(comprising of vocalization, protoword and words). The percentage occurrence of the following in mothers communication were analyzed (a) Gestures (Intentional presymbolic (IPS) gestures (comprising of deictic gestures) and Intentional symbolic (IS) gestures (comprising of conventional and representational gestures) and (b) child-directed speech. .

Comparison between age groups for the eye gaze orientation behaviours in TD group, DD group and DS groups showed different trends in typical group and the two clinical groups. Comparison across groups in younger age group revealed significant differences in triadic eye gaze orientation showing poorer triadic eye gaze orientation in both clinical groups. Comparison across older group revealed poorer dual and triadic eye gaze orientation in DD group. Thus, overall clinical groups had poorer dual and triadic eye gaze orientation scores implying deficits in joint attention skills. Comparison of Presymbolic forms in gestures and vocal behaviours of children in clinical and typical groups did not reveal significant differences, implying that the use of presymbolic communication behaviours were on par with typical group. Maternal gestures of the three groups were similar between age groups in clinical groups, indicating different trend than TD group. Comparison across mothers of younger and older group of children in the three groups revealed difference between DD group mothers and TD group mothers. No differences emerged across groups for child-directed speech, implying that all mothers used similar amount of child-directed speech irrespective of groups. However, only TD mothers of older children revealed significantly greater child-directed speech than mothers of younger age TD children, which was not evident in the clinical groups.

Joint attention skills form the basis for all the learning and symbolic representation. In the clinical groups, deficits in the symbolic skills are evident. No

significant differences in presymbolic skills in clinical groups indicates that they are preserved. In contrast, deficits in the symbolic skills must be appropriately considered for early intervention by moving from presymbolic communication to symbolic skills in children in the clinical group.

Chapter 1

INTRODUCTION

Use of language is a crucial part of human culture. Humans master this powerful social tool at a very young age. There are two primary approaches to understand the language development in children, generative or nativist approach and constructionist or empiricist approach (Owens, 2012).

Generative or nativist approach assumes that language development occurs because it is an inherent part of being human. One of the major proponents of the nativist approach is Chomsky (1957, 1959, 1965). According to Chomsky's Linguistic theory, the ability to acquire language is innate. So, children are programmed to learn the language. Chomsky pointed out that all human languages share certain common features, the 'linguistic universals.' Humans have an innate mechanism called the language acquisition device (LAD) that allows identification of the grammar of a language one is exposed to (Chomsky, 1957, 1959, 1965). Chomsky's theory has been the most influential theory of language acquisition and has dominated the field of psycholinguistics for the past few decades. However, the theory mainly focuses on the acquisition of verbal mode in language and does not extend to the acquisition of nonverbal skills such as the use of gestures in children that occurs along with the verbal language.

[1]The term "Intellectual disability" is used throughout the manuscript instead of the term 'Intellectual Impairment" (reflected in the title of the thesis). This is done in order to comply with the latest resolution passed by the RPWD act, 2016. No change in the title of the thesis is made, only the text within the manuscript carries the term "Intellectual disability".

Constructionist or Empiricists approach assumes that language development occurs because of learning from the environment. Two major theories that promote the empiricist approach are Cognitive theory of language development (Piaget, 1954, 1962) and Social interaction theory (Vygotsky, 1962). Both of these theories assume that children learn linguistic knowledge from the environment to which they are exposed (Christiansen & Charter, 1999; MacWhinney, 2004; Tomasello, 2005). However, the cognitive theory views children as active learners during the development of language and social interaction theory views the language development in children to be socially mediated. These theoretical grounds are mutually exclusive and are applicable in specific contexts of a child's life.

The focus of the present study is to investigate and compare the presymbolic communication behaviours in Typically Developing (TD) children and mental age-matched children with Down Syndrome (DS) and children with intellectual disability due to Developmental Disorders (DD). The term *Presymbolic Communication* originates from Piaget's term "symbolic representation," used to describe the stages of cognitive development in infancy (Piaget, 1954). Accordingly, "symbolic representation" implies the portrayal of an object, which is not present during the process and make-believe representation; so, that the child substitutes objects or events (signifiers) for other objects or events (the signified). Sensorimotor action precedes symbolic representation in infancy. These sensorimotor actions are referred to as presymbolic actions.

A significant portion of the Presymbolic actions (Pre- before in time or order; Symbolic- Serving as a symbol; Symbol- A thing that represents or stands for something else) serve as the presymbolic communication behaviours. Examples of

presymbolic communication behaviours exhibited by infants and toddlers include vocal behaviours such as crying, cooing, fussing; generalized body movements such as stiffening of body, showing facial grimaces (Rowland & FriedOken, 2010); ritualized gestures and deictic gestures (Tomasello, 2003). Features of presymbolic communication behaviours are concrete, oriented towards practical results and focused on actions. Ultimately these behaviours are idiosyncratic and distinctive to each infant (Flavel, 1985). Furthermore, in presymbolic communication behaviours, there exists a direct and often physical relation between the communicator and the message being sent (Crimmins et al., 1995).

An important aspect that is used to classify presymbolic behaviours is *intentionality*. The presence or absence of intentionality behind the behaviour determines if the presymbolic behaviour is intentional or preintentional. Pre-symbolic behaviours which lack evidence of deliberate communicative purpose in the child, but which often have a communication effect on an adult communication partner are referred to as *pre-intentional presymbolic* (PIPS) communication behaviours (Bates, 1976; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). These acts result in communication because the communication partner recognizes and attributes meaning to young children's behaviour (Wilcox, Kouri, & Caswell, 1990). On the other hand, the *intentional presymbolic* (IPS) are communication behaviours, which include those produced by a child deliberately to convey something to the communication partner. In general, the child's attention to the communication partner is the primary characteristic that differentiates the pre-intentional from intentional presymbolic communication behaviours (Bates, 1976; Harding, 1984).

The different forms of presymbolic communication behaviours in children are as follows:

a) *Deictic Gestures:* By definition, gestures are actions used to demonstrate the intent to communicate and are typically produced using the fingers, hands, and arms. Deictic gestures are used to establish reference by calling attention to or indicating an object or event (Bates, 1976; Bates et al., 1979).

b) *Vocalization:* It encompasses the set of sounds, other than words or word approximations, inclusive of cooing, vocal play, vowelizations and hums and babbles.

The different forms of symbolic communication behaviours in children are as follows:

a) *Representational gestures:* Representational gestures refer to information about objects, persons, or events conveyed through hand, body, or facial movements. These gestures are named as representational/iconic/symbolic, based on the observer's perception of a physical feature of the object/event which is being represented.

b) *Conventional gestures:* Conventional gestures refers to an event or a concept which is represented by a culturally agreed upon sign such as shaking the head "No", waving hand to indicate "bye-bye", "Touching heads" gesture (Facing the communication partner and gently bending to touch the partner's forehead with one's own forehead) (Iverson & Thal, 1998)

c) *Protowords:* An onomatopoeic/individualistic/peculiar sounds which have a specific meaning in a given situation, and are associated with a particular object/event through an iconic relationship are called as proto-words (Camaioni, Aureli, Bellagamba, & Fogel, 2003). For example, ‘Bow-wow’ (dog), ‘meow’

(cat), ‘vroom-vroom’ (car), ‘gi-gi’ (horse); 'am-am' (to refer to the sound of chewing), 'datum' (to refer to the sound of blocks collapsing), etc.

d) *Words:* Sound associated with specific referents are identified as words. The association between the sound and referent is arbitrary. Words are either single or combinations of two or more words (Camaioni, Aureli, & Bellagamba, 2003).

Research has revealed that gestures, language and speech share an intimate link and form an integrated system (Clark, 1996; Engle, 1998; Kendon, 2004; McNeill, 1998) in the process of communication. Research has supported the role of gestures in language development. Speech is considered one of the essential parts of language development. However, before children develop the use of gestures and speech for communication, they master the prerequisite skills such as coordinated visual attention, which facilitates the use of these modes of language for communication.

The prerequisite skills necessary for the development of language for social interaction purposes are reported to be deviant in children with Down Syndrome (DS) (Berger & Cunningham, 1981; Legerstee & Weintraub, 1997). However, passive joint attention in children with DS is reported to be better than that of typically developing (TD) children (Harris, Kasari & Sigman, 1996). There are conflicting views about the coordinated joint attention skills in children with DS. Callandrella and Wilcox (2000) compared children with DS and children with intellectual disability due to Developmental Disabilities (DD) for the rate of gestural production that involved coordinated visual attention and rate of production of actions that involved passive joint attention, and reported that these abilities were comparable in both the groups.

Development of gestures in TD children reveals that they use deictic gestures well before the end of the first year (Bates et al. 1975; Carpenter, Nagell, Tomasello, Butterworth, & Moore 1998; Masur, 1983; Zinober & Martlew, 1985). TD children have an understanding of the use of deictic gestures not only when directed to them but also when directed to the third party by 14 months age (Thorgrimsson, Fawcett, & Liszkowski, 2014), and they begin to use representational gestures at around 12 months (Iverson & Thal, 1998). In comparison, there are few studies on the development of gestures in children with intellectual disability due to DD. Few investigators have reported that when children are limited in cognitive, linguistic, metalinguistic, and articulatory skills, they use representational gestures more frequently to express meanings (Bello, Capirci, & Volterra, 2004; Capone & Mc Gregor, 2004; Thal & Tobias, 1992).

Some interesting results regarding the gesture-language relationship are reported in children with DS. Spontaneous speech in children with DS is often less intelligible compared to control normal participants (Abbeduto & Murphy, 2004). Wetherby, Yonclas, and Bryan (1989) reported that children with DS relied more on gestures, than did TD children who were matched for the rates of occurrences of prelinguistic communication behaviours. The gap between cognition and productive language skills is reported to become progressively wider with development in children with DS (Chapman, 1995; Franco & Wishart, 1995). It is also observed that as a compensatory strategy, children with DS with better cognitive abilities and social experience, develop relatively large repertoires of gestures (Caselli, Vicari, Longobardi, Lami, Pizzoli, & Stella, 1998; Stefanini, Caselli, & Volterra, 2007).

On the contrary, studies also report that children with DS use a comparable amount of gestures as TD children (Iverson, Longobardi, & Caselli, 2003). Franco

and Wishart (1995) reported that children with DS are aware of people as potential recipients of a message and they demonstrate the same pattern of gestural communication as that of TD children. Thus, it is unclear whether children with DS use similar amount of gestures as TD children or not. It is interesting to explore the use of gestures in children with DS and mental age-matched TD children and children with intellectual disability due to DD.

Research on the development of speech-language skills in TD children has reported that they initially express by vocalizing, followed by babbling, production of words and combination of words to form phrases and so on. According to Lund (2003), the vocal/verbal development in children happens in stages that are universal and apply to all children regardless of the language. The three broad stages include the pre-linguistic stage, one-word stage, and development of grammar (starting with the two-word stage), and are seen before 18 months of age in parallel with gesture production (Lund, 2003).

Research on the development of gesture and vocal behaviours in children with DS provides support to the premise that their language and communication skills follow the same trajectory and sequence as that of TD children but at a slower rate (Miller, 1987; Rondal, 1988). Between gesture and vocal modes, children with DS show a preference for the use of gestures over vocal communication early in language development, in both declarative and instrumental contexts (Abrahamsen, Cavallo, & McCluer, 1985; Greenwald & Leonard, 1979). Vicari, Caselli and Tonucci (2000) reported that in children with DS, verbal comprehension is better preserved than spoken production, and the lexical abilities are better than grammatical abilities.

However, there is a different opinion expressed regarding the use of gesture and vocal mode in children with DS. McCune et al. (1989) stated that children with DS did not differ from TD children in their communicative functions. Each communicative act was conveyed by gesture, spoken word, vocalization, or a combination of these and there was no significant difference between the two groups in terms of total vocal and gestural expressions. Thus they expressed that the evidence for both language deficit and a gestural advantage over speech in children with DS was inconclusive. Owing to the dearth of research, studies comparing the vocal mode of communication in children with DS and children with intellectual disability due to DD are warranted. Such studies will help resolve the gesture advantage if any in DS children.

Another highly indispensable influence on children's language development is that of the inputs provided by mothers mainly through child-directed speech and child-directed gestures. Significant recognition of the role of communication partners, especially mothers came from the social interaction theory of language development. Accordingly, the context in which the development of a child occurs along with the mother/caregiver plays a crucial role in the entire process of cognitive and communication development of the infant. The social interaction theory is based on the premise that the dynamic and dyadic reactions are the ideal contexts in which language acquisition occurs and these interactions are driven by the urge in a child to interact socially with others and to develop the concept of self. The language acquisition process of infants is enriched by the parents/caregiver as they alter and match their linguistic and gestural inputs to be compatible with the abilities of the child's developing language and communication.

Research on the interaction between mother-TD children dyad has revealed that language used by mothers is shorter in length, simpler in syntax and lexical complexity (Furrow, Nelson & Benedict, 1979; Vibbert, Bornstein, 1989). It has been reported that the mothers use a higher number of imperatives, interrogatives, and repetitions with TD children as well (Ninio & Snow, 1996). There have been reports that the modifications seen in speech mode are also present in gesture mode. Bekkan (1989) compared adult-directed and child-directed gestures. The study reported that child-directed gestures are produced at a lower rate and basically simpler gestures are used in child-directed gestures than in adult-directed gestures.

Several groups of researchers have addressed the maternal gestures directed to children at 14-month-old to 20-month-old children and have reported that the characteristic features of gestures directed to children are predominantly deictic, specifically pointing and culturally defined gestures. Few of the child-directed gestures are iconic (Iverson, Capirci, Longobardi & Caselli, 1999; Ozcaliskan & Goldin-Meadow, 2005). Child-directed speech is reported to be different in TD children and children with DS (Iverson, Longobardi, Spampinato & Caselli, 2006). There are also reports that speech addressed to children with DS differs from that directed to TD children and children with intellectual disability of other aetiologies (Iverson, Longobardi, & Caselli, 2003). So, more studies in this direction are warranted.

Evidence also suggests that a wide range of factors such as class (Bernstein, 1961, 1971), ethnic origin (Labov, 1972, 1995), gender (Owens, 2001) and geographical region have their share of influence, in addition to a robust influence of inputs of mother/caregiver on children's development of language.

Culture is one of the most critical influential factors on language development of children reported in the literature. Parent-infant interactions are shaped by and are a reflection of culture. Parents from all backgrounds interact with their infants in ways that promote universally relevant skills, while also providing infants with unique social experiences that signify culture-specific patterns of development (Adolph, Karasik & Tamis-LeMonda, 2010; Bornstein, 2010; Rogoff, 2003;). Parent-infant interaction is one of the most salient situations for human development. Therefore, in assessment and intervention programs for presymbolic communication, mother-child interactions should be regarded with a significant interest.

Many differences are reported between the interaction patterns of Asian mothers and Western mothers with their children. Bryan, Lisa and Gladys (2005) developed and used the Asian American value scales. They have pointed out some critical domains under which the two populations differ in their interactions with their children. The first is with respect to these was 'Conformity,' which refers to the behaviours that are socially accepted conventions. Asian mothers are reported to score higher on conformity than English mothers (Bryan, Lisa & Gladys, 2005). Bryan, Lisa and Gladys (2005) expressed that the Asian mothers are more likely to teach their child explicitly by directing the child to manipulate his hand and the toy and play with the toy in the intended fashion during mother-infant interactions. The second domain was 'family recognition through achievement,' which was about "parents' feeling of "pride or shame" depending on how their children fair (Kim et al. 1999). It was associated with the tendency of the parent to correct his or her child's utterances by providing feedback to the child about the strings of words he used incorrectly (Strapp & Federico, 2000). Aeir and Wilcox (2006) compared the child-directed Speech used by mothers who spoke English, Hindi, and Tamil. They reported

that Hindi and Tamil mothers provided more feedback than English mothers. That is, the Asian parents (speaking Hindi and Tamil) explicitly correct their children intending to induce a sense of pride for themselves and others when the child learns to speak correctly.

The next domain is 'Humility.' Bernstein et al. (2005) concluded that in North-American child-rearing practices, verbal interaction with eye contact is encouraged, but the Chinese-American children did not make eye contact with their parents. The authors asserted that the lack of eye contact expressed as a sign of humility should not be interpreted as the child's lack of involvement or interest in a joint activity. The other domain is 'Filial piety'. According to Kim et al. (1999), filial piety directs Asian children to believe that elders have more wisdom than youngsters do, and one should not question the authority of an older person and that one should work hard so as not to bring discontent to one's ancestors. Hence, parents from Asian backgrounds may use more directives and may direct their children's attention more than parents from other cultural backgrounds.

These research revelations call for more studies on mother-child interaction in specific cultural contexts. Thus, culture-specific information can form a strong foundation for providing assessment and intervention services for communication in children.

There are several documented procedures for recording the communication behaviours of children, which includes parental reports or checklists [McArthur Bates Communication developmental inventory (Fenson, Thal, Dale, Reznick & Bates, 1993); Communication and Symbolic Behaviour Scales (CSBS) Infant–Toddler checklist (Wetherby & Prizant, 2002); Communication matrix (Rowland & Fried

Oken, 2010); Structured play (Behavioural sample section of the Communication and Symbolic Behaviour Scales (CSBS) (Wetherby & Prizant, 2002); Early Social Communication Scales (ESCS) (Mundy et al., 2003)].

Naturalistic observation is used to study the mother-child interactions by the researchers in an unobtrusive and passive manner (Shaughnessy & Zechmeister 1997). The naturalistic observation method describes behaviours as it ordinarily occurs and hence is useful in investigating the relationship among variables that are present and is considered as one of the most appropriate methods that probe into the communication behaviours of children considering the cultural dynamics of the mother-child interaction.

Need for the Study

The focus of the present study was to understand the presymbolic communication behaviours in TD children and children with intellectual disability due to Developmental disability (DD) and due to Down syndrome (DS) in the mental-age range of 6 months to 18 months. The study also intended to investigate the maternal gestures and child-directed speech of mothers with the respective TD children and children with intellectual disability due to DD and DS.

An understanding of presymbolic communication behaviours can help in early identification of delays in language development if any (Wetherby, Goldstein, Cleary, Allen & Kublin, 2003) and is predictive of the emergence of language behaviour. Despite the fact, for clinical decision making, profiling the type, amount and frequency of use of gestures and vocalizations are underutilized (Crais, Watson, & Baranek, 2009). Addressing presymbolic communication behaviours in children with

intellectual disability is crucial because of its relevance in understanding the development of verbal language.

One of the leading causes of intellectual disability is Down syndrome (DS). Down syndrome (DS) affects 38,000 babies born in India every year; it is the highest number in the world (Sinha, 2018). The incidence of chromosomal disorders in the country is one in 166 live births and Down syndrome is reported in one out of 830 live births in India (Sinha, 2018). Therefore, cognizable information on the presymbolic communication behaviours of children with DS and the discerning factors if any to differentiate the children with DS and other conditions leading to intellectual disability becomes very important. However, the literature on children with DS below three years of age in the Indian context is scarce.

The significance of considering children with DS as a separate group is critical because, as per the principles of Genetic syndromes approach specific genetic conditions result in heightened probability or likelihood that people with a given syndrome will exhibit certain behavioural or developmental squeal relative to those without the syndrome (Dykens, 1995). There are many studies that have reported specific behavioural phenotype in children with DS in cognitive domain (Carr, 1995; Dunst, 1988, 1990; Harris, Bellugi, Bates, Jones, & Rossen, 1997; Hauser-Cram et al., 2001; Hodapp, Evans, & Gray, 1999; Marcell & Armstrong, 1982); prelinguistic domain (Sigman et al., 1999; Smith & Oller 1981) and in language domain (Cardoso-Martins et al., 1985; Dodd & Leahy 1989; Kumin 2001; Miller 1999; Rondal & Edwards, 1997).

A major chunk of the population with intellectual disability in India, approximately 59.7% was found to have no known genetic or obvious environmental

cause (Aggarwal, Bagula, Mandal, Kumar, & Phadke, 2012). Among the total population with intellectual disability, non-genetic causes like an environmental insult, the idiopathic cause was reported in 42%, and varied genetic causes were reported in remaining 58% of the population (Aggarwal et al., 2012). Thus, non-genetic conditions causing intellectual disability form a significant portion of the population, which require rehabilitation services in India. Intellectual disability is not a uniform condition, characterized by an undifferentiated delay in cognitive development. Instead, it is characterized by one or more deficits within a complex cognitive system in which some abilities may be impaired more than the others (Vicari, Carlesimo, & Caltagirone, 1995). An understanding of their communication interactions with their mothers is important.

There is a need to study the presymbolic communication behaviours in children with intellectual disability due to Developmental Disorders of non-genetic origin. This is because, common socio-cognitive resources are hypothesized to underlie the symbolic communication (Capone & McGregor, 2004; Iverson & Thelen, 1999). Any deficits in these resources would be expressed as deficits in the symbolic communication, be it in the gestural form or verbal form. As children may be functioning at a presymbolic level of communication, the brain would be incompatible for symbolic representation (Wilcox & Shannon, 1998). In such situations, if the intervention is targeted at the introduction of symbols, then it may be less successful.

However, there have been differing views expressed by investigators regarding the behavioural phenotype in children with DS. For instance, Singer-Harris, Bellugi, Bates, Jones, and Rossen (1997), Caselli, Longobardi, and Pisaneschi (1997)

and Caselli et al. (1998) reported that children with DS use a significantly greater amount of gestures than typically developing children. On the contrary, Iverson, Longobardi, and Caselli (2003) reported that a comparable amount of gestures were observed in children with Down syndrome and typically developing children. Whether the gestural advantage observed in children with DS is unique or is the same in children with intellectual disability due to DD is not well addressed. This is also true concerning the studies on prelinguistic behaviours of children with DS. While Callendrella and Willcox (2000) reported similarity in the rate of gestural production (that involved coordinated visual attention) and rate of production of actions (that involved passive joint attention) between children with DS and children with intellectual disability due to DD, Mundy et al. (1995), reported superior prelinguistic skills in children with DS compared to children with DD. This calls for further studies to evaluate the similarities and differences in the two groups (Intellectual disability due to Down syndrome and intellectual disability due to DD).

Improvement in the presymbolic communication behaviours is the primary requirement in such instances. For the same reason, to compare the presymbolic communication behaviours, an adequate knowledge of the presymbolic communication behaviours, their nature, and function in typically developing children should be addressed. In the development of language, gestures serve several functions. Like language, gesture provides an index of a child's cognitive status (Capone & McGregor, 2004). This may pave the way for the understanding of gestural developmental patterns to predict language performance at a later period and also serve as a means for early intervention, as pointed out by Chan and Iacono (2001).

The emphasis on research in the Indian context is important because India is culturally and socially distinct from the Western countries. Only studies in Indian context will serve as a useful foundation on which comprehensive rehabilitative services can be disseminated to parents and caregivers of Indian origin (Programme on mental health, 1997).

An understanding of the dynamics of mother-child interaction has an important bearing in the intervention in the clinical population. Mahney, Boyce, Farewell, Spiker and Wheeden (1998) reported that the salient features of social interaction between parent and child are incompatible with the goals commonly formulated for communication intervention. In practice, the intervention programs use a directive approach with different types of instructional techniques to help children achieve developmental milestones in language and communication. This is not congruent with the opinion that optimal child development and interaction are more associated with a parental style of adopted responsiveness. McCollum and Hemmeter (1997) thought that it is debatable if studies on early interaction between normally developing children and their caregivers are valid for planning and implementing interventions for clinical population functioning at a presymbolic level. There is hence a need to analyze and compare the dynamics of mother-child interactions in TD children and clinical population. The study intends to compare the communication behaviours of the mothers of typically developing children with the mothers of children with Down syndrome and children with intellectual disability due to DD.

The process of communication is successful only when the three important aspects of the communication, the communicator, communication partner and the environment in which the communication is taking place, interact meaningfully

(Tomasello, 2003; Vygotsky, 1986). The role of communication partner is very important especially in the presymbolic communication stages because, the initial stages of presymbolic communication lack intentionality and it is the communication partner who recognizes the communication behaviours and assigns meaning to the same. Although there is lack of deliberate intent to communicate, the preintentional behaviours often affect the communication partner as they recognize and attribute meaning to such behaviours (Wilcox, Kouri, & Caswell, 1990). Studies have also shown that scaffolding by mothers influences the mental abilities of infants. By treating the infants as intentional beings, mothers increase the awareness on the part of children that people are intentional agents (Meings, 1997). When mothers showed poor abilities in maintaining the attention of the infant during contingent play, infants showed poor skills in social interaction and coordinated attention towards the end of the first year (Goldsmith & Rogoff, 1997; Legerstee, Van Beek, & Varghese 2002).

Maternal behaviours such as maintaining infant attention, responsiveness, attuning affect and using mental state language are reported as mechanisms that promote sociocognitive abilities in children. Such behaviours only promote the zone of proximal development as reported by Vygotsky (1978) and promote a child's understanding of mind by sharing attention over objects etc. with their mothers. The role of facilitative input by parents on lexical acquisition in TD children as well as those with developmental language delays is highlighted by some investigators (Hart & Risley, 1995; Ninio & Bruner, 1978). Yoder and Warren (1999) showed that maternal verbal responsivity helped children produce high rates of intentional communication acts. So, it would be interesting to study the similarities and differences in the communication behaviours of the mothers of children with

intellectual disability due to Down syndrome, due to non-syndromic conditions and the typically developing children.

Technological advances have paved the way for advanced techniques used for annotating human communication behaviours. In the past, the behaviours were analyzed by viewing the interaction samples and manually writing down the observations. However, this procedure is time-consuming and complicated. The use of videos and annotation software tools for assessing communication behaviours has the advantage of replaying and re-watching the video samples, in turn strengthening the analyses procedure by making it more specific and precise. This has given rise to the development of coding schemes for analyses of communication behaviours even in children with communication disorders. Several coding schemes based on specific objectives and the dimensions from which they view communication behaviours have been used by researchers. However, for analyses of communication behaviours of infants, a comprehensive coding scheme incorporating the key dimensions of the communication behaviours is not yet available. In this study, an attempt is made to develop a coding scheme for communication behaviours of TD children and children with intellectual disability due to DS and DD in the mental age range of 6 months to 18 months through video analyses.

Aim of the Study

The aim of the study was to investigate and compare the *presymbolic communication behaviours* of three groups of children [Typically developing children (TD), Children with intellectual disability due to developmental disorders other than known genetic syndromes (DD) and Children with intellectual disability due to Down syndrome (DS)] in the age range of 6 to 18 months [divided into two age groups: (<6

to >12 months and >12 to <18 months)] and the cognate communication behaviours of their mothers in a dyadic communication context of mother–child interaction using free-play.

Objectives of the Study

The objectives of the study were to:

1) Investigate and compare the percentage occurrence of presymbolic communication behaviours of Eye gaze orientation (Single eye gaze orientation, Dual eye gaze orientation and Triadic eye gaze orientation), Gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, Intentional symbolic (IS) gesture] and vocal behaviours (Vocalization, Protoword, Word).
   a) Between children in the two age groups (<6 to ≥12 months and >12 to ≤18 months) in each group (TD, DD and DS)
   b) Across the three groups of children (TD, DD and DS groups)
2) Investigate and compare the percentage occurrence of gestures [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and Child-directed speech in mothers during dyadic communication context:
   a) Between the mothers of children in the two age groups (<6 to ≥12 months and >12 to ≤18 months) in each group (TDM, DDM, and DSM).
   b) Across the three groups of mothers [Mothers of TD children (TDM), Mothers of children with DD (DDM) and Mothers of children with DS (DSM)].

Hypotheses

1) There is no significant difference in the percentage occurrence of Eye gaze orientation (Single eye gaze orientation, Dual eye gaze orientation, and Triadic eye gaze orientation), Gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, Intentional symbolic (IS) gesture] and vocal behaviours (Vocalization, Protoword, Word) between the two age groups of children (>6 to ≤12 months and >12 to ≤18 months) in each group (TD, DD and DS) and across the three groups of children (TD, DD and DS groups).

2) There is no significant difference in the percentage occurrence of gesture [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and Child-directed speech between the mothers of children in the two age groups (> 6 to ≤12 months and >12 to ≤18 months) in each group (TDM, DDM and DSM) and across the three groups of mothers [Mothers of TD children (TDM), Mothers of children with DD (DDM) and Mothers of children with DS (DSM)]

Research Design

The study employed a standard group comparison research design. Mother-child dyads including children with intellectual disability due to developmental disorders (DD) and children with intellectual disability due to Down syndrome (DS) formed the "clinical groups," and mother-child dyads with typically developing children (TD) formed the 'typical group.'

Methods

Three groups of mother-child dyads were included: (1) Group I: Dyads consisting of typically developing (TD) children [N = 18] in the age range of > 6

months to ≤18 months and their mothers. (2) Group II: Dyads consisting children with developmental disability (DD) [N = 18] due to causes other than of known genetic origin matched for the mental age of children in Group I and their mothers (3) Group III: Dyads consisting of children with intellectual disability due to Down syndrome (DS) [N = 18] matched for the mental age of children in Group I and their mothers. Based on the mental age, the three groups were further divided into two constituent age groups. The TD group was divided into TD1, which comprised of children between the age range of > 6 to ≤12 months [N=9; Mean age- 8.87 months; SD- 1.92], and TD2 of children between >12 to ≤ 18 months [Mean age- 15.42 months; SD- 2.16]. Similarly, the DD group was divided into DD1 [N=9, Mean CA-17.54 ,SD-2.8, Mean MA-9.89, SD-1.69] and DD2 [N=9, Mean CA-28.30 ,SD- 4.6, Mean MA- 14.56, SD-2.74] and DS group was divided into DS1 [N=9, Mean CA- 11.31 months, SD-1.5 , Mean MA-7, SD-1] and DS2 [N=9, Mean CA- 22.60 ,SD-4.5, Mean MA-14.44, SD-2.35].

DD and DS children were considered based on their medical diagnosis of the condition by a medical professional and diagnosis of intellectual disability with mental age as assessed by qualified clinical psychologist between > 6 months and ≤ 18 months. The purposive sampling procedure was used. Most of the participants were residents of Mysore and Bangalore districts of Karnataka, India. Most children in the clinical group had just begun to receive speech-language rehabilitation services (N=21). None of the children in the clinical group had received speech and language therapy beyond two months (M= 5 sessions).

Each mother-child dyad was initially interviewed. Language age of the child was determined by administering REELS (Bzoch & League, 1971). Preschool

checklists for children with communication disorders were used to determine the developmental status in Social, Motor, Cognitive domains (Swapna, Jayaram, Prema, & Geetha, 2010) and the Socio-economic status scale (Venkatesan, 2011) was also administered to note the socio-economic status of the dyads. The medical records of the children from the clinical group were studied to ascertain that they satisfy the inclusion criteria of the study. The ethical guidelines for bio-behavioural research involving human subjects prescribed by the All India Institute of Speech and Hearing were followed.

Mother-child interaction between the three groups of dyads was video recorded separately in semi-structured free play interaction. The interaction between the mother and child dyad was video recorded by the researcher in the natural context without participating in the activities directly. Each mother-child interaction was video recorded for a total duration of one hour. After completion of the video recording, dyads were given a small token of appreciation for participating in the study.

The video recording of communication interactions between mother-child dyads was carried out in a silent room with minimal auditory and visual distractions and optimal lighting and ventilation. A single camera (Sony DCR-SR88 with 60X optical zoom) was used to record the video samples, and this was placed in front of the dyad at a distance of minimum 1 to 2 meters on the tripod stand. If the child was in the sitting position, it was ascertained that the dyads' face and upper body profile was captured in the video. If the child was in supine/prone position, the child's complete body and the mother's upper body profile was captured in the video.

A sample of minimum one-hour duration was obtained for each dyad. The video recording was done in 2-4 sittings with a gap of 1 to 6 days in between any two sittings. To elicit interactions between mother-child dyads, toys from the "Toy kit for infants with developmental disabilities" (Venkatesan, 2004) were used. From the toy kit, few toys were deleted and few were added. The toys were then classified into three groups based on the characteristics: (a) toys resembling living creatures or miniature objects (b) toys that could be mechanically manipulated and (c) toys that produced sound or light on manipulation.

Corel VideoStudio pro X4 was used for editing the video samples and EUDICO Linguistic Annotator (Sloetjes & Wittenburg, 2008); ELAN version 4.7.3 was used for data segmentation, coding and annotation.

Analyses

From the sample of 60 min mother-child interaction per dyad, meaningful interaction sample of 60-70 seconds with each of the nine toys were selected. This made up for a total duration of 540 to 630 seconds (9-10.5 min) per dyad. So, 8-9 hours of the samples from 54 mother-child dyads were subjected to further data analyses. The samples were segmented into mother's communication turns, and child's communication turns on two tiers of the annotation software (ELAN). The child's communication turns were annotated for Eye gaze orientation (Single eye gaze orientation, Dual eye gaze orientation, and Triadic eye gaze orientation), Gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, Intentional symbolic (IS) gesture] and vocal behaviours (Vocalization, Protoword, Word). Mother's communication turns were annotated for maternal gestures [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and Child-

directed speech. The data thus obtained from children's communication turns in the form of number of occurrence from the three subcategories of eye gaze orientation (Single eye gaze orientation, Dual eye gaze orientation, and Triadic eye gaze orientation); three subcategories of gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, Intentional symbolic (IS) gesture], three subcategories of vocal behaviours (Vocalization, Protoword, Word) were then converted to percentage of occurrence. Similarly, data obtained from mother's communication turns in the form of the number of occurrence on two subcategories of gestures [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and presence or absence of child-directed speech was then converted to a percentage of occurrence. The data were subjected to statistical analyses using SPSS 20 software.

Chapter 2

REVIEW OF LITERATURE

Cognitive development refers to the growth of perception, memory, imagination, conception, judgment, and reasoning. Cognitive development is the intellectual counterpart of biological adaptation to the environment (Nicolosi, Harryman, & Kresheck, 1989). Theoretically, four factors form the basis of cognitive development: maturation, physical experience, social interaction, and general progression toward equilibrium (Piaget, 1954). According to the cognitive development theory proposed by Piaget (1954), cognitive or intellectual development is the process of reorganizing existing knowledge. The process begins with a cognitive structure, based on the child's existing knowledge or experience. As the child encounters a novel experience, there is a conflict between the existing knowledge and the new experience that triggers disequilibrium. The child tries to balance the disequilibrium by integrating the new information through adaptation.

Two critical aspects of adaptation are assimilation and accommodation. Assimilation refers to the child's attempts to incorporate new stimuli into existing cognitive schemas (structures). Accommodation refers to the development of new schemes to integrate the latest information. As each of these adaptations in cognition is made, the child continues to maintain equilibrium with the environment. So, Piaget's theory (Piaget, 1954, 1962; Piaget & Inhelder, 1962) assumes that children are active thinkers, who try hard to build a clear comprehension of the world around them through numerous distinct cognitive stages (Siegler & Ellis, 1996).

The cognitive development from birth to 2 years is referred to as the sensorimotor period (Piaget, 1952, 1954, and 1967), as the child's behaviour is principally motoric and there is no conceptual thought. Piaget (1952, 1954, and 1967) subdivided the sensorimotor period into six stages describing the process of cognitive development in three important aspects: object concept, space, and causality. The six stages include:

a) Sensorimotor period (between 0-2 months): this predominantly includes reflex activity. The child cannot differentiate self from other objects in the environment. The child is egocentric with respect to space and causality.

b) Primary circular reactions stage (between 2-4 months): this is the first differentiating stage which coincides with the development of hand-mouth coordination along with differentiation of sucking as well as grasping. The child begins to coordinate sensory experiences and fresh/new motor patterns (Ginsburg & Opper, 1988; Labinowicz, 1980). If an object is placed and removed from the child's sight, there is no differential behaviour exhibited by the child and child does not differentiate between the movement of an external object or self.

c) Secondary circular reaction stage (between 4-8 months): this is marked by significant development in eye-hand coordination. In this stage, the child reproduces and repeats interesting events. The child tries to anticipate the position of moving objects and hence space is externalized, but the child cannot establish the spatial relationship with the objects. Input-output patterns or schemas become more complex. These schemas also become more and more externally focused.

d) Coordination of different schema (between 8-12 months): In this stage, the child applies known means for solving new problems. Since the child acquires the ability

to anticipate, he/she searches for objects which are not in view and hence the concept of object permanence is established. Also, the child develops perception of constancy of the object's size and shape, thus facilitating the extension of the causality. Intentional behaviour and imitation of other's actions are evident in this stage. The child starts recognizing particular qualities of the objects around (e.g., a rattle is shaken, a ball is thrown) (Ginsburg & Opper, 1988; Labinowicz, 1980).

e) The tertiary circular reaction stage (between 12-18 months): In this stage, the child discovers new means to achieve needs through experimentation. For example, the child searches for the objects that have vanished from view in the same sequence as the object was displaced. The child now develops awareness for the relation between the object, self and the object in space. The child views self as an object of action as well as self as an object among objects. For example, the child may knock over a container to access something inside the container. The child usually begins to walk and has excellent access to new aspects of the environment. Words also emerge, which gives the child great power and control in this stage as communication is more sophisticated (Ginsburg & Opper, 1988; Labinowicz, 1980).

f) Early representational thought stage (between 18-24 months): Here the child, via internal combinations, develops new problem-solving skills. Children have the representation of objects and their displacements, even when these are physically not present. This understanding that objects can exist outside of their immediate perception is central to Piaget's idea of cognitive representation. The child becomes aware of the movements which cannot be perceived and of spatial relationship representation. Infants with a fully developed concept of object

permanence now are capable of searching for objects when they are missing. Thus the child can represent not only object locations but also predict the object's movement even when they have not observed (Goswami, 1998). Piaget suggested that only when children develop the concept of object permanence and handle the object with well-organized actions in their day-to-day environment (Crain, 1992; Furth, 1994), they can begin to represent those actions through symbols. Thus, symbolic thought emerges at around two years of age.

Piaget proposes that language development occurs later and is initially bound to children's immediately present action. Initial attempts at language are personal to the child and only later, does the child understand that linguistic signs are conventional (Nokony, 1978). Thus, the initial development of symbolic representational abilities emerges between the early representational thought stage, the final stage of the sensorimotor period and the early preoperational stage. The ability to symbolically represent events is recognized as a critical factor for later cognitive outcomes such as the theory of mind understanding and literacy (Astington & Jenkins, 1995, 1999; Bergen, 2002; Christie & Roskos, 2009; Leslie, 1987; Yawkey, 1983).

Thus, the concept of object permanence is the foundation for the emergence of symbolic representation. This process occurs at the end stage of the sensorimotor stage between 18 to 24 months. The stages before the symbolic representation are considered as presymbolic behaviors. The present study addresses the presymbolic communication behaviors in children with a mental age between 6-18months, which is the ideal age for the study of presymbolic behaviors. In this study, seven types of gestures (Alerting behaviours, Mother assisted actions, Toy exploration, toy

manipulation, deictic gestures, conventional gestures and representational gestures) under three main groups: Preintentional presymbolic gestures (PIPS), Intentional presymbolic gestures (IPS) and Intentional symbolic gestures (IS) are considered. These three groups of gestures are classified based on the cognitive theory of development. In addition, the present study has also considered the production of vocal behaviours under which three subgroups are considered: vocalization, proto-words and words. Among these three, vocalizations is regarded as preintentional presymbolic and the latter two is regarded as intentional symbolic vocal behaviours according to the theory.

One of the major critical remarks on Piaget's theoretical perspective is that it considers symbolic representation as an egocentric act (Rakoczy, 2006). According to the theory, pretend play is viewed as the child's solitary attempt to extend their current reserve of action schemas to novel objects. This view is incongruent to the research that highlights a social foundation for pretend play development (Leslie, 2002; Lillard & Witherington, 2004; Nielsen & Christie, 2008), broadly based on the perspective of Vygotsky's social interaction theory.

Vygotsky's theory proposes that social interaction precedes the development of consciousness and cognition. Social interaction, the more knowledgeable other, and the zone of proximal development are the three key themes that define Vygotsky's theory:

a) *Social Interaction*: According to the theory, social interaction has a pivotal role in the process of cognitive development. While Piaget believed that symbolic development is a result of children's adaptations to the world around them, Vygotsky viewed children's cognitive development as a function

of social interaction. Vygotsky believed that the cognitive development takes place in two levels: firstly interpsychological (at the social level- between people), and then intrapsychological (at the individual level - inside the child) (Vygotsky, 1978).

b) *The more knowledgeable other (MKO):* refers to anyone with the child, who has a higher ability than the child, concerning a given task, process, or concept. The MKO in the child during its early years are primarily parents and caregivers, especially mother.

c) *The zone of proximal development (ZPD):* The ZPD is the gap between a child's ability to accomplish a task under the guidance of a MKO and the child's ability to perform a task independent of any guidance. According to Vygotsky, this is the zone in which learning occurs.

Contrary to Piaget's view, Vygotsky (1962, 1978, 1987) argued that it is not the general cognitive advancement that leads to advanced thinking, but it is the production of symbols (representational gestures, conventional gestures, proto-words, words) in a variety of contexts that leads to advanced thinking. As the tools assist in child's functioning in the physical world, the use of symbols assists in child's functioning in the mental world (Holland & Valsiner, 1988). According to Vygotsky (1978), pretend play can create an imaginary situation in which children adopt the roles dictated to them by the play. Thus, it forms a platform for children to practice representing objects and events (Stone & Stone, 2010), for thinking and imagination. As children use their representational abilities during pretend play, they do in speech as well. In this sense, Vygotsky argued that pretend play is a useful medium for the child to attempt new forms of representation in a safe context. While Piaget saw

pretend play as essentially solipsistic, Vygotsky saw it as more socially mediated (Howes & Tonyan, 1999; Parten, 1932).

The work of Werner (Werner & Kaplan, 1963) placed much emphasis on the interaction between the child and adult as indicated in Vygotsky's theory. As per Werner and Kaplan's (1963) distancing hypothesis, the emergence of gestures in children happens through actions on objects in interaction with others, and only later children begin to distance between person and object. The transition from use of contact to distal gestures reflects the shift in the ability of children to deal with objects as "ego-bound things-of-action" to "ego-distant objects-of contemplation" (Werner & Kaplan, 1963). Werner and Kaplan (1963) argued that interaction with a caregiver is crucial for symbolic awareness (Mundy & Sigman, 2006). They noted pointing as an early indicator of the child's ability to differentiate themselves from other objects and people (Goldfield, 1990). However, as pointing can only refer to entities in the immediate context, Werner and Kaplan (1963) regard pointing as an intermediate stage in symbol formation.

According to Transactional model (McLean & Snyder-McLean, 1978; Sameroff & Chandler, 1975), deficits in communication result from a breakdown in the interaction between the child and his environment. The failure in communication may be partially attributed to the child's cognitive, motivational, affective, linguistic, and/or attentional abilities; partially to the environment's input (parent/caregiver); or to an interaction between both the factors. In the transactional model, how a child turns out is a function of both the infant and the infant's experience. The transactional model places the child in an environment of social relationships that will boost some early characteristics and lessens others. The inherent characters of the child at birth,

the type of family exposure that a child gets and the types of experiences that a child has determines the child's characteristics. According to the transactional model, the development of the child is a product of the continuous dynamic interactions between the three factors: the child, the experience provided by his or her family and the social context. The model places equal emphasis on all three factors.

This does not imply that some children with birth complications, perhaps with severe anomalies, will not end up with developmental disabilities—but so will some children without birth complications. Sameroff and Chandler (1975) reviewed and reported that children with high-risk births ended up with later developmental problems not only because of brain damage at birth but also because of the negative influence such children had on their parents/caregivers. For example, a generally calm mother has complicated childbirth. Her anxiety during the initial months of her child's life influences her and makes her interactions with the child less appropriate and uncertain. In response, the infant may develop irregular feeding and erratic sleeping patterns that present as the child's difficult temperament. This in turn, reduces the parenting pleasure, so the mother spends less time with her child and there is lesser interaction and learning by the child reflected at a later point as poorer scores on preschool language tests and poorer social maturity. Thus, developmental achievements are rarely the resultant of either child or parent characteristics alone.

The causal links between perinatal problems and early childhood problems are mostly embedded in a framework of interpretation of the child and the people involved in the child's environment. The mother's anxiety rests on the interpretation of the meaning of complicated childbirth; mother's avoidance for interaction with the child rests on the interpretation of the meaning of the child's feeding and sleeping

habits. Because transactions are located in the way the mother and child think about each other, knowledge of their interpretive frameworks are essential to predict or intervene effectively. Understanding how infants and their parents influence each other over time is a necessary prologue to recommendations for appropriate treatment. Once we have an overview of the complexity of the systems involved, we can turn to the search for nodal points at which to direct our interventions.

This model appears to be suited to the language learning of children with developmental disabilities. For instance, children with Down syndrome have been observed to exhibit deficits in their cognitive, linguistic, affective, motivational, and attentional systems. Further, the fact that a child has Down syndrome and will likely exhibit deficits in the above areas is generally known to the mother at the time of or shortly following, the child's birth. Maternal knowledge of the disorder, along with the child's observed deficits, may combine to form a less than optimal language-learning environment. If the development of functional communication skills is dependent upon a finely tuned interaction between the child and his/her mother (Bruner, 1975; Chapman, 1981; Snow, 1972, 1977), it may be that the failure of this interaction to develop adequately may in large account for the observed deficits in the communication skills of some children with Down syndrome.

This study aims to investigate the eye gaze orientation, gesture and vocal behaviour of the children, in three groups of children: the typically developing (TD) group, children with intellectual disability due to non genetic developmental disorders (DD) group, and children with intellectual disability due to Down Syndrome (genetic disorder) (DS) group.

The primary difference between the latter two groups of children is their medical diagnosis. The basis for considering children with DS as a separate group is the principles of Genetic syndromes approach. Although the exact mechanism of how genetic disorders influence behaviours is unclear, it is reported in the literature that genetic disorders not only display characteristic physical-medical features but also specific intellectual disabilities syndromes show etiology-related behaviours/ behavioural phenotypes. Specificity is the principle that establishes scientifically the existence of associations that affect a given syndrome. Specificity is 'that which is intrinsic to something that has particular characteristics,' 'that which characterizes and distinguishes one entity from another' (Perera, 2004). The concept of specificity is similar to behavioural phenotype. Behavioural phenotype is defined as "the heightened probability or likelihood that people with a given syndrome will exhibit certain behavioral or developmental sequelae relative to those without the syndrome" (Dykens, 1995, p. 523) and is documented in children with Down syndrome.

Thus, considering the concepts of specificity and behavioural phenotype, the scientific analysis of intellectual disabilities needs serious consideration of the etiological dimension (Perera, 2004). However, it should also be noted that although many individuals with a specific intellectual disability of genetic origin present the behaviours that are 'characteristic' of the syndrome, they do not show all of these behaviours. Neither do all individuals present such behaviours to the same degree or even at the same time in their development (Dykens, 1995). Another important point to be noted is that the genetic causes are numerous, but the developmental outcomes are few (Opitz, 1985). As a result, a few genetic disorders demonstrate unique

behavioral outcomes, whereas some outcomes are “shared” with one or more conditions (Hodapp, 1997).

From the past research, it is evident that Down syndrome is the most common autosomal aneuploidy in humans, with the incidence of around 1 in 700 to 1 in 1000 live births. No significant differences in the language between the three main etiological subcategories of DS are reported (standard trisomy 21- 97% of the cases; translocations - 2%; and mosaïcism -1%), except that, mosaic DS subjects, who tend to have higher IQs demonstrate a slight referential lexical superiority (Fishler & Koch 1991).

Some of the well-established pieces of evidence that can be considered as the specificity of behaviors of children with DS are as follows:

a) In cognitive domain, infants with DS display higher cognitive level initially (70 to 80 standard IQ score range), but standardized IQ scores show a gradual decline and are within the low-to-moderate range (average 30 to 40) by 11 years of age (Carr 1995). This trend reflects a low rate of development and not a loss of skills already gained (Hauser-Cram et al. 2001). Infants with DS are reported to exhibit difficulties developing from Piaget’s sensorimotor stage III to stage IV, and from stage IV to stage V (Dunst, 1988, 1990). It is also reported that children with DS have relative strengths in visual than in auditory short- term memory skills (Marcell, Armstrong, 1982; McDade & Adler, 1980). Specifically, children with DS show levels of visual short-term memory that are one or more years advanced over identical short-term memory tasks that are presented auditorily (Hodapp, Evans, & Gray, 1999). Furthermore, babies and toddlers with DS display skills to remember hand

movements and other visual gestures (Harris, Bellugi, Bates, Jones, & Rossen, 1997). Toddlers with DS, compared to TD children at the same comprehension and production levels, display levels of gesture at the 77th and 80th percentiles, respectively (Guazzo, 2006).

b) In the domain of prelinguistic skills and turn-taking skills which are essential for future conversational exchanges, a slower pace of development is reported. The prelinguistic behaviours in children with DS is different from that displayed by TD children. In TD children, prelinguistic behaviours begin at around three months of age (intermittent babbling, approximately 3s long, with phrase-ending syllables lasting longer than other syllables). The sounds of babbling of DS infants are reported to be similar to that of TD infants in both types and tokens (Smith & Oller 1981). Nonverbal, social and play skills are reported to be strong profiles of children with DS (Sigman et al. 1999).

c) In the domain of language skills, children with DS display predominant deficits in expressive language (Sigman et al. 1999). The development of articulatory skills is slow in children with DS (Kumin 2001), with consistent production of true words only at 2 or 3 years chronological age (CA) due to impairments in motor development (Wishart 1988). Children with DS demonstrate lexical retardation consequent to articulatory difficulties. Also, semantic development is delayed in proportion to general cognitive impairment. However, the overall speech progression parallels TD children (Dodd & Leahy 1989). Rondal and Edwards (1997) reported a positive linear relation between early lexical development (both productive and receptive) and mental age (MA). However, the rate of acquisition of new words in children with DS was reported to be slower than that of TD children (Miller

1999). The gap is reported to widen with age, specifically for productive lexicon (Cardoso-Martins et al. 1985).

d) In the domain of learning, Ohr & Fagen (1994) reported that 3-month-old infants with DS followed TD children in learning about reinforcement contingent to their own movements (leg kicking) in terms of acquisition speed and retention. However, 9-month-old infants with DS displayed impairments in learning about the reinforcement contingent to their arm movements (Ohr & Fagen, 1994). The authors concluded that there is a decline in conditionability in infants with DS than in TD infants after six months. Contingency learning forms the basis for Means-end thinking (Fidler, 2006). Means-end thinking involves linking a chain of behaviours to reach an end state, e.g., pulling a string to obtain a toy tied to the string. There is evidence of atypical development of means-end thinking in children with DS. The age at which means-end thinking begins to develop is between 2 to 8 months. At around eight months, infants learn to use manual skills such as reaching and grasping to achieve goals. Development of manual skills, act as a new set of strategies to achieve different goals. However, this is an area of major challenge in children with DS as reported by Fidler (2006).

e) Children with DS also display atypical development of instrumental thinking during transition of sensorimotor stage (Uzgiris & Hunt 1975). It is reported that infants with DS are slower to move from means-end stage V (for example, pulling a string to obtain a toy) to means-end stage VI (for example, putting a necklace in a cup intentionally) than TD infants (Dunst, 1988). However, DS children acquire object permanence, gestural imitation and causality at the same age as TD children (Dunst, 1988). Delays in the emergence of more

advanced means-end thinking in infancy may serve as evidence of specific impairments in aspects of problem-solving skills in children with DS (Fidler, 2006).

Thus, major revelations from research on children with DS, is inclined toward the existence of a syndrome specificity in the cognitive, behavioural, medical and social aspects. Understanding the behavioural phenotype requires not only an understanding of genes and development but also environmental inputs. In neurodevelopmental disorders, the underlying genetic pathology affects the behaviours. The environments in which persons with neurodevelopmental disorders live also affects the development which is referred to as indirect or interactive effects (Hodapp, 1997). Thus, children with DS form a unique group and need to be considered as a separate group (Hodapp, DesJardin & Ricci, 2003). There is dearth of etiology-based behavioral studies.

Specific care for persons with DS, over the last couple of decades in the West, has helped to change the image of persons with DS and has created an optimistic outlook. This specific care has already translated into greater life expectancy, better health, better intellectual functioning, more skill and responsibility to carry out useful paid work, a higher level of autonomy and independence to steer their future, a higher capacity to live a life that is fully integrated into the community (Perera 1999). Consequently, specificity must be the new therapeutic focus for attending to persons with DS and, in future, we must ensure that the first quality criterion in the provision and evaluation of educational and social services to persons with intellectual disability is that of specificity (Perera, 2006).

Eye Gaze Orientation of Children

Infants display interest in external objects and events during interactions with their mother/caregivers towards their second six months of age. Previously established “infant-mother” interactional structures gradually transform to “infant-object-mother” social system (Moore, & Dunham, 1995). In this framework, the infants learn to master visual joint attention. Some authors prefer the term joint engagement (Bakeman & Adamson, 1984) over joint attention. The emergence of visual joint attention has received several interpretations and researchers have hypothesized theories to explain the phenomenon and link it with social cognition.

However, there is a controversy; some theorists take a nativist approach and believe that human infants have adult-like social cognition from birth (Baron-Cohen, 1995;Trevarthen, 1979). Other theorists believe that infants' triadic interactions at 9-12 months of age represent learned behavioral sequences (Moore, 1996). One of the most comprehensive explanations on the joint attention as the basis for social cognition was provided by Tomasello (1995). Accordingly, infants engage in joint attentional interactions when they understand other persons as intentional agents. This pattern of attention marks a major change in the infant's communicative competence (Bruner, 1975a, 1975b, 1983; Werner & Kaplan, 1963) and provides the foundation for all subsequent acts of cultural learning involving reference to the outside world (Bruner, 1975a, 1975b, 1983). It has also been considered as the foundation for both infant’s interactions with caregivers (Trevarthen & Hubley, 1978) and subsequent symbolically mediated conversations (Bruner, 1975).

Joint attention is a social, or social-cognitive phenomenon. In the context of mother-child interaction, the knowledge of the dyad that they are attending to something in common is referred to as Joint attention (Since this socio-cognitive phenomenon is evidenced through the behavioral expression of eye gaze orientation between the communication partner and the object of interest, it is referred to as visual joint attention). This mutual knowledge is judged to be present, if mother and child both are looking at the same object at the same time and the child looks at the mother during their joint focus or alternates gaze, thus demonstrating knowledge of the mother's attention (Tomasello, 2003). At around the time of their first birthday, infants follow the gaze of mother to an object and then look back, as if to check on the mother's continued attentional focus (Butterworth, 1991). Similarly, when infants point to or show adults objects, they often alternate their attention between the object and the adult spontaneously, again without any discernable adult provocation (Bates, 1976).

Another terminology synonymously used with joint attention is coordinated joint attention. Coordinated joint attention refers to relatively longer interactions between mother and child in which the child coordinates attention to the mother and object, almost always and this involves a spontaneous, unprecipitated look to the adult during their joint play (Bakeman & Adamson, 1984). Thus, in the present study, the behavioral evidence of joint attention by the child is considered in two forms: Dual eye gaze orientation and Triadic eye gaze orientation. Dual eye gaze orientation is the alternation of eye gazes between the object of interest and mother/ mother and object of interest within a 5-second window (Brady et al., 2012). Triadic eye gaze orientation is an alternation of eye gaze across the object of interest-mother and back to object of

interest or mother- object of interest and back to mother within a 5-second window (Brady et al., 2012).

Infants need not always express their knowledge of attending to an object that is also attended by the mother at the same time with eye gaze orientation. The infant may know and continue with the activity. Mothers may be such great supporters of joint attention that they in effect free their infants of the need, to shift attention back and forth between the mother and the object of mutual concern. This phenomenon is referred to as "passive joint engagement" (Bakeman & Adaomson, 1984). Example of an episode of passive joint engagement is when a baby might look intently at a string of beads, attempting to grasp it as the mother dangles it. Although the infant might be interacting with the beads in a way that would not be possible if the mother were not also involved, the baby's attention appears to be primarily on the beads while the mother complements this engagement. In the present study, such instances where the child only has its gaze on either mother or on the object of mutual interest are considered as single eye gaze orientation as defined by Brady et al. (2012).

The orientation in any one or a combination of visual, physical orientation, proximity, touch may be considered as measures of joint engagement (Brady et al., 2012). However, as visual attention is the most directly observable measure of joint engagement (Carpenter et al., 1998), only this is considered in the present study. The development of coordinated joint attention is regarded as the hallmark of transition from preintentional to intentional communication (Beuker, Rommelse, Donders & Buitelaar, 2013; Mundy & Newell, 2007; Mundy, Sigman & Kasari, 1990). The process of transformation from preintentional to intentional communication

behaviours occurs at around 9-12 months of age (Carpenter et al. 1998; Crais, Douglas & Campbell, 2004).

Emergence and development of joint attention in TD children and in children with intellectual impairments.

Scaife and Bruner (1975) conducted the first systematic study on infants' ability to follow the gaze of other persons. Infants in this study were seated facing an adult. For each trial, after establishing eye contact with the infant, the adult shifted his direction of gaze, turning his head, to one of several locations in the room. No targets that infants could see were used; the experimenter simply fixated on concealed marks on the wall. Using a cross-sectional design, these researchers tested 24 infants in the age range of 2-14 months. Results indicated that 30% of 2-4-month-olds, 39% of 5-7-month-olds, 67% of 8-10-month-olds, and 100% of 11-14-month-olds followed the adult's line of regard on at least one of two trials. Furthermore, 80% of "negative trials" involved no response: when infants responded, they usually did not turn in the wrong direction. These results suggest that even infants as young as 2-4 months of age can follow others' direction of gaze. This study was one of the earliest studies that reported a very early age of emergence of gaze following behavior, a subset of joint attention.

Carpenter et al. (1998) found in a longitudinal study that infants began to coordinate attention between people and objects by 9 months of age. The number of joint engagement episodes increased from 1.6 at 9 months to 4.3 episodes at 15 months. The authors proposed that the occurrence of triadic abilities, in the sense that they involve child, interlocutor and some object external to the dyad, reveals that both

participants have a shared goal over which they coordinate their activity during this period. This enables each member of the dyad to be aware of something the other is attending to and allows each member to anticipate the other's actions. Carpenter et al. (1998) found that in their study, CA emerged together with successful performance on other joint attentional tasks, such as imitative learning, social referencing, and goal detection between 9 and 12 months. Consequently, they argued that infants undergo a so-called cognitive revolution during this period, at which point they understand the basics of goal-directed actions. Prior to the 9-month-old benchmark, infants may have strong inclinations to share emotions with others, while engaging in dyadic communication, but they do not perceive communication as meaningful interpersonal sharing. Thus, according to these authors, mental state awareness in others appears at 9 months and not before. The mental states of others define sociality in humans and is a prerequisite for meaningful communication, and it develops only by 9 months of age.

Later in 2007, Legerstee, Markova and Fisher with a twofold aim to explore whether gaze monitoring at three months predicted coordinated attention at ten months and to test if maternal affect attunement, is a necessary element in promoting dyadic and transition from dyadic to triadic abilities; devised a longitudinal study. Like Scaife and Bruner (1975), these authors also agreed on gaze-following behavior a subset of joint attention to emerge as young as 3months age. 53 mother- typically developing infant dyads were considered and observed at 3 months, 5 months, 7 months and 10 months of TD infants' age. Gaze monitoring was recorded from a 3 min free play mother-child interaction sample elicited at 3 months. Coordinated attention was recorded from a 3 min free-play mother-child interaction sample with

toys at 5 months, 7 months and 10 months of the infants. Both measures were expressed as frequency. Maternal attunement was measured in terms of maternal maintaining attention expressed as a proportion of time for which mother followed or maintained infant's focus of attention with a verbal or nonverbal remark by the total duration of the interaction. Results revealed that mean frequency of coordinated attention increased from 5 months to 7 months to 10 months of age. The results also unraveled that gaze monitoring during dyadic interaction at 3 months and coordinated attention during triadic interactions at 10 months are related. However, this relationship was true only for the group of infants which displayed high maternal attunement. Thus the study emphasized maternal attunement and considered it as a mechanism that fosters a link between gaze monitoring and coordinated attention. Maternal attunement was also considered to serve as a piece of strong evidence about the impact of social factors on the development of meaningful communication during the first year of life, and the relation between mother-child interaction and socio-cognitive abilities. Thus the study highlighted the role of maternal attunement in the emergence of gaze monitoring and its relation with coordinated attention.

Other dimensions of joint attention, other than gaze following was explored by Bakeman and Adamson (1984) in a longitudinal study considering TD children between 6 month to 18 months age. The study reported that as children grew older from 6 months to 18 months, they spent significantly greater time in coordinated joint play and lesser time engaged with the other person and in unengaged condition. There was no significant difference in the amount of time spent engaged in passive joint activity, on looking, and with objects. Two salient observations from the study were: a) firstly, the average duration for which infants had coordinated joint engagement

with their mothers comprised only 10% until 15 months of age and b) secondly, all infants observed coordinated joint engagement at least once only at 18 months of age (Bakeman & Adaomson, 1984). So the study cast light on the proportion of joint engagement in the mother-child interaction and age at which the joint engagement emerged. One of the most salient findings of the study was on the passive joint engagement, which was ignored by the studies (Scaife & Bruner, 1975; Legerstee, Markova & Fisher, 2007) quoted earlier.

Emergence of alternation of eye gaze between the object/event of interest and the other person was reported to be by 5-6 months of age (Camaioni, 1997). The authors reported that this visual act indicated coordinated attention that is shared between infants, other people and a preferred object or event (Camaioni, 1997; Legerstee, Markova & Fisher, 2007). The second and significant development at this age reported was the emergence of social referencing; a process where infants seek out, interpret the emotional responses of their parents and form their emotional understanding of unfamiliar objects, events or persons.

Moore and Corkum (1994) reported that by eight months, infants begin to follow and monitor gaze. These authors contradict the earlier studies that report gaze following at a much younger age i.e., by 2-3 months of age (e.g., Scaife & Bruner, 1975; Legerstee, Markova & Fisher, 2007). The authors reported that, there were instances of person-object orientation that develop by 8 months. It was reported that infants follow another person's direction of gaze when there are changes in the person's eye orientation, accompanied by head turning (Moore & Corkum, 1994). In addition, the study reported that, infants follow a point and look at the object when the mother's hand and the target are in the same visual field. On similar lines, another

study reported that infants begin to understand the intentional actions of others in the last few months of their first year of life (Gergely, Nadasdy, Csibra, & Biro, 1995).

Thus, from all the studies reported on various dimensions of joint attention mostly in terms of visual behaviors such as gaze following, alternation of eye gaze etc. in TD children, it can be inferred that these prelinguistic skills prerequisite for the development of language and communication emerge right from a very young age of 2-3 months and then develop and take different forms. Once children master to enter joint attentional interactions, they learn from and through others about the environment and about the artifacts used by members of their culture to mediate interactions with the environment (Cole, 1996; Rogoff, 1990).

There are limited studies exploring the joint attention in children with intellectual impairments in relation to TD children.. One of the pioneering studies on eye contact in children with DS was carried out by Berger and Cunningham (1981), which reported that the developmental pattern of attention in infants with DS over the first six months is different from TD infants. It was a longitudinal study planned to gather data on the percentage of eye contact (%EC) and mean eye contact duration (Mean bout duration- MBD) across six month period from children with DS and TD children. The major findings from the comparative longitudinal study were as follows: a) Firstly, according to the mother's report, the mean age of establishment of mutual eye contact (10% of eye contact) for TD children was 4.1 weeks, and for children with DS was 6.7 weeks. So, the initial delay in the mutual eye contact of children with DS was 0.7 weeks which was statistically significantly later than TD children. b) Secondly, on comparison between the % EC of TD children and children with DS, the % EC in children with TD was higher than the other group. However, this was not a

statistically significant difference. c) Thirdly, the %EC of TD children across the six months followed a double peak pattern, with peaks at a mean age of 7.4 weeks and 13.9 weeks, The DS children did not follow the same pattern. The authors attributed these quantitative differences measured in terms of %EC and MBD in TD children and children with DS to hypotonia of the muscles of eye and maturation of primary visual system. Impairments in information processing capacity and learning processes especially in the acquisition of face schema were also speculated as the causes of contrast in the eye contact measures. The authors opined that changes in the quantity and quality of eye contact are related to the maturational and psychological processes, indicating a complex interplay between these processes and the development of social interaction. Thus, the study took a nativist stand by attributing the reasons of a deviant eye contact behavior to physiological aspects of children with Down syndrome.

Legerstee and Fisher (2008) included four groups of infants with their mothers, a same-aged peer and the peer's mother. Two age groups of infants with Down syndrome (DS) (age group 1 with mean mental age M=- 0;8.6 years; age group 2 with mean mental age M= 1;4.5) and their mental age matched TD children were considered and followed bimonthly for 8 months. Each visit, infants participated in three randomized 5-minute interactions: one with the mother, one with a peer's mother, and one with a peer. Three infant behaviors were assessed in the study: coordinated attention, declarative pointing, and imperative pointing. The frequency (number of times) and proportional duration (number of seconds spent in coordinated attention out of the total interaction time) of coordinated attention were calculated for each interaction. The raw data demonstrated that frequency of the coordinated attention increased across the four visits in all four conditions for both low MA and

high MA DS children and increased for low MA TD children and decreased for high MA TD children. The authors reasoned this interesting finding to more reliance on verbal communication by TD children with increase in age than on non- verbal behaviors (Legerstee et al., 2002). The authors also reported that there was no difference in the frequency and duration of coordinated attention between DS group and TD group in low MA group. In high MA group, TD infants produced more coordinated attention than infants with DS at visits 1, 2 and 3, but not at visit 4. Thus, although High MA infants with DS may have shown delays in the amount of coordinated attention they produced in the beginning of the study, they were comparable at the final visit. Interestingly, coordinated attention at visits 1, 2 and 3 correlated with declarative pointing and not imperative pointing at visit 4. The authors attributed the poorer coordinated attention in children with DS to their less active involvement with toys than typically developing infants (Kasari, Mundy, Yirmiya & Sigman, 1990; Legerstee & Weintraub, 1997). Factors such as children taking longer to habituate and have poorer visual recognition memory than typically developing infants (Fantz, Fagan & Miranda, 1975) were also speculated to contribute to poorer coordinated attention.

Totally conflicting results were reported by Harris, Kasari and Sigman (1996). The study examined joint attention and topic initiation of TD children and children with DS in caregiver–child dyadic interactions. Twenty eight dyads with children with Down syndrome (DS) (aged 13–41 months) and 17 dyads with typically developing (TD) children were administered an intelligence and a developmental language scale. Both groups of dyads were videotaped during free play interaction. Results revealed that caregivers of children with DS spent more time in joint attention

than caregivers of TD children. The gains in Receptive language of children with DS were found to be associated with caregivers' maintaining attention to child-selected toys and also to the longer lengths of joint attention. It was reported that there exists a negative association between caregivers redirecting attention away from child-selected toys; higher frequency of joint attention episodes with children's language gains. In TD children, it was observed that time spent in joint attention and caregivers maintaining attention to mother-selected toys were associated with receptive language gains. Thus the study reported better joint attention in terms of longer duration in children with DS than in TD children. Also, the study highlighted the role of caregiver in the whole context on interaction with the child which facilitated the receptive language abilities of the children.

The studies reported earlier compared the joint attention skills in children with DS and TD children. Comparison between the joint attention skills of children with DS and children with DD was carried out by Calandrella and Wilcox (2000). The authors planned a longitudinal study to explore the probable relationships between prelinguistic nonverbal intentional communication and subsequent language ability, and predictive value of the former on latter parameter in children with developmental delays as measured using formal assessment procedures and investigation of spontaneous communication samples. 25 children matched for the communication ability (13 with DS and 12 children with DD of undetermined etiology) in the age range of 17-38 months were considered. On comparison of scores on language measures at O1 and O3 and the rate of three sets of gestures, no statistically significant difference between children with DS and children with DD was found. The three sets of gestures were the Intentional nonverbal communication acts- identified

as referential gestures (e.g., reach, point, show, give) and/or vocalizations that were clearly linked to an object or event in the environment and were coordinated with visual attention to the adult partner. The Social interaction signals, identified as gestures and/or vocalizations were not linked with an object or event in the environment, but were accompanied by visual attention to the adult. Further, gestural indicating behaviors included those that served to indicate or refer to an object or event, in the absence of coordinated visual attention to the adult. On correlational analyses of prelinguisitc measures obtained at O1 and O2 and language measures obtained at O1 and O3, rate of intentional communication (gestures with visual joint attention) at O1 was significantly related to the language measures from the spontaneous language samples. In addition, rate of gestural indicating behavior (absence of coordinated visual attention) at O2 was correlated significantly with expressive and receptive language scores and rate of symbol use at O3. Rate of intentional nonverbal communication was the only O1 predictor of language outcomes; thus, it was the only variable that was associated with outcomes 12 months later. Thus, the study considered the presence of coordinated visual attention during the usage of gestures as one of the deciding factors to classify the gestures into the three categories. The rate of intentional nonverbal communication, the gesture category with the presence of visual attention stood out to be the only parameter that could predict the language outcomes at a later age. This emphasized the important role that coordinated visual attention has in the later language development in both children with DS and in children with DD of undetermined origin.

In summary, studies report that children with DS have deviant coordinated joint attention skills. Whereas, Berger and Cunningham report delayed emergence of

mutual eye contact and lesser percentage of eye contact in children with DS; Legerstee and Fisher report poorer coordinated attention in DS children than in TD children; Harris, Kasari and Sigman report longer duration of joint attentional episodes in children with DS. The difference in results might be explained by the difference in coding definitions used by the authors. Lastly, Calandrella and Wilcox, report no significant difference in the gestures with visual joint attention in children with DS and children with DD due to undetermined origin. These conflicting results indicate need for more research in this particular area.

Contraindications of considering instances in mother-child interactions as joint attentional behaviours

A key feature of each of the three types of joint attentional behaviours: shared attention, social referencing and gaze following is that, at some point the infant alternates gaze between person and object. However, gaze alternation is not an infallible indicator of joint attention (Carpenter et al., 1998). For example, infants "check back" with adults as if to assure themselves of the adults' presence, as a sign of infants' attachment to adults (Ainsworth, 1973). These checking-back behaviors may not be instances of joint attention as the infant is not integrating attention to the object and the person in one interaction, or monitoring the adult's attention, but only switching attention from the one to the other. Another example of an instance that can be confused to be that of joint attention would be; when there is a sudden noise in the room when the adult-child are looking at each other, the adult and infant both look at the window from where the noise originated. This instance is not an instance of joint attention because, both child and mother look at a common event at the same time but the mutual knowledge that communication partner is also focusing on the same object

may be missing at the child's end. In the three different types of joint attentional interaction, therefore, there may be precursor forms of the behaviors that involve some key operational features (e.g., gaze alternation) but that do not involve the most important feature from a social-cognitive point of view: the infant's understanding that the other person is an intentional being like me whose attention to the world may be shared, followed into, or directed. Nevertheless, despite limitations in the operationalization of this phenomenon, joint engagement remains an important indicator of infants' ability to coordinate and share an attention to objects with social partners.

Gestures and Vocal Behaviours of Children

The present study has considered seven types of gestures (Alerting behaviours, Mother assisted actions, Toy exploration, toy manipulation, deictic gestures, conventional gestures, and representational gestures) under three main groups Preintentional presymbolic gestures (PIPS), Intentional presymbolic gestures (IPS) and Intentional symbolic gestures (IS). These three groups of gestures are classified based on the cognitive theory of development and social interaction theory. Preintentional presymbolic category of gestures is preintentional because these gestures lack intentionality on part of the child but still is responded to by the mother and the communication continues. These gestures are presymbolic because, children do not substitute objects or events (signifiers) for other objects or events (the signified), which defies the definition of symbolic representation. Intentional presymbolic gestures are intentional because, the intentionality of the children is evident as these gestures are directed to the mother, but the gestures do not have the quality of signifying another object that is not present in the context of

communication, so these are presymbolic. Intentional symbolic gestures are intentional by virtue of its production and symbolic because the gesture represents an absent object. In the domain of vocal behaviours, the present study has considered vocalization, production of proto-words and words. Vocalization, falls under presymbolic communication and proto-words and words fall under symbolic communication.

The emergence of different presymbolic communication behaviours in typically developing children follows a pattern. Broadly, based on the intentionality of the communicator, preintentional presymbolic communication behaviours occurs first followed by intentional presymbolic communication behaviours (Crimmins et al., 1995; Rowland & FriedOken, 2010; Tomasello, 2003). These two levels of presymbolic communication behaviours are further classified into finer levels based on the nature of behaviours. Pre-symbolic communication behaviours are divided into four stages by Rowland and FriedOken (2010), based on a longitudinal study of nine typically developing children who were followed from 6 months to 20 months of age. The behaviours of these children were observed three times and were categorized under seven levels in the order of emergence. Out of the seven levels described, the first four levels were pre-symbolic communication behaviours, and the last three were symbolic communication behaviours. As per Rowland and FriedOken (2010), Level I of the pre-intentional behaviours are not under the infant's control but reflect the general status (such as comfortable, uncomfortable, hungry or sleepy) of the infant which the caregivers interpret. Behaviours such as body movements, facial expressions, and sounds are enlisted in this level. This level of communication is exhibited by typically developing children between 0 to 3 months. Level II is

intentional behaviour, which is characterized by behaviours which are under the infant's control but is not yet used to communicate intentionally. Also, at this level, the caregivers have the role of interpreting the infant's needs and desires based on the behaviours such as body movements, facial expressions, vocalizations, and eye gaze. Typically developing children between 3 to 8 months show such behaviours. Level III is unconventional pre-symbolic behaviours, wherein behaviours are used to communicate intentions. These are "pre-symbolic" as they do not involve any type of symbols and are "unconventional" because they are not socially acceptable if infants older than 6-12 months of age use these for communication. Behaviours such as body movements, vocalizations, facial expressions and simple gestures (such as tugging on people) are included in this level. The Level IV of presymbolic communication stage is the conventional pre-symbolic behaviours which are also used to communicate intentions. These are "pre-symbolic" because they do not involve the use of symbols as in Level III, and "conventional" because they are socially accepted and are used continuously along with language even at a later age. However, meanings of some gestures may be unique to the culture in which they are used. This stage lasts from 12-18 months of age. Examples include pointing, nodding or shaking the head, waving, hugging, and looking from a person to a desired object.

Empirical evidence supports the view that gestural mode of expression is tightly coupled with language and speech in the process of communication (Goldin-Meadow, 2003; Kendon, 2004; McNeill, 1992, 2005). Gestures are considered spatio-visual phenomena closely associated with linguistic processes of the speaker. So, most studies on gestures focus on either gestures being a medium of language development or gestures as an expressive language system by itself (Gullber,

Marianne & deBot, 2010). Thus, both gestures and vocal behaviours are studied together.

With the aim to explore age of the emergence of three major deictic gestures and the coemergence of vocalization and words from 9 through 18 months, Masur (1983) carried out a longitudinal research. The three major deicitic gestures considered were pointing, open-handed reaching, and extending objects. The accompaniment of vocalization, production of words and direction of gaze were also noted. Four mother- TD infants were considered in the context of natural interactions. It was reported that open-handed reaching emerged by 8 or 9 months followed by extending objects and pointing. Authors reported that the ability to send coordinated gestural and gaze signals, emerged by 12 months. Use of combination of word with a gesture, appeared only when the children had demonstrated the coordination of gestural and gaze signals. Words generally emerged by 13-16 months of age. Use of both gestures and vocal behaviours emerged by 18 months age. Thus, the results revealed the sequence of emergence; gestures first, followed by combination of gestures with gaze signals and finally use of combination of gestures and words. A transition from simpler to more complex communication with age was demonstrated by the study. A similar study was carried out by Crais, Douglas and Campbel in 2004 to examine the development of deictic and representational gestures in typically developing children from 6 to 24 months of age. The emergence of gestures were reported under three functional categories. The authors reported the mean age of emergence to be 7.42 months for open handed reaching, 9.33 months for giving, 9.55 for showing and 10.64 months for pointing. In addition, it was reported that deictic gestures emerged in isolation initially and after a mean duration of 2-4 weeks, it was

accompanied by vocalization. These were similar to the results reported by Masur, 1983. Crais et al. (2004) inferred that same gestures were used to fulfill more than one function with age and also strengthened the coemergence of vocalization with gestures.

Considering the coemergence of gestures and speech, Iverson and Golden-Meadow (2005) carried out a longitudinal research to understand whether gesture production merely precedes language development or these two are related to each other in TD children. The study was based on the premise that the children communicate two pieces of information in a single utterance with gesture-plus-word amalgamation and two-word combination follows (Butcher & Goldin-Meadow, 2000; Capirci, Iverson, Pizzuto, & Volterra, 1996; Goldin-Meadow & Butcher, 2003). Ten children were followed from 10 months to 24 months, mother-child interaction was recorded on 8 sessions across 10-24 months. Results revealed that around 50% of each child's object references across sessions occurred in gesture only; 25% occurred in gesture-speech combination and remaining 25% occurred through speech only. Thus, children relied extensively on gesture to refer to objects, initially. Eventually, items initially referred through gestures were switched to be expressed through speech. On an average, children produced a gesture for a particular object 3.0 months before they produced the word for that object. These results are slightly different from that reported by Crais et al. (2004), who reported that emergence of gestures lead the emergence of words by 2-4 weeks. However, both studies agreed that use of gestures was followed by that of speech.

In summary, the studies on TD children reported emergence of gestures initially followed by gesture-plus-gaze combination followed by gestures-plus-

vocalization and gesture-plus-word combination. From the review it is evident that deictic gestures emerge in TD children by the second six months of age. Use of gesture to represent an object preceded production of word for that object by 2 weeks to 3 months. Children learn the use of gestures in difference communication contexts for different functional purposes.

Research on presymbolic communication behaviours in children with intellectual impairments has addressed different dimensions of these behaviours, such as amount, rate, type, functional value; and different combinations of these. The studies propose two contradictory evidences on the amount of gestures used by children with Down syndrome. Studies by Abrahamsen, Cavallo and McCluer (1985); Smith and von Tetzchner (1986); Singer-Harris, Bellugi, Bates, Jones and Rossen (1997); Caselli, Longobardi, and Pisaneschi (1997) and Caselli et al. (1998) report that children with Down syndrome use significantly greater amount of gestures than typically developing children, thus demonstrating a gestural advantage. On the other hand, study by McCune, Kearney and Checkoff (1989); Iverson, Longobardi, and Caselli (2003) report the use of comparable amount of gestures in children with Down syndrome (DS) and typically developing (TD) children.

Abrahamsen et al. (1985) carried out research that aimed to study the robustness of the sign advantage phenomenon. The authors ran the toddler sign program of communication intervention for 9-months; and carried out bimodal input and assessed 12 children with speech-delayed due to DS and 13 TD toddlers (11–33 month old). A sign advantage for children with DS was noted, despite the provision of consistent speech input. It was reported that children with DS at the prelinguistic stage in a sign-training study demonstrated an advantage for gestures over speech.

However, from 20 to 30 months of age, children with DS showed a preference for speech. The authors inferred that the gestural mode is a highly robust vehicle for early vocabulary, whereas the speech shows variation according to type of disability in question. These results were backed up by Kouri's (1989) findings that gestures tend to play an essential role during the prelinguistic stage, whereas speech seems to take over during the linguistic period. Smith and von Tetzchner (1986) reported that children with DS have particularly infrequent pre-speech vocalizations when compared to mental age-matched children without disabilities. Thus, the study demonstrated that for the group of children with DS, there is a preference for input through gestures at earlier age indicating a gestural advantage over speech. This phenomenon was not there for the group of children with DD due to undetermined etiology and in TD children.

The study by Singer-Harris et al. (1997) included 39 children with Down syndrome from US families with an average language age of 15.4 months. The children's word comprehension, word production and gesture production were measured using MacArthur Communicative Developmental Inventory (CDI) (Fenson et al., 1993) which the parents completed. On comparison of the scores of children with Down syndrome with that of the normative data, it was found that children with Down syndrome used gestures more than most of the typical children, at similar comprehension and word production levels, and they were placed at the 77th percentile for gestures on an average relative to typical children with same comprehension levels, and at the 80th percentile for gestures relative to typical children at the same production levels.

Caselli et al. (1997) studied the quantity of gesture use and rate of occurrence in mother-child play interactions in three children with Down syndrome and age-matched typically developing children. Before recording the interactive play situation, the mothers were also asked to complete the Italian version of MacArthur CDI, (Caselli & Casadio 1995). The amount of word and gestural production in all three children with Down syndrome was comparable to typically developing children.

A similar study was conducted by Caselli et al. (1998) wherein Italian version of MacArthur CDI (Caselli & Casadio 1995) was used. The mean language comprehension, language production and gesture production age were found to be 14.2; 15.1 and 14.6 months respectively for 40 children with Down syndrome who were matched for language comprehension age of typically developing children. Children with Down syndrome showed significantly greater gestural repertoire than the typically developing group and the types of gestures used by children with Down syndrome were significantly more than typically developing children with respect to symbolic communication gestures, pretending gestures. It was further observed that children with Down syndrome with higher language comprehension produced more symbolic gestures.

With the objective to study the role of gestures in the emergent language of three children with Down syndrome of age 19 months, 17 months and 17 months, Chan and Iacono (2001) conducted a study. The gestures produced by the children before and during the emergence of word production and the functions they served were analysed. Mother-child interactions during structured activities over a period of 5 months were used to sample children's gestures. Results indicated that most frequent gesture types used were conventional, deictic, and enactive naming. The

production of gestures was noted to occur prior to the production of words. The children demonstrated a gestural preference, the authors attributed this to specific difficulty with speech that makes gestures, for them, an easier route for communication. In summary, Singer-Harris et al. (1997); Caselli e al. (1997); Caselli et al. (1998); Chan and Iacono (2001) reported a gestural advantage in children with DS in relation to TD children.

McCune et al. (1989) examined whether children with DS differed from TD children in their communicative functions. The authors considered 20 children with DS (ages 20 to 53 months), and 20 mental age-matched TD children. Results revealed that each communicative act was conveyed by a gesture, a spoken word, a vocalization, or a combination of these and there was no significant difference between the TD group and DS group on total vocal and gestural expressions. Thus the authors did not support gesture advantage. They also opined that the evidence for both language deficit and a gestural advantage over speech in children with DS was inconclusive.

On similar lines, Iverson et al. (2003) compared the word and gesture use by five children with Down syndrome with chronological age of 47.6 months, mental age of 22.4 months, and language age of 18 months with matched typically developing children in mother-child interaction situation. The samples were analysed for frequency of gestures (deictic gestures- showing, pointing, and ritualized and representational gestures) and words and the information content of gesture- word combinations. While the typically developing children produced all the three deictic gestures, only three out of five children with Down syndrome produced all the three deictic gestures. All children with Down syndrome except one had significantly lesser

representational gestures in their repertoire. There was no difference between the groups with respect to the amount of gestures used. Out of three possible combinations of gesture-gesture, gesture-word and word-word; gesture-word combination was the most used in both groups. There were also group differences in the information content in children's gesture-word combinations. Children with Down syndrome used combinations of gesture-word to convey the same piece of information. In contrast, most of the TD children's combinations were complementary.

Iversion et al. (2003) speculated the following reasons for contradictory results on the amount of gestures used by children with DS in relation to that used by TD children. Firstly, methodological differences, the studies that reported a gestural advantage used parental report for data collection in contrast studies that reported similar amount of gesture use by TD and children with DS used behavioral analysis. Secondly, the former group of authors reporting gestural advantage matched TD children with children with DS based on language age elicited through parental reports (Caselli et al., 1997; Caselli et al., 1998; Singer-Harris et al., 1997), in contrast, Mc Cune et al.(1989) and Iversion et al. (2003) used behavioural observation for matching language age.

To summarize the findings from comparison of children with DS and TD children on various dimensions of gestures, firstly there is controversy on the amount of gestures produced by TD children and children with DS. Some studies report gestural advantage and some report comparable amount in both the groups. Secondly, the use of combination of gesture+ word is different in TD children and children with DS. Whereas TD children use gesture+ word combination to express two separate

pieces of information, children with DS use gesture+word combination to express same single piece of information. Finally, studies report that the usage of nonverbal communication in terms of gestures or vocalization predicts the later language and communication development in both TD children and children with DS.

In an attempt to compare the prelinguistic communication abilities of young children with Down syndrome to those of TD children and DD children of undefined aetiology, Ramruttun and Jenkins (1998) carried out a study. Ten children with Down syndrome, 10 non-delayed children and 5 DD children, matched for one word comprehension level were recruited. Data was gathered using parents report and a 10 minutes samples of video recordings in a low structured free play interaction with mothers. Results revealed that maternal reports revealed no significant difference in the number and range of non-verbal, vocal and non-vocal communicative behaviors used by all three groups of children. The video data analysis results revealed no significant difference in the average number of times children with Down syndrome and TD infants used deictic gestures such as reaching, showing, giving, turning away. Children with Down syndrome demonstrated significant delay using referential looking and use of words when compared to TD children. On comparison between TD children and children with DD due to undefined etiology, no significant difference in the use of gestures were reported. Children with DD also demonstrated significantly poorer vocalizing, words and total vocabulary than TD children. Thus on comparison with TD children on production of gestures, vocalization and words, children with DS and children with DD due to undefined etiology demonstrated similar profiles. Both clinical groups had comparable production of gestures but had poorer performance on vocalization and production of words.

Considering similar variables as Ramruttun and Jenkins (1998) i.e., production of gestures, words and combination of gesture-words Vandereet, Bea Maes, Dirk Lembrechts and Zink (2011) conducted a study on children with Intellectual disabilities. The authors aimed to investigate developmental changes in speech and gesture use as well as to relate the use of gesture–word combinations to the onset of two-word speech in children with intellectual disabilities. 16 children with intellectual disabilities with chronological age range of 3;1 and 5;7 years; and mental age range of 1;5 and 3;3 years were considered. Structured interactions were documented every 4 months within a 2-year period to note children's requests and comments. All gestures and words used communicatively to request and comment were transcribed. Results revealed that rate of speech only and rate of gesture-speech combinations increased significantly over time. In contrast, there was no significant change in children's rate of gesture only over time. More diverse spoken vocabularies were used with increasing age. On comparing the nature of combining gesture-speech acts it was found that, there was no significant change in children's rate of complementary combinations. In contrast, rate of supplementary combinations significantly increased over time. The sequence of emergence of gesture-word combination noted in the children with intellectual disabilities considered was, initially children combined gestures with words followed by two-word speech combination.

Thus, on comparison of gestures and vocal behaviors in children with intellectual disabilities due to DD and TD children significantly poorer skills in vocalization, production of words were reported for children with DD. These groups of children did not differ much on production of gestures. In addition, children with

DD followed similar developmental trend in the usage of gesture-word combination with advance in age as TD children.

Capone and McGregor (2004) reviewed the development and functions of TD children and in populations with developmental language impairments. The authors inferred from their review that gesture enhanced, language development. The authors also reported that gesture and language development parallel each other and share underlying symbolic abilities irrespective of typical development or developmental disabilities. Many functions served by gestures including those of communication, compensation, and transition to spoken language were acknowledged. Finally the authors emphasized that in clinical practice major decisions related to diagnosis, goal selection, and intervention for children with language impairments, prognosis should be based in children's gestural profile (Capone & McGregor, 2004). Crais, Watson and Baranek, (2009) reviewed and provided an overview of the types of gestures; gesture development with age. The authors highlighted the gestures role in development of intentionality and communication. The role of gestures in children with language impairments, the use of gestural profiling for arriving at assessment decisions and in intervention planning were also emphasized.

Communication Behaviours of Mothers

Child-directed speech, child-directed gestures are an indispensable part of the child's language and communication development process. Joint attention is recognized as the key factor in the entire process of the children learning from child-directed speech (Tomasello, 1988; Tomasello & Farrar, 1986) or child-directed gestures. The use of child-directed speech is not universal across cultures (Pye, 1986).

However, the nature of the modifications made in the speech directed to children is similar across a variety of different European and Asian languages (Fernald et al., 1989; Grieser & Kuhl, 1988; Masataka, 1998). One of the aspects that children learn from the speech directed to them is the functional significance of language (Nelson, 1981). Not all child-directed speech, facilitates children's language and communication development. It has been pointed out that only when the mother uses a new piece of language to follow into the child's current focus, the child-directed speech gained the quality of facilitating the child's learning process (Tomasello, 1988; Tomasello & Farrar, 1986). This line of the hypothesis was boosted and refined by Akhtar, Dunham and Dunham (1991) based on their study on 13-month-old children and their mothers. The authors reported a positive correlation between the mother's directive speech on a new aspect of the object that is within the child's joint attention when the children were 13 months old with the productive vocabulary of the children nine months later. Negative correlations were reported when the mother's directive speech was on an object that was out of the child's joint attention and the productive vocabulary of the child at 22 months. These findings point out the critical role of joint attention and the nature of the mother's responsiveness in the whole process of communication development of the child. These concepts takes it roots from the social interaction theory (Vygotsky, 1986), specifically the zone of proximal development.

To discern the characteristics of child-directed gestures and adult-directed gestures Bekken (1989) examined the gestures mothers produced when talking to their eighteen-month-old daughters and compared them to the gestures the mothers produced when talking to an adult. Results revealed that mothers gestured less

frequently and used conceptually simpler gestures (i.e., more deictic gestures indicating concrete referents) when they addressed their child than when they addressed the adult. These results suggest the presence of motherese in gesture analogous to motherese in speech. On similar lines, Iverson, Caprici, Longobardi & Caselli (1999) carried out research considering child-directed gestures in Italian-speaking mother-child dyads, when the child was 1;4 and 1;8 years. They found that Italian mothers often produced deictic and conventional gestures but produced few representational gestures when interacting with their young children. These studies imply qualitative and quantitative differences between child-directed gestures and adult-directed gestures. On a comparable line, Golden-Meadow, Goodrich, Sauer and Iverson (2007) planned a longitudinal study on English speaking TD children and their mothers. Ten 10-month-old children and their mothers were followed till the children were of 24 months. The dyads were videotaped monthly for 30 minutes each session in spontaneous play. The children' gestures and speech were recorded and classified into deictic, representational, conventional and ritualized gestures and proto-words and words. The focus of the study was to note the mother's immediate responses to child utterances containing gesture, and classifying it to whether it is a 'translation' of the child's gesture or not. In the initial sessions, the children used deictic gestures to refer 75% of the objects. The children learned the object names to two-thirds of these gestures eventually on an average of 3.0 months following the production of gesture. The object names of a child's gesture were significantly more likely to enter the child's vocabulary when mother translated the gesture. In other words, when mother translated her child's gestures into words, those words were more likely to become part of the child's spoken vocabulary. So, the study highlighted

two aspects, the role of joint attention and the role of mother's responsiveness to the child's acts.

Another line of research has focused on exploring the similarities and differences in the child-directed speech and child-directed gestures and the speech and gestures produced by the children. To study the link between children's use of gesture and speech during the transition from one- to two-word speech and the input from their parents, Ozcaliskan and Golden-Meadow (2005) planned a longitudinal study considering 40 English-speaking child-caregiver dyads. Three video-recorded observations were made for each dyad when the child was 1;2, 1;6, and 1;10 each video-recording for 90 minutes duration. The Communicative acts of the parents and children were divided into three categories: gesture only, speech only and gesture+speech combinations. The gestures were classified into deictic gestures, conventional gestures, representational gestures, and beat gestures. The speech of the children and the caregivers was analyzed further for type and token frequency of different words. The total number of words and gestures were analyzed for children and caregivers. Results on the speech of children revealed that children produced more speech over time. They produced more communicative acts containing speech, more different types of words and more words overall with age. The caregivers, on the other hand, remained relatively stable in their speech, showing no significant differences across the three data points in their use of communicative acts containing speech word tokens or word types. Thus, it was demonstrated that children's speech changed considerably from 1;2 to 1;10 in terms of amount, complexity, and diversity, on the other hand caregivers' speech remained similar. Thus, no quantitative and qualitative changes in the use of child-directed speech and child-directed gestures

were found in mothers when the child's age was 1.2; 1.6 and 1.10 years. Though the mother's input had no changes, significant qualitative and quantitative changes were reported in the children's gesture and speech production over the developmental course of time. These findings were contradictory to the findings reported by Longobardi (1995), which reported that child-directed speech increased between 16 and 20 months when children improved in their expressive language.

Several authors reported that speech to children with DS differs from that directed to TD children and to children with intellectual impairments of other etiologies (Mahoney 1988). The following section details about the differences reported between child-directed speech to children with intellectual impairments and TD children.

Mahoney (1988) carried out research on communication patterns of mothers and children with intellectual impairments. He considered 60 mother-child dyads in free-play interaction context. These dyads comprised of 20 children of 1 year, 2 year and 3 years chronological age each. The results reported which are relevant to the present study are that mothers' style of communication with their children with intellectual impairment were determined by the manner that their children respond to them. The two ways that these children responded to their mothers' communication in the study, were "Attend" and "Ignore". Another finding was that maternal responsiveness to children's communication did not differ across age levels. This finding suggests that as children's communication changed in quantity and content from one age level to the next, mothers' pattern of responding to children's communication remained the unchanged.

Iverson, Longobardi, Spampinato and Caselli (2006) carried out research with one of the aims to compare and contrast frequency and types of gestures in mothers of children with DS with that of TD mothers. Five mothers of children with DS and five mothers of TD children who were native Italian speakers with their children were considered. The chronological age ranged from 37 to 56 months, and mental ages ranged between 18 and 27 months. The gestures were classified into deictic, representational, conventional and emphatic. The instances of gestures only, speech only, and speech and gesture combinations were noted. Results revealed that mothers of children with DS produced significantly fewer utterances than mothers of TD children with comparable expressive language abilities. Both groups of mothers displayed a similar trend in which, utterances consisting of speech alone occurred to the maximum extent, followed by utterances in speech with gesture followed by utterances in gesture only. The majority of gestures produced by mothers in both groups were deictic. However, relative to mothers of TD children, mothers of children with DS produced a significantly higher proportion of deictic gestures. Mothers of children with DS used significantly fewer conventional gestures than mothers of TD children. Though no statistically significant, mothers of children with DS produced fewer representational gestures than their counterparts with TD children. Both groups of mothers used proportionately lesser representational gestures. Thus, mothers of children with DS produced quantitatively lesser child-directed speech than mothers of TD children, which is congruent to the findings of the study by Biuim, Rynders and Turnure (1974). Mothers of DS children produced a higher amount of deictic gestures than mothers of TD children. Mothers of DS children also used lesser conventional, representational and emphatic gestures than mothers of TD children, indicating quantitative differences in the use of gestures as well.

In summary, it can be said that the key factor that makes the child-directed speech and child-directed gesture to be facilitative to the children's language and communication development is firstly, the joint attention and secondly the mother's responsiveness. The studies have reported that child-directed speech and child-directed gestures differ from that directed to the adults both in quantity and quality. Longitudinal studies considering the TD children and mother dyads have reported that although the children display significant qualitative and quantitative developments in their speech and gestures and their combinations, the child-directed speech and child-directed gestures show no such differences either qualitatively or quantitatively. These results are consistent not only for mothers of TD children, but also to the mothers of children with intellectual impairments due to undertemined etiologies and mothers of children with Down syndrome.

Chapter 3

METHOD

The aim of the study was to investigate and compare the *presymbolic communication behaviours* of three groups of children [Typically developing children (TD), Children with intellectual impairments due to developmental causes other than known genetic syndromes (DD) and Children with [1]intellectual impairments due to Down syndrome (DS)] in the age range of 6 to 18 months [divided into two age groups: (Age group 1= >6 to ≤12 months and Age group 2= >12 to ≤18 months)] and the communication behaviours of their mothers in a dyadic communication context of mother–child interaction using free-play.

The objectives of the study were to:

1) Investigate and compare the percentage occurrence of presymbolic communication behaviours of Eye gaze orientation (Single eye gaze orientation, Dual eye gaze orientation and Triadic eye gaze orientation), Gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, Intentional symbolic (IS) gesture] and vocal behaviours (Vocalization, Protoword, Word).

   a) Between children in the two age groups (>6 to ≤12 months and >12 to ≤18 months) in each group (TD, DD and DS groups)

   b) Across the three groups of children (TD, DD and DS groups)

[1]The term "Intellectual impairment" is used interchangeably with the term "Intellectual Disability" across the manuscript. Intellectual Disability is defined as a condition characterised by significant limitation both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behaviour which covers a range of every day, social and practical skills. As given in RPWD act, 2016.

2) Investigate and compare the percentage occurrence of maternal gestures [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and Child directed speech in mothers during dyadic communication context:

a) Between the mothers of children in the two age groups (>6 to ≤12 months and >12 to ≤18 months) in each group [Mothers of TD children (TDM), Mothers of children with DD (DDM) and Mothers of children with DS (DSM)].

b) Across the three groups of mothers (TDM, DDM, and DSM).

Participants

Three groups of dyads were included in the study:

Group I: included typically developing (TD) children and their mothers (TDM). 18 TD children (5 Males and 13 Females) were considered in this group. The chronological age of this group of children was >6 months to ≤18 months. All children were of Indian origin and were from Mysore, Karnataka, India. The children in the group and their respective mothers were divided into two sub groups based on the age of the children as follows:

Group IA

TD children: included 9 children between the age range of > 6 to ≤12 months [Mean age = 8.87 months; SD- 1.92].

Mothers of TD children: included 9 mothers (Mean age=28.44 years, SD- 2.97).

Group I B

TD children: included 9 children in the chronological age range of >12 to ≤ 18 months [Mean age= 15.42 months; SD- 2.16].

Mothers of TD children: included 9 mothers (Mean age= 28.78 years, SD- 2.05).

Group II: Included Children with intellectual disability due to developmental disabilities (DD) and their mothers (DDM). This group included 18 children with DD (7 Males and 11 Females). The chronological age range of this group of children ranged from 12.8 months to 38.7 months (Mean age = 22.5, SD = 4.5). Purposive sampling procedure was used to select children in this group. The children were selected from major hospitals in Mysore including Cheluvamba hospital, JSS hospital, and CSL Holdsworth Memorial hospital. Also, children enrolled for diagnostic and therapeutic purposes at AIISH, Mysore were also considered. The children in this group presented one or combination of the following risk factors: (a) history of jaundice in the mother during pregnancy (b) Premature delivery (c) history of neonatal jaundice in children (d) delayed birth cry and birth asphyxia (e) history of convulsions (f) Observation in NICU for more than 3 days This group was further divided into two subgroups as follows based on the mental age of the children that was matched with the chronological age of TD children in Groups IA and IB:

Group II A

Children with intellectual disability due to DD: included 9 children with intellectual disability due to DD [Mean CA=17.54 months; SD=2.8; Mean MA=9.89 months; SD=1.69].

The oromotor examination revealed that three children had mild hypotonia and weakness in one of the upper limbs. None of the children in this group had availed speech-language therapy at the time of data collection.

Mothers of Children with intellectual disability due to DD: included 9 mothers (Mean age = 23.33 years, SD = 2.74).

Group II B

Children with intellectual disability due to DD: included 9 children with intellectual disability due to DD [Mean CA=28.30 months, SD= 4.6, Mean MA =14.56 months, SD=2.74].

Oromotor examination of the children revealed that three children had mild hypotonia. Four children were availing speech-language therapy for 2 months and had attended 3 sessions each at the time of data collection.

Mothers of children with intellectual disability due to DD: included 9 mothers (Mean age= 30.44 years, SD= 6.11).

Group III: Included children with intellectual disability due to Down syndrome (DS) and their mothers (DSM). This group included 18 children with intellectual disability due to DS. Purposive sampling procedure was used to select children in this group. The children were selected from major hospitals in Mysore including Cheluvamba hospital, JSS hospital, and CSL Holdsworth Memorial hospital. Few children were also selected from rehabilitation centers at Mysore and Bangalore. Children enrolled for diagnostic and therapeutic purposes at All India Institute Speech Hearing, Mysore were also considered. On oromotor examination, it was noted that all children with DS had high arched palate, small mouth, and flat nasal bridge. Generalized hypotonia was a common characteristic observed in all children. The children in this group presented a single or combination of the following risk factors: (a) neonatal jaundice (b) delayed birth cry (c) admission to NICU for more than 3 days (d) congenital heart disease which was treated. This group was further divided into two subgroups based on the mental age of the children matched with the chronological age of TD children in Groups IA and IB.

Group III A

Children with intellectual disability due to DS: included 9 children with intellectual disability due to DS [Mean CA= 11.31 months, SD=1.5, Mean MA =7, SD=1].

None of the children in this group had availed speech-language therapy at the time of data collection.

Mothers of children with intellectual disability due to DS: included 9 mothers (Mean age= 25 years, SD= 3.39).

Group III B

Children with intellectual disability due to DS: included 9 children with DS [Mean CA= 22.60 months, SD=4.5, Mean MA=14.44 months, SD=2.35].

Five children in this group had availed speech-language therapy for an average of 4 sessions at the time of data collection.

Mothers of children with intellectual disability due to DS: included 9 mothers (Mean age = 29.22 years, SD= 4.87).

The demographic details of three groups of dyads and the subgroups are presented in Tables 1 and 2.

Table1

Details of children in the three dyadic groups

	Group I		Group II		Group III	
	Group IA (TD)	Group IB (TD)	Group IIA (DD)	Group IIB (DD)	Group IIIA (DS)	Group IIIB (DS)
Age in months						
Mean CA	8.87	15.42	17.54	28.30	11.31	22.60
SD	1.92	2.16	2.80	4.60	1.50	4.50
Mean MA	8.87	15.42	9.89	14.56	7.00	14.44
SD	1.92	2.16	1.69	2.74	1.00	2.35
HRR			Neonatal jaundice, premature delivery, convulsions, typhoid in second trimester, delayed birth cry, NICU, birth asphxia	NICU for > 3 days, convulsion, birth asphyxia, delayed birth cry,	Neonatal Jaundice, delayed birth cry, congenital heart disease, NICU for 3 days	delayed birth cry, Neonatal jaundice
Mean age on various domains of Preschool checklists						
Social	9	15	9	18	9	15
Gross motor	9	16	12	16	9	12
Fine motor	9	15	12	15	9	15
Cognitive	9	15	9	18	6	12
Mean age on REELS						
RLA	10	16	11	16	7	16
ELA	10	16	10	11	6	11

Note: CA- Chronological age, MA- Mental age, HRR- High risk register, RLA- Receptive language age, ELA- Expressive language age

Table 2

Details of mothers in the three dyadic groups

		Group I		Group II		Group III	
		Group IA (TDM)	Group IB (TDM)	Group IIA (DDM)	Group IIB (DDM)	Group IIIA (DSM)	Group IIIB (DSM)
		Age in years					
Age of the mothers	Mean	28.44	23.33	25	28.78	30.44	29.22
	SD	2.97	2.74	3.39	2.05	6.11	4.87
No. of years of formal education	Mean	15.33	11.78	12.00	18.22	14.67	14.00
	SD	2.65	2.54	2.45	2.33	3.16	3.00
Educational qualification		PUC to Master's degree	SSLC to Bachelor's degree	SSLC to Master's degree	Bachelor's to Doctor's degree	SSLC to Master's degree	SSLC to Bachelor's degree
Occupation	Working	N=2	N=1	N=0	N=7	N=1	N=0
	Home maker	N=7	N=8	N=9	N=2	N=6	N=9

Inclusion criteria common for children in the three groups (TD DD and DS) were as follows:

1. Children with their native language as [1]Kannada were considered.
2. In addition to the native language being Kannada, it was ensured that children were exposed only to another Indian language.
3. A questionnaire was developed by the investigator to gather information about the children's language environment to elicit information on how the waking hours of the child was distributed across the day (Appendix 1). The questionnaire was filled by the mothers of the children in the 3 groups.

[1]Kannada is a member of the Dravidian language family. It is a language spoken predominantly in the state of Karnataka. The estimated population of this Karnataka is 6,11,30,704 as per the census conducted in 2011 (Government of India, Ministry of Home Affairs, Office of the Registrar General and Census Commissioner, India, 2011).

4. Children in TD group DD group and DS group were assessed using Receptive-Expressive Emergent Language Scale (REELS) (Bzoch & League, 1971) to determine the receptive language age (RLA) and expressive language age (ELA).
5. The families of children included in the study belonged to middle socioeconomic status as per the Socio-economic status scale (Venkatesan, 2011).
6. Mental age and the social adaptive skills of the children were determined as per the evaluation by a qualified Clinical Psychologist. Children with mental age and social adaptive skills appropriate to their chronological age were considered in TD group, and children with mental age-matched with the chronological age of the TD children were considered in DD group and DS group.
7. The developmental status in social, motor and cognitive domains were assessed in children belonging to the three groups using the *Preschool checklists for children with communication disorders (0-6 years)* (Swapna, Jayaram, Prema, & Geetha, 2010).
8. Only children with appropriate functions of the oral mechanism were considered for the study based on oral mechanism examination by the investigator.
9. Only those children who were physically healthy without any upper respiratory tract infection or fever were included.

Specific inclusion criteria for children in the TD group.

1. Only those children who did not present any positive risk factors for delays or deviancies in communication development during prenatal, natal and postnatal period, as screened using High-risk register (Developed at All India Institute of Speech and Hearing, Mysore) were included.

Specific Inclusion criteria for children in the DD group

1. Children diagnosed as having nongenetic causes of intellectual impairment in the prenatal, natal or postnatal period by qualified paediatricians and Clinical Psychologists were included.
2. Mental age of the children as assessed by qualified Clinical Psychologist was between 6 months to 12 months in the younger age group and 12-18 months in the older age group.
3. Only those children who had not undergone speech and language therapy or who had undergone speech and language therapy for less than 6 months were included.

Specific inclusion criteria for children in DS group

1. Children diagnosed as having Down syndrome due to Trisomy 21 by qualified Paediatrician were included in this group.
2. Mental age of the children as assessed by qualified Clinical Psychologist was between 6 months to 12 months in the younger age group and between 12-18 months in the older age group.
3. Children with functional hypotonia were considered, as it is reported to be a phenotypic feature of children with Down syndrome (Roizen & Patterson, 2003).
4. Only those children who had not undergone speech and language therapy or had undergone speech and language therapy for less than 6 months were included.

Exclusion criteria common for children in the three groups (TD DD and DS) were as follows:

1. Children with a history of and/ or presenting complaints of hearing or visual impairments were excluded from the study.
2. Children with a history of and/or presenting complaints of systemic diseases requiring frequent medical attention were eliminated from the study.

Common Inclusion criteria for mothers in TDM, DDM and DSM group

1. The chronological age of all the mothers in the 3 groups was in the range of 20 to 35 years
2. The native language of the mothers and the dominant language used with children was Kannada. None of the mothers used a second language to communicate with their children.
3. All the mothers in the 3 groups had a minimum of 7 years of formal education.
4. All the mothers in the 3 groups did not have any history of or presenting complaints of speech, hearing, language or communication as ascertained by interview of the mothers by the investigator before data collection.
5. All mothers had normal physical range of movements in the upper limbs as ascertained by interview of the mothers by the investigator before data collection.
6. None of the mothers had any type of health problems that would hinder their interaction with children during data collection as ascertained by interview of the mothers by the investigator before data collection.
7. All the mothers belonged to families with middle socio –economic status
8. The working mothers mostly depended on family members such as child's grandparents to take care of the child in their absence.

Ethical Approval

The study was approved by the "Committee for Ethical guidelines for bio-behavioural research involving human subjects of the All India Institute of Speech and Hearing, Mysore (Basavaraj & Venkatesan, 2009).

Informed consent

After a detailed interview with each mother, they were informed about the aims and objectives of the study and written informed consent (Appendix 2) was obtained from all participant mothers as per the prescribed guidelines before data collection.

Research design

A standard group comparison research design was used. Mother-child dyads including children with intellectual impairment due to developmental disabilities (DD) and children with intellectual impairment due to Down syndrome (DS) formed the "clinical groups" and mother-child dyads with typically developing children (TD) formed the 'typical group'.

Procedure

Each mother-child dyad was initially interviewed. Language age of every child was determined by administering Receptive-Expressive Emergent Language Scales (REELS) (Bzoch & League, 1971) by the investigator. The investigator also administered preschool checklists for children with communication disorders (Swapna, Jayaram, Prema, & Geetha, 2010) and the Socio-economic status scale (Venkatesan, 2011). The medical records of the children in the clinical groups were

verified by the investigator to ascertain that they satisfy the inclusion criteria of the study.

To elicit information on children's language environment, the native language of the child, additional languages to which the child was exposed, factors such as the extent of language stimulation provided to children and distribution of child's waking hours across various language activities, a language environment questionnaire was developed (Appendix 1) and was administered on all the participating mothers. The waking hours of the children were mostly distributed across three domains, playtime with parents or caregiver, involved in routine activities like feeding, bathing and involved in parallel activities, monitoring child while the mother is carrying out household chores

Materials

To elicit communication interactions between mother-child dyads, toys from the "Toy kit for infants with developmental disabilities" (Venkatesan, 2004) were used. From the toy kit, few toys were excluded, and few were added. The toys were then classified into three groups based on the characteristics: (a) toys resembling living creatures or miniature objects (b) toys that could be mechanically manipulated (c) toys that produced sound or light on manipulation. Table 3 provides a list of toys under the three categories that was used in the study.

Table 3

Toys used in the study

Toys resembling living creatures/miniature objects	Toys which could be mechanically manipulated	Toys that produced noise/light on manipulation
Doll, Mickey mouse	Stack of rings	Rattles, Office bell
Hand puppet	Blocks, Connector set	Drum, Xylophone
Push along Car/train	Soft, colored Ball	Torch

Task

Semi-structured free play interaction between mother-child dyads was used to collect data on communication between the dyads in the study. Mothers were instructed to interact with the child as naturally as possible. Mothers were told to use one toy at a time as far as possible. As each child's preference for toys was different and for different children the total time for which a toy was used differed, the time allotted to each toy was not fixed, rather the procedure was made flexible to give complete opportunity for the mother-child dyad to use any toy from the available kit for any duration of time. However, each dyad had to play with three toys each from each group of toys shown in Table 3.

Instrumentation

A digital video camera, Sony DCR-SR88 with 60X optical zoom and its accessories was used. An Asus Pro P53E laptop with basic accessories was used to transfer, store, segment, code and annotate the data. In addition, Creative headset HS-150 with on-the-ear, supra-aural closed headset, the behind-the-neck design was used. Corel VideoStudio pro X4 was used for editing the video samples and EUDICO Linguistic Annotator (Sloetjes & Wittenburg, 2008); ELAN version 4.7.3 was used for data segmentation, coding, and annotation.

EUDICO Linguistic Annotator (Sloetjes & Wittenburg, 2008); ELAN version 4.7.3 was used for data segmentation, coding, and annotation. ELAN (EUDICO Linguistic Annotator) is an annotation tool that allows creating, editing, visualizing and searching annotations for video and audio data. It was developed at the Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands. ELAN is specifically designed for the analysis of language, sign language, and gesture.

Setup

The communication interaction between the mother-child dyads was carried out in the respective homes of the dyads. Before recording the communication interactions between the dyads, the investigator ensured removal of unwanted toys and other objects from the the child's reach. The tripod stand and camera were fixed and floor mats were spread on the floor.

The video recording of the communication interaction between the mother-child dyad was carried out in a silent room in the house with minimal auditory and visual distractions and optimal lighting and ventilation. The seating of the participants was on the matted floor. The child was made to sit facing the camera. The mother sat either across from the child or on one of the child's sides, so the dyad was clearly in view of the camera. A single camera placed on the tripod stand in front of the dyad at a distance of minimum 1 to 2 meters was used to record the video samples. If the child was in the sitting position, it was ascertained that the dyads' face and upper body profile was covered in the video. If the child was in supine/prone position, the child's complete body and the mother's upper body profile was covered in the video (Figure 1). The locomotion of the child or mother if any was also captured by adjusting the height and position of the tripod stand appropriately. Mothers were instructed to

interact with the child as naturally as possible. Mothers were told to use one toy at a time as far as possible. The mother was given access to the toy kit. The mother chose one toy at a time for interaction with the child. The mother-child interaction was video recorded to obtain a sample of minimum one-hour duration. The video recording was done in 2-4 sittings with a gap of 1 to 6 days in between the two sittings. It was ensured that after each session of data collection, the toys used during the interaction were sterilized using appropriate procedures to curtail cross contamination of any infection.

Figure 1. Examples of Setup of video recording of mother-child dyads

Recording

The interaction between the mother and child dyad was video recorded by the investigator in the natural context without participating in the activities directly. Each mother-child interaction was video recorded for a total duration of 1 hour. After the

completion of the video, recording dyads were given a small token of appreciation for participating in the study.

Data analyses

Stage 1: Editing

Recording of each mother-child dyad was captured in free-play interaction context for a minimum of 60-minute duration. The interaction was facilitated by use of toys listed in Table 3. There was no preset time limit for interaction facilitated by any toy. Thus free-play mother-child interaction sessions provided flexibility in the use of toys of the child's preference. This had two effects, firstly not all children used all fifteen toys in the interaction and secondly, the duration of use of a single toy varied across the dyads. To maintain uniformity in the interaction across the dyads, interaction with only three toys from each category of toy set was considered. With each toy, an interaction lasting for a minimum of 60 to 70 second was considered. Thus, a meaningful interaction sample of 60-70 second from each of the nine toys, made up for a total duration of 540 to 630 second (9-10.5 min) per dyad. So, totally 8-9 hours of the samples from 54 mother-child dyads were subjected to further data analyses.

The editing of the videos was done in three levels using Corel video studio X4 pro software. Appendix 3 provides the details of editing the communication behaviours of mother-child dyad.

Stage 2: Segmentation

The edited meaningful sample of 9-10.5 min duration of each dyad was considered for further analyses. The communication interaction between the mother-

child dyads were segmented into mother's communication turns and child's communication turns on two tiers of the annotation software (ELAN). The details on the criteria to segment the interaction into child's communication turns and mother's communication turns can be found in Appendix 3.

Stage 3: Coding

Each child's communication turn was assigned on the basis of seven codes and mother's communication turn were assigned on the basis of six codes, that were operationally defined by the investigator for the study. In both child's and mother's communication turns, first four characters of the code represented the a) Type of the toy used, b) the serial number of the communication interaction, c) performer of the communication act (mother/child) and d) serial number of the communication turn. The next three codes represented the e) Eye gaze orientation, f) Gestures, and g) Vocal behaviour. For the mothers, eye gaze orientation was not coded. Since each communication turn comprised of more than a single gesture, in both mother's and child's communication turns, up to 3 Gestures were annotated. The last three codes for the child's communication turns (E,G,V) and the last two codes for the mother's communication turns (G, V) were further annotated.

Stage 4: Annotation.

a) Eye gaze orientation (E) was annotated as the communication partner or object on which the eye gaze was fixed or the eye gaze shifted between any two points E.g., If the child's eye gaze alternated between a toy and the communication partner, annotation was E- toy-mother.

b) Gestures (G) were annotated as a short keyword, phrase or a sentence. This code was annotated as "0" if there was no gesture used in the given communication turn.

In any given communication turn, up to a maximum number of three gestures were annotated. E.g, G- mouth toy in mother's hand- reach toy. The operational definitions of the annotations are provided in Appendix 3.

c) Vocal behaviours (V)/ Child-directed speech (V): Vocal behaviours in children was annotated using broad IPA E.g., V- a; Child-directed speech produced by mothers comprised of phrases and sentences and not vocalization or protowords in isolation. So, for mother's communication turns presence or absence of child-directed speech was annotated. Annotation of '0' was used to indicate absence of child-directed speech and '1' for presence.

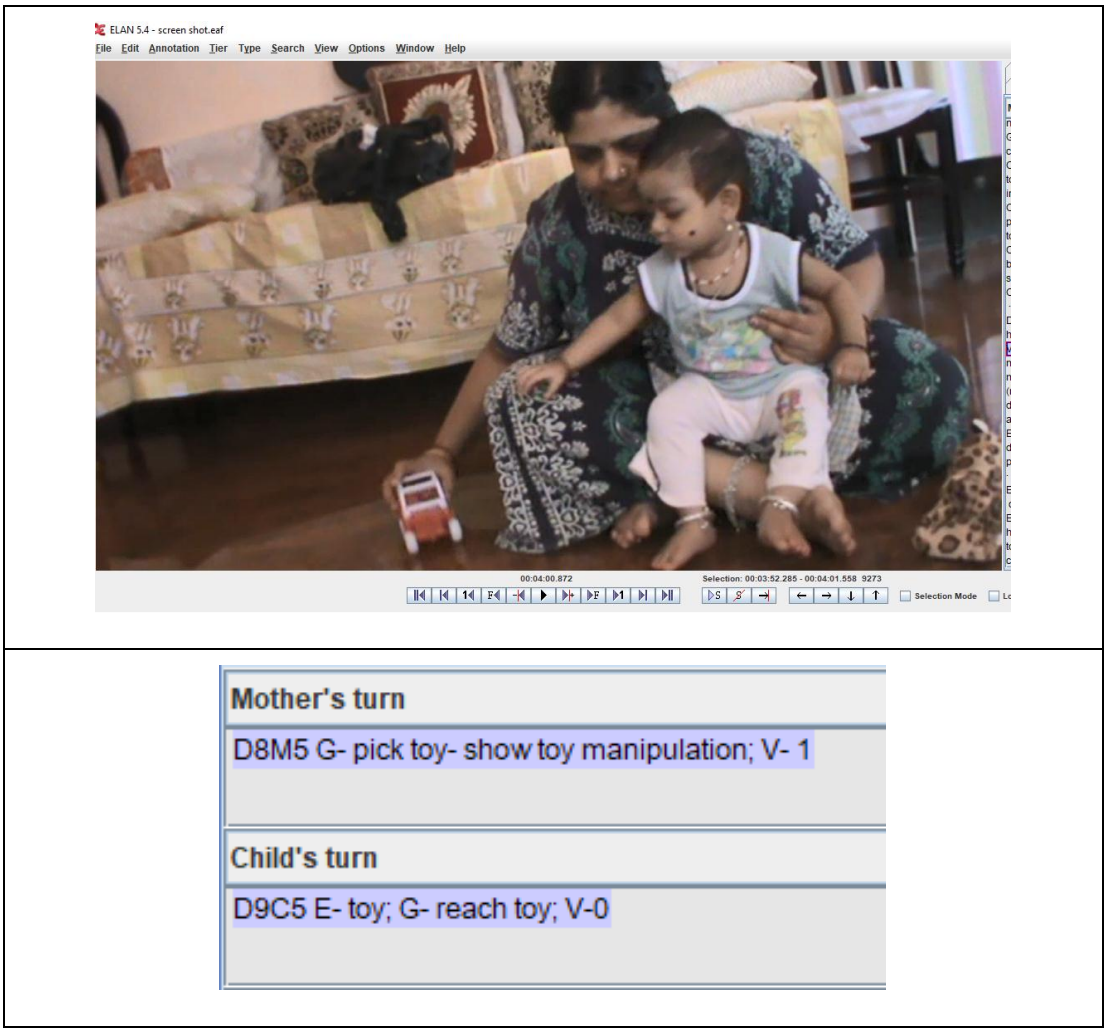

Figure 2. A sample screenshot of the codes and annotations done using ELAN software

Hence child's each communication turn comprised of 7 codes and three annotations. E.g., A6C3 E- toy; G- mouth toy in mother's hand- reach toy; V- a. Mother's each communication turn comprised of 6 codes and 2 annotations e.g., I9M5 E- child-toy; G- offer toy- show toy manipulation; V- 1.

Stage 5: Categorization of the annotations into subcategories from child's communication turns

The annotations for child's communication turns on Eye gaze orientation, Gesture, and vocal behaviour were then categorized into subcategories.

1. Eye gaze orientation

The eye gaze orientation had three subcategories namely single eye gaze orientation, Dual eye gaze orientation and triadic eye gaze orientation. The operational definition of the subcategories of the eye gaze orientation is provided in the Appendix 3

2. Gesture

In this study, seven types of gestures are considered under three main groups Preintentional presymbolic gestures (PIPS), Intentional presymbolic gestures (IPS) and Intentional symbolic gestures (IS) as follows:

a) Alerting behaviours,
b) Mother assisted actions,
c) Toy exploration,
d) Toy manipulation,
e) Deictic gestures,
f) Conventional gestures and
g) Representational gestures)

These three groups of gestures are classified based on the cognitive theory of development (Piaget, 1926, 1954, 1962) and social interaction theory (Vygotsky, 1962, 1978, 1987). Preintentional presymbolic category of gestures is called preintentional because, these gestures lack intentionality on part of the child but are still responded to by the mother and the communication continues. These gestures are presymbolic because, children do not substitute objects or events (signifiers) for other objects or events (the signified), which defies the definition of symbolic representation. The first four types of gestures were categorized under PIPS gesture subcategory. Intentional presymbolic gestures are called intentional because, the intentionality of the children is evident as these gestures are directed to the mother, but the gestures do not have the quality of signifying another object that is not present in the context of communication. Deictic gestures are categorized under IPS gesture subcategory. Intentional symbolic gestures are intentional by virtue of its production and symbolic because the gesture represents an object that is absent. Conventional and Representational gestures are categorized under IS gesture subcategory. The operational definition and the examples for each of the subcategories of gestures are provided in Appendix 3

3. Vocal behaviours

Annotations in the vocal behaviour were categorized into any one of the subcategories: Vocalization, Protoword and Word. The operational definitions are provided in Appendix 3.

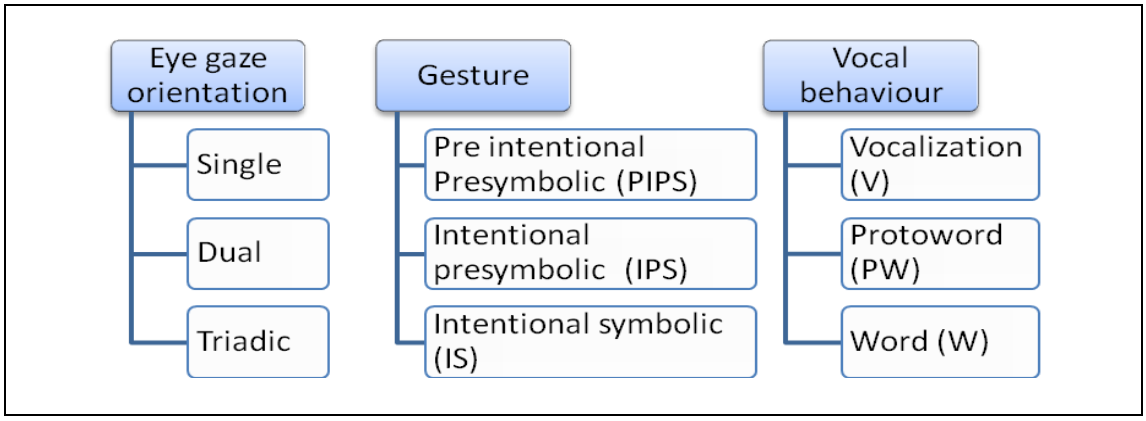

Figure 3. Schematic representation of subcategories of annotations used for eye gaze orientation, gesture and vocal behaviours of children

Stage 5: Categorization of the annotations into subcategories from mother's communication turns

1. Maternal Gesture

Annotations of maternal gesture category in mother's communication turns were categorized into either intentional presymbolic (IPS) gestures or intentional symbolic (IS) gestures. The operational definitions and examples are provided in the Appendix 3.

2. Child-directed speech

Mother's speech directed towards child was annotated as '1' if present and as '0' if absent.

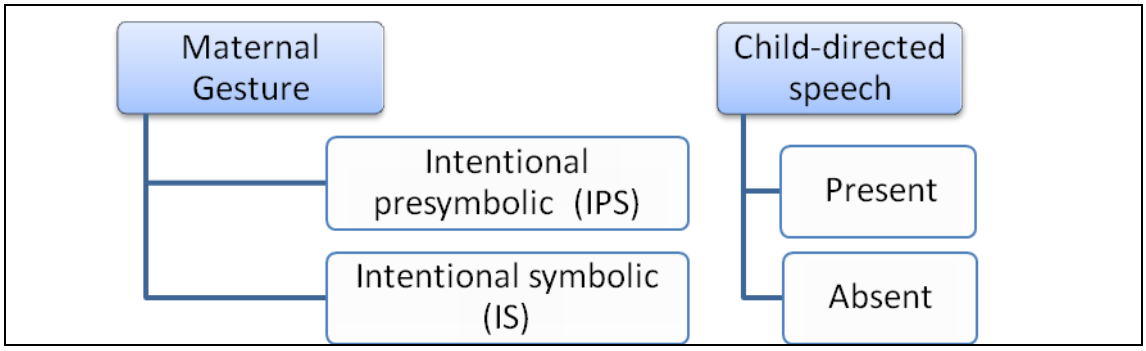

Figure 4. Schematic representation of subcategories of maternal gesture and child-directed speech used

Reliability Check

Inter judge reliability

Two qualified Speech-Language Pathologists were recruited to determine interjudge reliability for the annotated samples. These SLPs were trained with samples which were not included in the study for a minimum of 3 hours to ensure that the annotations and codes used for analyses were well understood. Six mother-child dyads considered in the study were selected randomly and the trained SLPs were instructed to indicate their agreement or disagreement with the annotations of the investigator on the three domains in child's communication turns and two domains in mothers' communication turns. There were totally 501 child communication turns and 501 mothers communication turns each from the six dyads. Agreement on 3,507 communication behaviours of six children from 501 communication turns and 3,006 communication behaviours of six mothers from 501 communication turns were calculated. Mean percentage agreement was calculated, considering the percentage agreement with the investigator and judge one (SLP1) and investigator and judge 2 (SLP2). Cut off criteria for reliability scores was set as 90%.

Intrajudge reliability

The investigator carried out the annotation of the video samples of the six mother-child dyads after a time gap of 6 months. Agreement on 3,507 communication behaviours of six children from 501 communication turns and 3,006 communication behaviours of six mothers from 501 communication turns were calculated. Cut off criteria for reliability scores was set as 90%.

Analyses

The annotations in child's communication turns under eye gaze orientation, gesture and vocal behaviour were categorized into subcategories. The number of occurrences of the subcategories of eye gaze orientation (Single, Dual and triadic eye gaze orientation), gestures (Perintentional presymbolic-PIPS gesture, Intentional presymbolic-IPS gesture and Intentional symbolic-IS gesture) and vocal behaviours (Vocalization, Protowords, Words) were converted into percentage of occurrence. Similarly, the number of occurrences of mother's communication turns annotated and categorized under maternal gesture (Intentional presymboli-IPS gesture and Intentional Symbolic- IS gesture) and Child-directed speech (Present, Absent) were converted into percentage of occurrences.

Statistical Analyses

The statistical analyses were carried out for the child's communication turns, and mother's communication turns separately. As the data did not follow normal distribution and had outliers, non parametric statistical measures were used.

Mann Whitney U test was used to compare between-age groups in children's communication behaviours, Mother's communication behaviour, comparison of children's communication behaviours (the three subcategories of eye gaze orientation, three subcategories of gestures and three subcategories of vocal behaviours) between two age groups, comparison of mothers' communication behaviours (two subcategories of maternal gestures and child-directed speech) between two age groups. This was followed by Kruskal Wallis H test pair wise comparison of children's communication behaviours (three subcategories of eye gaze

orientation, three subcategories of gestures and three subcategories of vocal behaviours) across TD group, DD group and DS group; mothers' communication behaviours (two subcategories of maternal gestures and child directed speech) across the three groups of mothers (TDM, DDM and DSM). When significant differences were seen across three groups, Mann Whitney U test was used for pairwise comparison. Friedman's test was used to compare within each communication behaviours (Single, dual and triadic eye gaze orientation within Eye gaze orientation, PIPS, IPS and IS gestures within gesture and vocalization, protoword and word within vocal behaviours). Post hoc test of Wilcoxon signed rank test was used when significant differences across the subcategories were observed.

Chapter 4

RESULTS

The results of the study are presented under two major sections as follows:

Section 1:Presymbolic communication behaviours of children in Group I [Typically developing (TD) children], Group II [Children with Intellectual disability due to Developmental Disorders (DD)], and Group III [Children with Intellectual disability due to Down Syndrome (DS)],

Section 2: Communication behaviours of the mothers of children in Group I [Mothers of Typically developing (TDM) children], Group II [Mothers of Children with Intellectual disability due to Developmental Disorders (DDM)], and Group III [Mothers of Children with Intellectual disability due to Down Syndrome (DSM)],

Reliability Check

Inter judge reliability : The percentage agreement for child's communication turns with the investigator and judge 1 (SLP1); investigator and judge 2 (SLP2) and Judge 1 and judge 2 was 93.61%; 92.41% and 90.11% respectively. The percentage agreement for mothers' communication turns with the investigator and judge 1 (SLP1); investigator and judge 2 (SLP2) and Judge 1 and judge 2 was 98.61%; 96.10% and 98.11% respectively.

Intrajudge reliability: 93.01% of intrajudge reliability for child's communication turns and 98% of intrajudge reliability for mother's communication turns was obtained.

Tabulation of data on presymbolic communication behaviours of children, scoring and statistical analyses

The mother-child interaction samples of 54 dyads were segmented into 4,640 child's communication turns. As described in chapter 3 (Method section), each communication turn was annotated under three categories: a) Eye gaze orientations b) Gestures and c) Vocal behaviours. A single communication turn was annotated under each category. The annotations under gesture formed a complex in most communication turns. To breakdown the complex, in each communication turn, up to three gestures were annotated. Finally, a total of 12,587 annotations under the three groups of communication behaviours [Eye gaze orientation (4,404 annotations), Gestures (6,800 annotations) and Vocal behaviours (1,383 annotations)] were obtained. The annotations made under these three groups were further divided into subcategories (Table 4). The operational definitions of these subcategories and the behaviours that occurred under each subgroup are provided in Appendix 3.

The data obtained in the form of number of occurrences of the three subcategories of eye gaze orientations; three subcategories of gestures, three subcategories of vocal behaviours were then converted to percentage occurrence scores. The conversion into percentage was done because the number of communication turns for each participant was different. The data was analysed using SPSS 20 software.

Initially, box plots were constructed to identify the outliers in the three groups for all the categories of communication behaviours and the two sub age groups in each of the three groups. There were outliers in all the groups for all the dependent variables. Owing to the small sample size in each group, the outliers were not eliminated for further data analyses.Shapiro wilk's test of normality was administered. The data was normally distributed for some groups, but was non normally distributed for most of the communication behaviours analysed.Descriptive statistics was computed and both mean and median scores were estimated [% Mean and SD, % Median and Inter quartile range IQR]. Standard deviation and Inter quartile range was also estimated.As the data had significant outliers and showed non normal distribution withhigh standard deviations, nonparametric tests were used to test the hypotheses of the study.

The results pertaining to eye gaze orientations, gestures and vocal behaviours of children in Groups I, II and III are presented separately. Under each of these communication behaviours, comparisons between age groups, across groups, and within behaviours is reported.

Table 4

Overview of subcategories annotated under Eye gaze orientations, Gestures and Vocal behaviours.

Eye gaze orientations			*Gestures*			*Vocal behaviours*		
Single	Dual	Triadic	Pre intentioanlPresymbolic (PIPS)	Intentional presymbolic (IPS)	Intentional symbolic (IS)	Vocalization (V)	Protoword (PW)	Word (W)

SECTION 1: Presymbolic communication behaviours of children in the three dyadic groups

4.1. Eye gaze orientationbehaviours in childrenof the three groups

The total number of annotations for eye gaze orientation including single, dual and triadic eye gaze orientations was 4,404. Mean, median, standard deviation and interquartile range for percentage occurrence of single, dual and triadic eye gaze orientations were calculated and the same is presented in Table 5.

Table 5

Mean (M), Standard Deviation (SD), Median (Mdn) and Interquartile range(IQR) of subcategories of eye gaze orientation behaviours in three groups

Eye gaze orienta-tionbeha-viours (in %)		Group I TD children (CA)			Group II DD children (MA matched)			Group III DS children (MA matched)			Age groups-total	
		Gp (Tot)	Gp IA (>6 to ≤ 12 mths)	G IB (>12to ≤ 18 mths)	Gp II (Tot)	Gp IIA (>6 to ≤ 12 mths)	Gp IIB (>12to ≤ 18 mths)	Gp III (Tot)	Gp IIIA (>6 to ≤ 12 mths)	Gp IIIB (>12to ≤ 18 mths)	Tot (>6 to ≤ 12 mths)	Tot (>12to ≤ 18 mths)
Single eyegaze	M	69.34	80.56	58.12	80.8	79.78	81.82	76.46	81.87	71.05	80.74	70.33
	SD	16.57	11.25	13.18	11.06	11.53	11.15	13.87	5.88	17.56	9.55	16.86
	Mdn	68.19	81.67	60	80.58	79.41	82.28	80.35	82.76	74.39	81.66	69.9
	IQR	22.94	19.89	16.82	19.05	21.79	19.27	16.49	4.49	31.57	10.16	23.46
Dual eyegaze	M	20.44	13.8	27.09	14.42	15.78	13.06	18.32	16.34	20.29	15.31	20.15
	SD	10.85	9.71	7.53	8.21	10.26	5.83	9.03	6.26	11.19	8.64	10.02
	Mdn	23.38	10.77	26.15	15.74	15.69	15.79	16.38	16.16	20.73	14.71	18.45
	IQR	16.13	14.29	5.88	11.83	18.27	9.71	16.01	3.54	20.07	11.34	14.14
Triadic eyegaze	M	10.22	5.64	14.8	4.78	4.44	5.11	5.22	1.79	8.66	3.96	9.52
	SD	7.63	2.7	8.32	4.8	2.28	6.6	6.1	1.53	7.09	2.69	8.17
	Mdn	8.44	5.13	13.85	4.36	4.76	3.53	3.01	2.3	7.95	3.39	8.14
	IQR	10.95	5.46	13.92	5.39	3.37	8.88	6.95	3.01	12.51	3.08	13.74

Note: M = Mean; SD= Standard deviation; Mdn = Median; IQR = Interquartile range; CA = chronological age; MA = Mental age; mths = months; TD = Typically developing children; DD= Children with Intellectual disability due to developmental disorders; DS = Children with Intellectual disability due to Down syndrome.

4.1.1. Comparisons of percentage occurrence of eye gaze orientation behaviours between age groups.

Mann Whitney U test was used to compare the eye gaze orientation behaviours between the two age groups in all the three groups of children (TD,DD

and DS). Results of Mann whitney U test are represented in Table 6. There was significant effect of age on eye gaze orientation behaviours.

Table 6

Results of Mann Whitney U test for comparison of eye gaze orientation behaviours between age groups

Groups of children						
Age groups	TD children		DD children		DS children	
>6 to ≤ 12 mths Vs. >12to ≤ 18 mths (in %)	Group IA (>6 to ≤ 12 mths) Vs Group IB (>12 to ≤ 18 mths)		Group IIA (>6 to ≤ 12 mths) Vs Group IIB (>12 to ≤ 18 mths)		Group IIIA (>6 to ≤ 12 mths) Vs Group IIIB (>12 to ≤ 18 mths)	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Single eye gaze	2.87	.004*	0.662	0.508	1.457	0.145
Dual eye gaze	2.428	.015*	0.574	0.566	0.751	0.453
Triadic eye gaze	2.297	.022*	0.622	0.534	2.397	.017*

* Significant difference ($p<0.05$)

TD children

From the results in Table 6, it is seen that younger TD children (>6 to ≤ 12 mths) in Group IA (Mdn= 81.67) obtained significantly greater median percent occurrence of single eye gaze orientation than the older children in Group IB (>12 to ≤ 18 mths) (Mdn= 60.00), [/Z/=2.870, p= 0.004]. The older TD children, Group IB (>12 to ≤ 18 mths) (Mdn= 26.15) showed significantly greater median percent occurrence of dual eye gaze orientation than the younger TD children in Group IA(>6 to ≤ 12 mths) (Mdn= 10.77) [/Z/= 2.428, p=0.015]. For the triadic eye gaze orientation, older TD children in Group IB (>12 to ≤ 18 mths) (Mdn= 13.85) showed significantly greater median percent occurrence compared to the younger children in Group IA (>6 to ≤ 12 mths) (Mdn= 5.13), [/Z/=2.297, p=0.22]. Figure 5 represents the percent occurrence of the eye gaze behaviours in TD children.

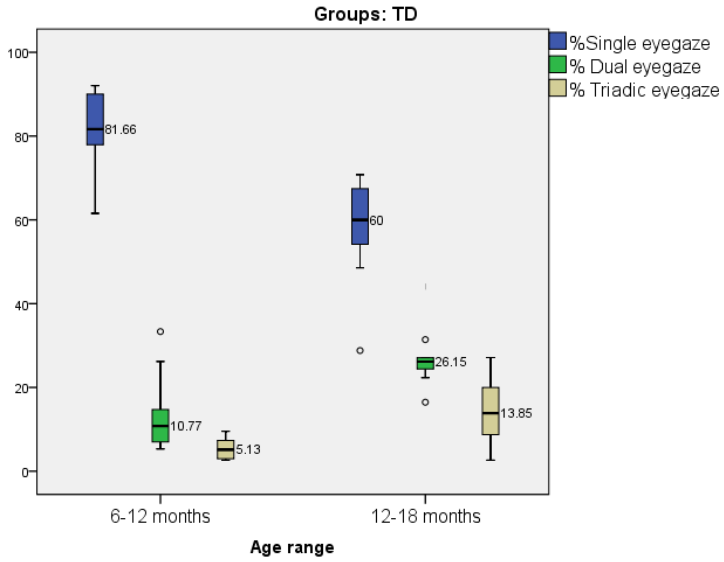

Figure 5. Median and IQR for % occurrence of Single, Dual and Triadic eye gaze orientation between the two age groups of TD children in Group I

DD children

From the results in Table 6, it is seen that DD children in younger age group (>6 to ≤ 12 mths) in Group IIA (Mdn= 79.41) did not reveal significant difference in the median percent occurrence of single eye gaze orientation compared to the older DD children in Group IIB (Mdn= 82.28), [/Z/=0.662, p= 0.508]. For the dual eye gaze orientation, the older DD children, Group IIB (>12 to ≤ 18 mths) (Mdn= 15.79) showed no significant difference in the median percent occurrence compared to the younger DD children in Group IIA (>6 to ≤ 12 mths) (Mdn= 15.69) [/Z/=0.574, p=0.566]. For the triadic eye gaze orientation, older DD children in Group IIB (>12 to ≤ 18 mths) (Mdn= 3.53) showed no significant difference in median percent occurrence compared to the younger DD children in Group IIA (>6 to ≤ 12 mths) (Mdn= 4.76), [/Z/=0.622, p= 0.534]. Figure 6 represents the percent occurrence of the eye gaze behaviours in DD children.

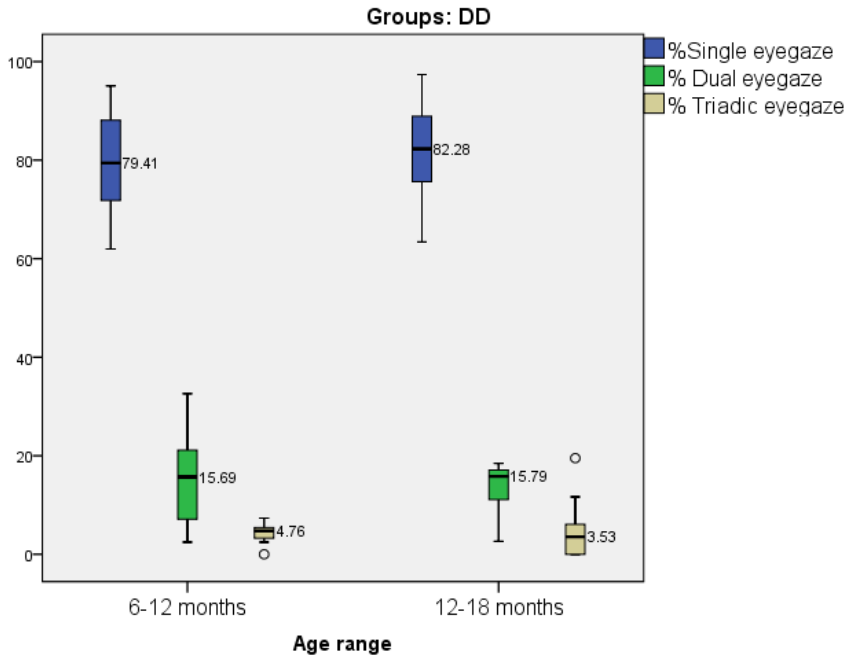

Figure 6. Median and IQR for % occurrence of Single, Dual and Triadic eye gaze orientation between the two age groups of DD children in Group II.

DS children

From the results in Table 6, it is seen that younger DS children (>6 to ≤ 12 mths) in Group IIIA (Mdn= 82.28) showed no significant difference in median percent occurrence of single eye gaze orientation compared to older DS children in Group IIIB (>12 to ≤ 18 mths)(Mdn= 74. 39), [/Z/= 1.457, p=0.145]. The older DS children in Group IIIB (>12 to ≤18 mths) (Mdn= 15.79) did not show significant difference in median percent occurrence of dual eye gaze orientation compared to the younger DS children in Group IIIA (>6 to ≤ 12 mths) (Mdn= 15.79) [/Z/= 0.751, p= 0.453]. For the triadic eye gaze orientation, older DS children in Group IIIB (>12 to ≤ 18 mths) (Mdn= 7.95) showed significantly greater median percent occurrence compared to the younger DS children in Group IIIA (>6 to ≤ 12 mths) (Mdn= 2.30), Z/=2.397, p= 0.017]. Figure 7 represents the median percent occurrence of the eye gaze behaviours in DS children.

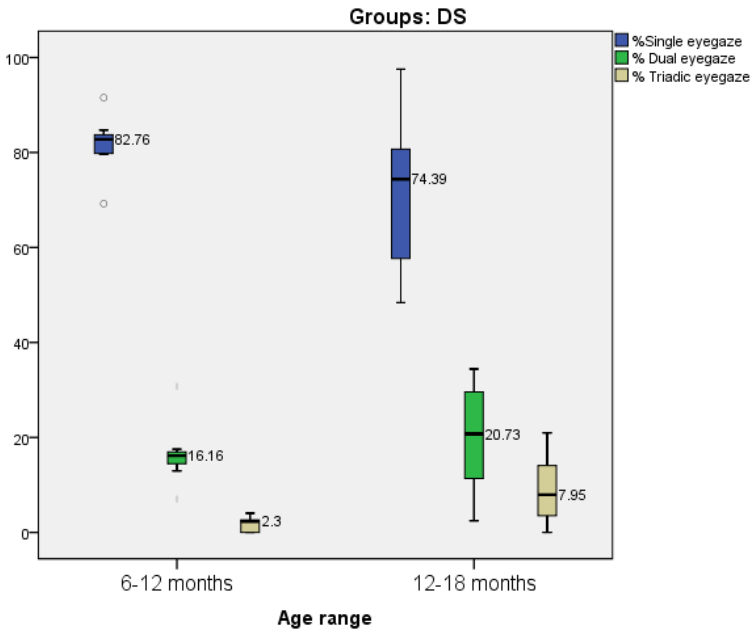

Figure 7. Median and IQR for % occurrence of Single, Dual and Triadic eye gaze orientation between the two age groups of Group III (Group IIIA and Group IIIB)

To summarize, younger TD children in Group IA showed greater median percent scores on single eye gaze orientation which was statistically significant. For dual and triadic eye gaze orientation, older TD children in Group IB showed significantly greater median percent occurrence than younger TD children in Group IA. Both the age groups of DD children in Group II did not demonstrate any statisitically significant difference on single, dual and triadic eye gaze orientation. Lastly, on single and dual eye gaze orientation, younger DS children in Group IIIA and older DS children in Group IIIB showed similar median percent occurrence. Older DS children in Group IIIB showed significantly greater median percent occurrence on triadic eye gaze orientation than younger DS children in Group IIIA..

4.1.2. Comparisons of percentage occurrence of eye gaze orientation behaviours across groups.

Kruskal Wallis H test was used to compare the percentage occurrence of eye gestures across the three groups, as comparison between age group showed main

effect of age. Mann Whitney U test was used for pairwise comparison of eye gaze orientation behaviours between the groups in both age groups. Results of Kruskal Wallis H test and Mann whitney U test are represented in Tables 7 and 8 respectively.

Table 7

Results of Kruskal Wallis H test for comparison across group for subcategories of eye gaze orientation

Across group comparison of subcategories of eye gaze orientation in two age groups separately					
>6 to ≤ 12 months			>12 to ≤ 18 months		
Group IA (TD) Vs Group IIA (DD)Vs Group IIIA (DS)			Group IB (TD) Vs Group IIB (DD) Vs Group IIIB (DS)		
Chi-Square	df	Asymp. Sig.	Chi-Square	df	Asymp. Sig.
0.296	2	0.862	9.175	2	.010*
1.598	2	0.45	8.99	2	.011*
10.82	2	.004*	6.894	2	.032*
* Significant difference (p<0.05)					

Table 8

Results of Mann Whitney U test for pairwise comparison between groups

Comparison across subcategories of eye gaze orientation in two age groups						
Age group A (>6 to ≤ 12 months) Group IA (TD)Vs Group IIA(DDVs Group IIIA (DS)						
	Group IA Vs Group IIA		Group IA Vs Group IIIA		Group IIA Vs Group IIIA	
% Triadic eyegaze	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig.(2-tailed)
	0.707	0.479	3.05	0.002*	2.49	0.013*
Age group (>12 to ≤ 18 months) Group IB (TD)Vs Group IIB(DD)Vs Group IIIB (DS)						
	Group IB Vs Group IIB		Group IB Vs Group IIIB		Group IIB Vs Group IIIB	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
% Single eyegaze	3.13	0.002*	1.37	0.171	1.37	0.171
% Dual eyegaze	3.31	0.001*	0.883	0.377	1.37	0.171
% Triadic eyegaze	2.43	0.015*	1.634	0.102	1.288	0.198
* Significant difference (p<0.05)						

Eye gaze orientation in younger age groups (>6 to ≤ 12 months)

From the results in Table 7, it is seen that there was no significant difference in the median percent occurrence of single eye gaze orientation [$X^2(2) = 0.296$, p= 0.862]; dual eye gaze orientation [$X^2(2) = 1.598$, p=0.45]. There was a significant difference across younger age children in the three groups (TD, DD and DS) in triadic

eye gaze orientation [X^2 (2) = 10.82, p=0.004] in the younger age group of children in the three groups. Figure 8 represents the median percent occurrence of the eye gaze behaviours in younger age group children.

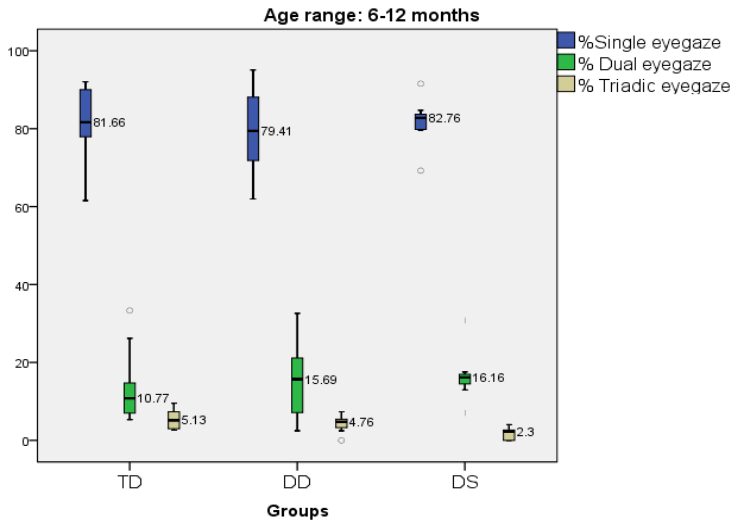

Figure 8. Median and IQR for % occurrence of Single, Dual and Triadic eye gaze orientation across three groups in younger age group (>6 to ≤ 12 months)

Mann Whitney U test was used for pairwise comparison of the triadic eye gaze orientation behaviours in the younger age group (>6 to ≤12 months) across children in the three groups (TD, DD and DS). From the results in Table 8, it is seen that the younger TD children (>6 to ≤12 mths) in Group IA (Mdn= 5.13) showed significantly greater median percent occurrence of triadic eye gaze orientation than the younger DS children in Group IIIA (>6 to ≤12 mths) (Mdn= 2.30), [/Z/= 3.05, p = 0.002]. The younger DD children, Group IIA (>6 to ≤12 mths) (Mdn= 4.76) showed significantly greater median percent occurrence of triadic eye gaze orientation than the younger DS children in Group IIIA (>6 to ≤12 mths) (Mdn= 2.30) [/Z/= 2.49, p = 0.013]. Younger TD children in Group IA (>6 to ≤ 12 mths) (Mdn= 5.13) and younger DD children in Group IIA (>6 to ≤ 12 mths) (Mdn= 4.76) showed no significant difference in the median percent occurrence of triadic eye gaze orientation, [/Z/= 0.707, p= 0.479].

Eye gaze orientation in older age groups (>12 to ≤18 months)

From the results in Table 7, it is seen that there was significant difference in the median percent occurrence of single eye gaze orientation [$X^2(2) = 9.175$, p=0.010]; dual eye gaze orientation [$X^2(2) = 8.99$, p=0.011] and triadic eye gaze orientation [X^2 (2) = 6.894, p=0.032]in the older age group of children in the three groups (TD, DD and DS). Figure 9 represents the median percent occurrence of the eye gaze behaviours in older age group children.

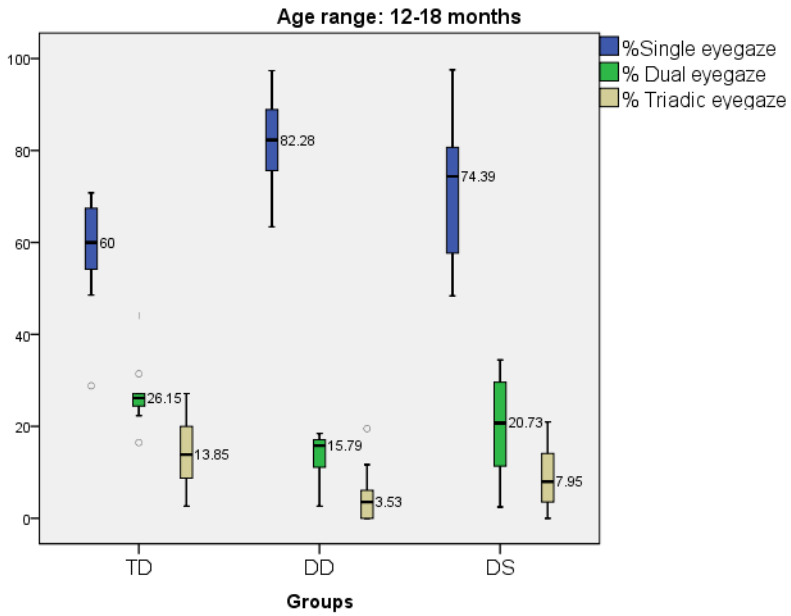

Figure 9. Median and IQR for % occurrence of Single, Dual and Triadic eye gaze orientation across three groups in older age group(>12 to ≤ 18 months)

Mann Whitney U test was used for pairwise comparison of the single, dual and triaidic eye gaze orientation behaviours across children in the three groups (TD, DD and DS) in older age group. From the results in Table 8, it is seen that the older DD children (>12 to ≤ 18 mths) in Group IIB (Mdn= 82.28) revealed significantly greater median percent occurrence of single eye gaze orientation than the older TD children in Group IB (>12 to ≤ 18 mths) (Mdn= 60), [/Z/= 3.13, p = 0.002]. The older TD children in Group IB (>12 to ≤ 18 mths) (Mdn= 4.76) showed significantly greater

median percent occurrence of dual eye gaze orientation than the older DD children in Group IIB (>12 to ≤ 18 mths) (Mdn= 2.30) [/Z/= 3.31, p = 0.001]. The older TD children in Group IB (>12 to ≤ 18 mths) (Mdn= 13.85) showed significantly greater median percent occurrence of triadic eye gaze orientation than the older DD children in Group IIB (>12 to ≤ 18 mths) (Mdn= 3.53) [/Z/= 2.43, p= 0.015].

There was no statistically significant difference on pair wise comparison of older TD children in Group IB and older DS children in Group IIIB on single, dual and triadic eye gaze orientation. There was no significant difference in single, dual and triadic eye gaze orientation between older DD children in Group IIB and older DS children in Group IIIB.

In summary, comparison of single, dual and triadic eye gaze orientation behaviours across group revealed that there was no significant difference in the median percent occurrence of single and dual eye gaze orientation behaviours in the younger age group children. For the triadic eye gaze orientation, younger TD children in Group IA showed significantly greater median percent of occurrence than younger DS children in Group IIIA. Also, younger DD children in Group IIA showed significantly greater median percent than younger DS children in Group IIIA.

Comparison across the three older age groups showed significant difference in the median percent occurrence of single, dual and triadic eye gaze orientation. Older DD children in Group IIB showed significantly greater median percent occurrence than older TD children in Group IB in single eye gaze orientation. Older TD children in Group IB showed significantly greater median percent of occurrence than older DD children in Group IIB in dual and triadic eye gaze orientation.

4.1.3. Comparison of percentage occurrences of types of eye gaze orientation behaviours.

To compare within single, dual and triadic eye gaze orientation, Friedman's test followed by Wilcoxon signed rank test with Bonferroni correction was applied resulting in a significance level set up at $p<0.017$. The Friedman's test was run four times. In the first condition, Friedman's test was run to determine if the median percent occurrence of single, dual and triadic eye gaze orientation showed statistically significant differences irrespective of groups and age. In the second condition, percentage occurrence of single, dual and triadic eye gaze orientations were compared in each group by splitting the three groups. In the third condition, percentage occurrence of single, dual and triadic eye gaze orientation was compared between age group A and age group B. In the last condition, percentage occurrence of single, dual and triadic eye gaze orientations was compared in each of the groups in age group A and each of the groups in age group B. Pairwise comparison was carried out using Wilcoxon signed rank test, if significant differences were shown. Tables 9 and 10 represent the results of Friedman's test and Wilcoxon signed rank test respectively.

Table 9

Results of Friedman's test for comparison within subcategories of eye gaze orientation comparison

Condition 1: Comparison of percentage of occurrence of single, dual and triadic eye gaze orientation				
	N	Chi-Square	df	Asymp. Sig.
Group I, Group II and Group III as a single group	54	101.65	2	0*
Condition 2: Comparison of the percentage of occurrence of single, dual and triadic eye gaze orientation in Group I, Group II and Group III separately				
	N	Chi-Square	df	Asymp. Sig.
Group I	18	32.11	2	0*
Group II	18	33.72	2	0*
Group III	18	36	2	0*
Condition 3: Comparison of percentage of occurrence of single, dual and triadic eye gaze orientation in Group I, Group II and Group III separately				
	N	Chi-Square	df	Asymp. Sig.
Age group A	27	53.51	2	0*
Age group B	27	48.22	2	0*
Condition 4: Comparison of percentage of occurrence of single, dual and triadic eye gaze orientation in Group IA, Group IIA and Group IIIAs and Group IB, Group IIB and Group IIIB separately				
	N	Chi-Square	df	Asymp. Sig.
Group IA	9	18	2	0*
Group IIA	9	17.54	2	0*
Group IIIA	9	18	2	0*
Group IB	9	14.22	2	0.001*
Group IIB	9	16.22	2	0*
Group IIIB	9	18	2	0*
* Significant difference ($p<0.05$)				

Table 10

Results of Wilcoxon Signed Rank Test

Condition 1: Comparison of percentage occurrence of single, dual and triadic eye gaze orientation in percentage						
	Dual - Single eyegaze		Triadic - Single eyegaze		Triadic - Dual eyegaze	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group I, Group II, Group III	6.38	0*	6.393	0*	6.139	0*
Condition 2: Comparison of percentage occurrence of single, dual and triadic eye gaze orientation in Group I, Group II and Group III separately						
	Dual - Single eyegaze		Triadic - Single eyegaze		Triadic - Dual eyegaze	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group I	3.68	0*	3.72	0*	3.376	0.001*
Group II	3.72	0*	3.72	0*	3.527	0*
Group III	3.72	0*	3.72	0*	3.724	0*
Condition 3: Comparison of percentage occurrence of single, dual and triadic eye gaze orientation in Group I, Group II and Group III separately						
	Dual - Single eyegaze		Triadic - Single eyegaze		Triadic - Dual eyegaze	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Age group A	4.54	0*	4.54	0*	4.458	0*
Age group B	4.49	0*	4.54	0*	4.325	0*
Condition 4: Comparison of percentage occurrence of single, dual and triadic eye gaze orientation in Group IA, Group IIA and Group IIIA and Group IB, Group IIB and Group IIIB separately						
	Dual - Single eyegaze		Triadic - Single eyegaze		Triadic - Dual eyegaze	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group IA	2.66	0.008*	2.66	0.008*	2.668	0.008*
Group IIA	2.66	0.008*	2.66	0.008*	2.521	0.012*
Group IIIA	2.66	0.008*	2.66	0.008*	2.666	0.008*
Group IB	2.55	0.011*	2.66	0.008*	2.547	0.011*
Group IIB	2.66	0.008*	2.66	0.008*	2.547	0.011*
Group IIIB	2.66	0.008*	2.66	0.008*	2.666	0.008*
*significant difference as set up with Bonferroni correction ($p<0.017$)						

The results indicated significant effect of subcategories of eye gaze orientation. The results on four conditions of Friedman's test followed by Wilcoxon signed rank test revealed that there was no interaction effect between the three subcategories of eye gaze orientation, groups and age groups. Thus, within group comparison of the subcategories of eye gaze orientation revealed similar results across age and groups. Consistently, it was observed that the median percent occurrence of single eye gaze orientation was the most significantly occurring subcategory followed by dual eye gaze orientation and lastly the triadic eye gaze orientation.

4.2. Gestural behaviours in children of the three Groups

The total number of annotations done were 6,800, including Preintentional Presymbolic gestures (PIPS), Intentional Presymbolic gestures (IPS) and Intentional symbolic gestures (IS). Means, medians, standard deviations and interquartile ranges for percentage occurrence of PIPS gestures, IPS gestures and IS gestures were calculated and the same is presented in Table 11.

Table 11

Means (M), Standard Deviations (SD), Medians (Mdn) and Interquartile ranges (IQR) of subcategories of gestures in children of the three groups

Gestural Behaviours in %		Group I TD children			Group II DD children			Group III DD children			Age groups (Total)	
		Gp I (Tot)	Gp IA >6 to ≤ 12 mths	Gp IB >12 to ≤ 18 mths	Gp II (Tot)	Gp IIA >6 to ≤ 12 mths	Gp IIB >12 to ≤ 18 mths	Gp III (Tot)	Gp IIIA >6 to ≤ 12 mths	Gp IIIB >12 to ≤ 18 mths	>6 to ≤ 12 mths	>12 to ≤ 18 mths
M	PIPS	45.61	49.96	41.26	48.87	49.55	48.19	45.56	48.65	42.47	49.39	43.97
Mdn		44.58	49.11	41.23	47.04	47.06	46.56	42.25	47.29	41.23	48.67	42.29
SD		6.85	6.08	4.50	10.49	9.64	11.82	9.87	12.81	4.64	9.53	8.09
IQR		8.82	12.51	6.45	20.31	16.05	25.03	12.79	23.68	8.28	15.65	9.60
M	IPS	51.23	48.71	53.75	48.42	48.82	48.02	51.79	49.75	53.83	49.09	51.87
Mdn		52.57	48.32	53.14	49.51	49.01	50.48	52.47	51.16	53.78	49.01	53.13
SD		4.97	5.87	1.94	10.36	9.59	11.65	10.00	13.20	5.38	9.63	7.71
IQR		6.92	12.01	3.76	18.25	14.93	23.2	11.09	24.07	9.64	13.96	7.35
M	IS	3.16	1.32	5.00	2.71	1.63	3.79	2.65	1.61	3.7	1.52	4.16
Mdn		1.87	1.43	4.39	2.40	1.94	3.57	2.19	1.55	2.91	1.55	3.57
SD		3.18	0.99	3.60	2.11	1.47	2.16	2.64	1.34	3.24	1.24	3.00
IQR		3.29	1.87	7.11	2.63	2.80	3.75	2.62	2.69	4.99	2.65	4.84

Note: M = Mean; SD= Standard deviation; Mdn = Median; IQR = Interquartile range; CA = chronological age; MA = Mental age; mths = months; TD = Typically developing children; DD= Children with Intellectual disability due to developmental disorders; DS = Children with Intellectual disability due to Down syndrome;PIPS = PreintentionalPresymbolic gestures; IPS = Intentional Presymbolic gestures and IS = Intentional symbolic gestures

Mann Whitney U test was used to compare types of gestures between the two age groups in all the three groups of children (TD,DD and DS). Results of Mann Whitney U test are represented in Table 12. The results revealed main effect of age and interaction of age and groups on percentage occurrence of gestures.

Table 12.

Results of Mann Whitney U test on comparison of subcategories of gestures between age groups

Gestural behaviours in %	Groups of children: TD children Group IA (>6 to ≤ 12 mths) Vs Group IB(>12 to ≤ 18 mths)		DD children Group IIA (>6 to ≤ 12 mths) Vs Group IIB (>12 to ≤ 18 mths)		DS children Group IIIA (>6 to ≤ 12 mths) Vs Group IIIB (>12 to ≤ 18 mths)	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
PIPS	2.782	0.005*	0.044	0.965	0.486	0.627
IPS	1.722	0.085	0.132	0.895	0.309	0.757
IS	2.522	0.012*	1.991	0.046*	1.372	0.17

* Significant difference ($p<0.05$)

Note: PIPS =Preintentionalpresymbolic gestures; IPS = Intentional presymbolic gestures; IS = Intentional symbolic gestures

4.2.1. Comparisons of percentage occurrence of gestures between age groups.

From the results in Table 12, it is seen that younger TD children (>6 to ≤ 12 mths) in Group IA (Mdn= 49.11) showed significantly greater median percent occurrence of PIPS gestures than the older TD children in Group IB (>12 to ≤ 18 mths) (Mdn= 41.23), [/Z/= 2.782, p= 0.005]. There was no significant difference in IPS gestures between younger TD children in Group IA (Mdn= 48.32) and older TD children in group IB (Mdn= 53.14) [Z/= 1.722, p= 0.085]. The older TD children in Group IB (>12 to ≤18 mths) (Mdn= 4.39) showed significantly greater median percent occurrence of IS gestures than the younger TD children in Group IA (> 6 to ≤ 12 mths) (Mdn= 10.77) [/Z/= 2.522, p=0.012]. Figure 10 represents the percent occurrence of the gestures in TD children.

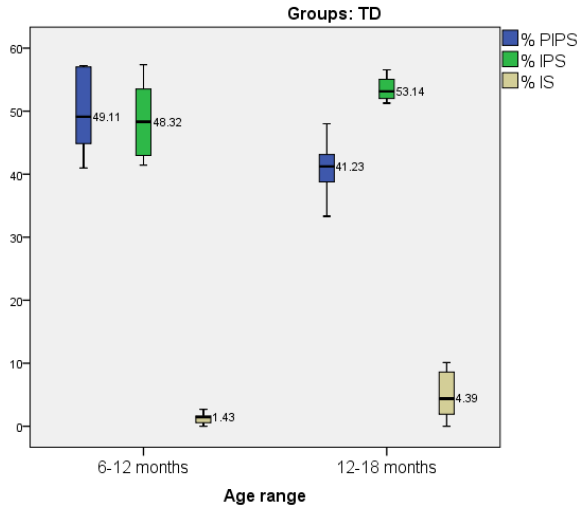

Figure 10. Median and IQR for % occurrence of PIPS, IPS and IS gestures between the two age groups of TD children in Group I

Preintentional Presymbolic gestures (PIPS) Gestures in TD Children (Group I)

As there was significant difference in PIPS gestures in younger and older age groups of TD children, further statistical analyses was carried out. PIPS gestures comprised of alerting behaviours, mother assisted actions, toy exploration and toy manipulation, further analysis was carried out to analyse the difference in median percent occurrence of these gestures in two age groups of Group I (TD children). The results are shown in Table 13 and Figure 11.

Table 13

Results of Mann Whitney U test comparing younger age group (Group IA) Vs. older age group (Group IB) of TD children in Group I for types of PIPS gestures

Types of PIPS gestures in %	Median% occurrence in Group IA (>6 to ≤ 12 mths)	Median% occurrence in Group IB (>12 to ≤ 18 mths)	/Z/	Asymp. Sig. (2-tailed)
Constituents of PIPS gestures				
Alerting behaviour	9.38	1.41	2.43	.015*
Mother assisted action	2.46	2.40	0.488	0.625
Toy exploration	36.72	14.91	2.87	.004*
Toy manipulation	2.68	10.94	3.135	.002*
* Significant difference (p<0.05)				

Note:TD = Typically developing children; PIPS – Preintentionalpresymbolic gestures

As seen from the results in Table 13, younger TD children in Group IA (Mdn= 9.38) showed significantly greater median percent occurrence of alerting behaviours than older TD children in Group IB (Mdn = 1.41) [/Z/= 2.43, p=0.015]. There was no significant difference between the younger TD children in Group IA (Mdn= 2.46) and older TD children in Group IB (Mdn=2.40) in the median percent occurrence of mother assisted actions [/Z/= 0.488, p= 0.625]. Younger TD children in Group IA (Mdn= 36.72) showed significantly greater median percent occurrence on toy exploration than older TD children in Group IB (Mdn= 14.91) [/Z/= 2.87, p= 0.004]. However, on toy manipulation, older TD children in Group IB (Mdn= 10.94) displayed significantly greater median percent occurrence of toy manipulation than younger TD children in Group IA (Mdn = 2.68) [/Z/= 3.135, p= 0.002].

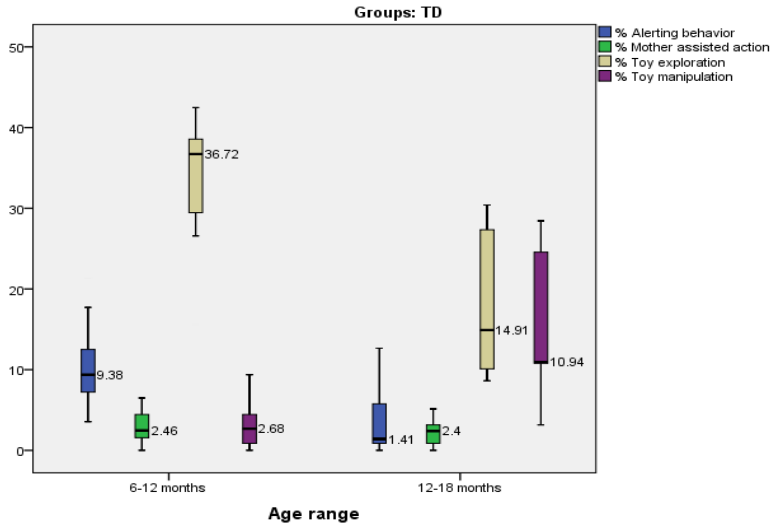

Figure 11. Median and IQR of Alerting behaviour, Mother assisted actions, Toy exploration andToy manipulation of PIPS gestures in Group IA and Group IB of TD children in Group I.

Intentional symbolic gestures (IS) Gestures in TD Children (Group I)

As TD children in younger groups in Group IA and older children in Group IB showed significant difference in median percent occurrence of IS gestures, further statistical analyses was carried out on types of IS gestures. Older TD children in

Group IB group (Mdn = 3.52) displayed significantly greater median percent occurrence of conventional gestures than younger TD children in Group IA (Mdn = 1.43) [/Z/= 2.168, p=0.030)]. Older TD children in Group IB (Mdn = 0.70) showed significantly greater median percent occurrence of representational gestures than younger TD children in Group IA (Mdn = 0), [/Z/= 2.514, p= 0.012]. Results of Mann Whitney U test for types of IS gestures is shown in Table 14.

Table 14

Results of Mann Whitney U test comparing types of IS gestures in Group IA Vs. Group IB of TD children in Group I

IS gestures	Median % occurrence in Group IA (>6 to ≤ 12 mths)	Median% occurrence in Group IB (>12 to ≤ 18 mths)	/Z/	Asymp. Sig. (2-tailed)
Conventional	1.43	3.52	2.168	.030*
Representational	0	.70	2.514	.012*
* Significant difference (p<0.05)				

Note: IS = Intentional symbolic gestures; TD =Typically developing children

It may be noted that Intentional Presymbolic gestures (IPS) did not include sub categories.

DD children

From the results in Table 12, it is seen that younger DD children in Group IIA (Mdn= 47.06) and older DD children in Group IIB (Mdn= 46.56) did not show significant difference in median percent occurrence of Preintentioanl Presymbolic (PIPS) gesture [/Z/= 0.044, p=0.965]. Younger DD children in Group IIA (Mdn= 49.01) and older DD children in Group IIB (Mdn= 50.48) did not show significant difference between the median percent occurrence of IPS gesture [/Z/= 0.132, p= 0.895]. Older DD children in Group IIB (Mdn= 3.57) showed significantly greater median percent occurrence of Intentional symbolic (IS) gestures than younger DD children in Group IIA group (Mdn= 1.94), [/Z/= 1.991, p=0.046] as depicted in Figure 12.

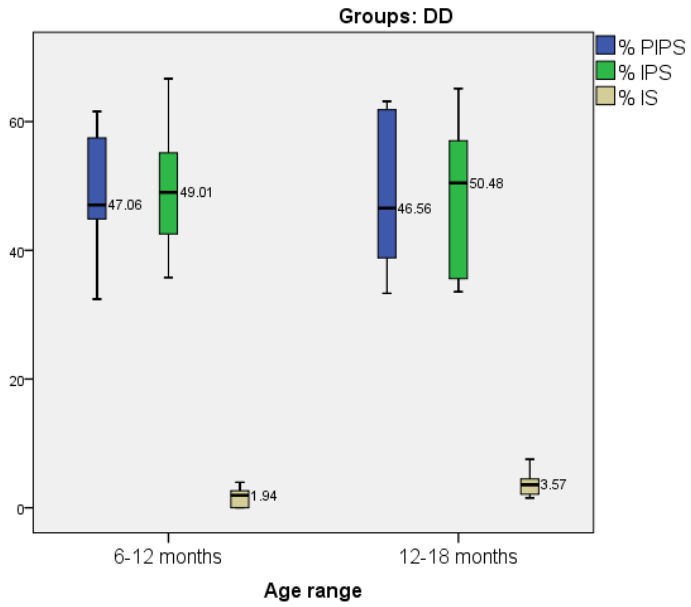

Figure 12. Median and IQR of PIPS, IPS and IS gestures in Group IIA and Group IIB

IS gestures in Group IIA (DD 6-12 mths) Vs. Group IIB (DD 12-18 mths)of DD children in Group II

As, there was significant difference in median percent occurrence of IS gestures between younger DD children in Group IIA and older DD children in Group IIB, the median percent occurrence of types of IS gestures in younger DD children in Group IIA and older DD children in Group IIB were analyzed further using Mann Whitney U test and the same is shown in Table 15.

Table 15

Results of Mann Whitney U test comparing types of IS gestures between-Group IIA Vs. Group IIB of DD children in Group II

Types of IS gestures	Median % occurrence in Group IIA (>6 to ≤12 months)	Median % occurrence in Group IIB (>12 to ≤ 18 months)	/Z/	Asymp. Sig. (2-tailed)
Conventional	1.94	2.54	1.637	.102
Representational	0	0.00	2.182	.029*

* Significant difference (p<0.05)

Note: IS = Intentional symbolic gestures ; DD = children with Developmental disorder

As shown in Table 15, no significant difference was observed between younger DD children in Group IIA (Mdn= 1.94) and older DD children (Mdn = 2.54) in Group IIB in the median percent occurrence of conventional gestures [/Z/= 1.637, p=0.102)]. The older DD children in Group IIA (Mdn = 0.00), showed significantly greater median percent occurrence of representational gestures than younger DD children (Mdn = 0) [/Z/= 2.182, p=0.029)].

DS children

As presented in Table 12, younger DS children in Group IIIA (Mdn= 47.29) and older DS children in Group IIIB (Mdn=41.23) did not show statistically significant difference in median percent occurrence of Preintentional Presymbolic (PIPS) gesture [/Z/= 0.486, p= 0.627]. Younger DS children in Group IIIA (Mdn= 51.15) and older DS children in Group IIIB (Mdn= 53.78) did not show significant difference in median percent occurrence of Intentional presymbolic (IPS) gesture [/Z/=0.309, p= 0.757]. Younger DS children in Group IIIA (Mdn= 1.55) and older DS children in Group IIIB (Mdn= 2.91) did not reveal statistically significant difference in median percent occurrence of Intentional symbolic (IS) gesture[/Z/= 1.372, p= 0.17]. The median percent occurrence of gesture types in DS children is shown in Figure 13.

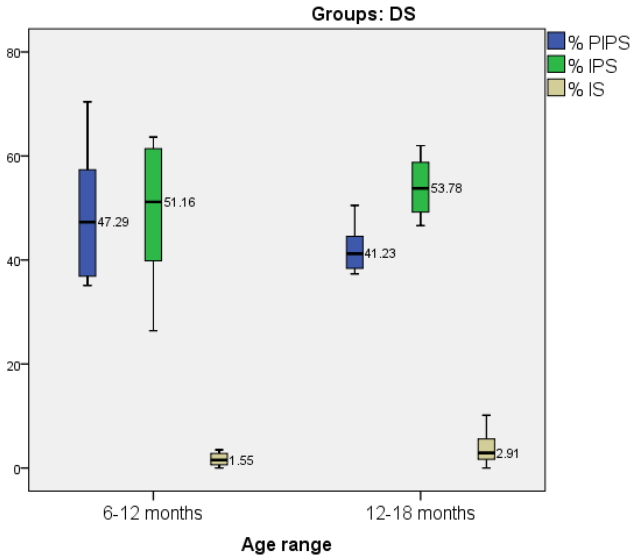

Figure 13. Median and IQR of PIPS, IPS and IS gestures in Group IIIA and Group IIIB

In summary, comparisons of median percent occurrences of gestures between two age groups showed main effect of age on the PIPS and IS gestures. On comparing the two age groups in each group, younger TD children in Group IA showed significantly greater median percent occurrence on PIPS than older TD children in group IB. There was no significant difference between younger TD children in Group IA and older TD children in Group IB on IPS gestures. Older TD children in Group IB scored significantly greater median percent occurrence on IS gestures than younger TD children in Group IA.

Comparison between younger DD children in Group IIA and older DD children in Group IIB on median percent occurrence of PIPS and IPS gestures revealed no significant difference. On IS gestures older DD children in Group IIB had significantly greater median percentage occurrence than older DD children in group IIB. Comparison between younger DS children in group IIIA and older DS children in Group IIIB revealed no statistically significant difference in the median percent occurrence of PIPS, IPS and IS gestures.

4.2.2. Comparisons of occurrence of subcategories of gesture across groups

Kruskal Wallis H test was used to investigate if there is any significant difference across the three groups on the median percent occurrence of Preintentional presymbolic gestures (PIPS), Intentional presymbolic gestures (IPS) and Intentional symbolic gestures (IS). As there was significant main effect of age on the median percent occurrence of PIPS and IS gestures, the two groups were divided into age groups and analyses was carried out across groups in each age. Results of Kruskal Wallis H test is shown in Table 16

Table 16

Results of Kruskal Wallis Test for comparison of subcategories of gestures across groups

Across group comparison of subcategories of gestures in two age groups			
Across Group IA Vs Group IIA Vs Group IIIA (>6 to ≤ 12 months)			
	PIPS	IPS	IS
Chi-Square	0.133	0.455	0.362
df	2	2	2
Asymp. Sig.	0.936	0.797	0.835
Across Group IB Vs Group IIB Vs Group IIIB (>12 to ≤ 18 months)			
	PIPS	IPS	IS
Chi-Square	1.409	1.189	0.837
df	2	2	2
Asymp. Sig.	0.494	0.552	0.658
* Significant difference ($p<0.05$)			

Note: PIPS = Preintentionalpresymbolic gestures ; IPS = Intentional presymbolic gestures ; IS = Intentional symbolic gestures

Gestures in younger age groups (>6 to ≤ 12months)

From Table 16, it was seen that there was no statistically significant difference across the median percent occurrence of younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIA in median percent occurrence of PIPS gestures, [X^2 (2) = 0.133, p=0.936]. There was no statistically significant difference across the younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIA in median percent occurrence of IPS gesture, [X^2 (2) = 0.455, p=0.797]. There was no statistically

significant difference across the younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIA in median percent occurrence of IS gesture [X^2 (2) = 0.362, p=0.835] (Figure 14).

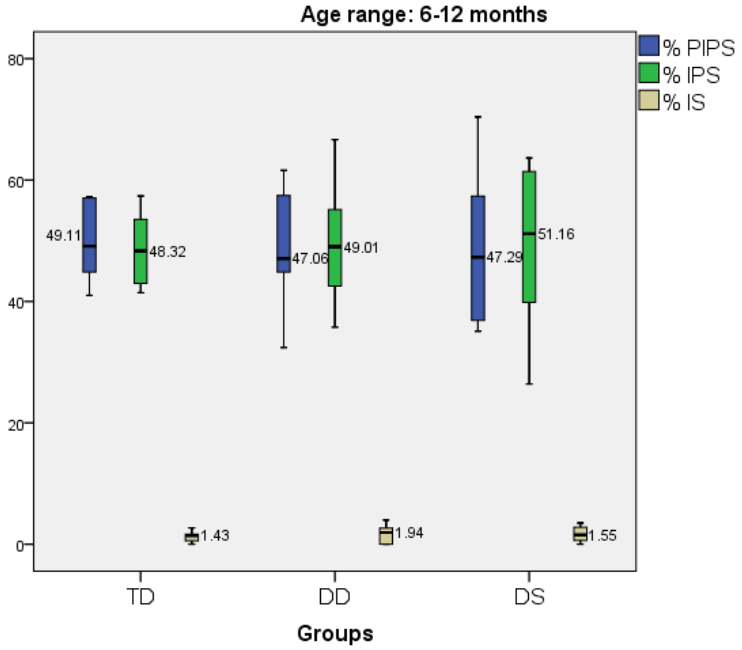

Figure 14. Median, IQR of PIPS (Preintentional presymbolic gestures) ; IPS (Intentional presymbolic gestures) and IS (Intentional symbolic) across groups in younger age (>6 to ≤ 12 months)

Gestures in older age groups (>12 to ≤ 18months)

From Table 16, it was seen that there was no statistically significant difference across the median percent occurrence of older TD children in Group IA, older DD children in Group IIA and older DS children in Group IIIA in median percent occurrence of PIPS gestures, [X^2 (2) = 1.409, p=0.494]. There was no statistically significant difference across the older TD children in Group IA, older DD children in Group IIA and older DS children in Group IIIA in median percent occurrence of IPS gesture, [X^2 (2) = 1.189, p=0.552]. There was no statistically significant difference across the older TD children in Group IA, older DD children in Group IIA and older DS children in Group IIIA in median percent occurrence of IS gesture [X^2 (2) = 0.837, p=0.658] (Figure 15).

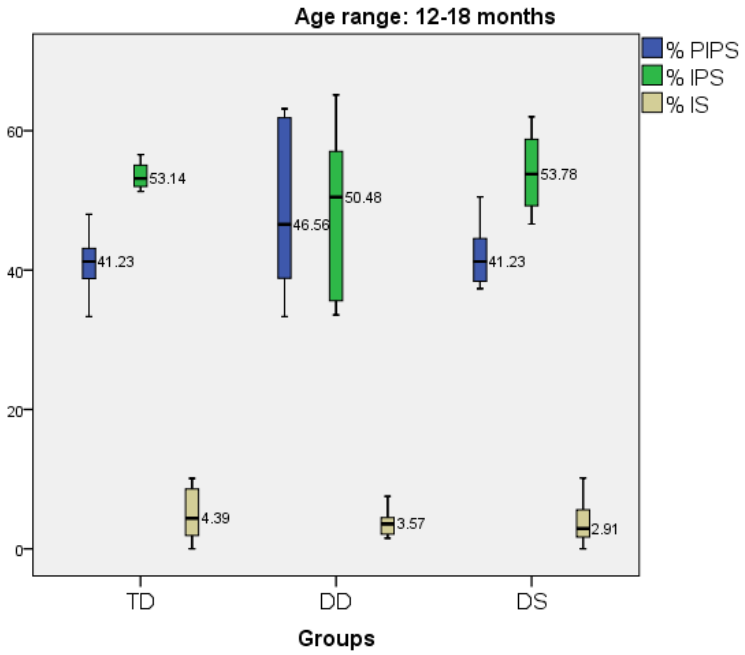

Figure 15. Median, IQR of PIPS (Preintentional presymbolic gestures) ; IPS (Intentional presymbolic gestures) and IS (Intentional symbolic) gestures across groups in older age

4.2.3. Comparisons within the subcategories of gesture across groups

To compare within PIPS, IPS and IS gestures, Friedman's test followed by Wilcoxon signed rank test with Bonferroni correction applied was used and tested at a significance level set up at $p<0.017$.The Friedman's test was run four times. In the first condition, Friedman's test was run to determine if the median percent occurrence of PIPS, IPS and IS gestures had statistically significant differences, irrespective of groups and age. In the second condition, percentage of occurrence of PIPS, IPS and IS gestures were compared in each group by splitting the three groups. In the third condition, percentage occurrence of PIPS, IPS and IS gestures was compared between age group A (>6 to $\leq$12 months) and age group B (>12 to $\leq$18 months). In the last condition, percentage occurrence of gestures was compared in each of the age groups of A and each of the age groups in B. Table 17 and Table 18 represent the results of Friedman's test and Wilcoxon signed rank test respectively.

Table 17

Results of Friedman's test comparing the percentage occurrence of PIPS, IPS and IS gestures

Condition 1:Comparison of the percentage occurrence of PIPS, IPS and IS gestures				
	N	Chi-Square	df	Asymp. Sig.
Group I, Group II and Group III	54	84.065	2	0*
Condition 2:Comparison of the percentage occurrence of PIPS, IPS and IS gestures in Group I, Group II and Group III separately				
	N	Chi-Square	df	Asymp. Sig.
Group I	18	28.761	2	0*
Group II	18	27.111	2	0*
Group III	18	28.778	2	0*
Condition 3:Comparison of percentage occurrence of PIPS, IPS and IS gestures in two age groups (>6 to ≤ 12 months and >12 to ≤ 18 months)of Group I, Group II and Group IIIs separately				
	N	Chi-Square	df	Asymp. Sig.
Age group A	27	40.879	2	0*
Age group B	27	45.852	2	0*
Condition 4:Comparison of the percentage occurrence of PIPS, IPS and IS gestures in Group IA, Group IIA and Group IIIAs and Group IB, Group IIB and Group IIIB separately				
	N	Chi-Square	df	Asymp. Sig.
Group IA	9	14.114	2	0.001*
Group IIA	9	13.556	2	0.001*
Group IIIA	9	13.556	2	0.001*
Group IB	9	18	2	0*
Group IIB	9	13.556	2	0.001*
Group IIIB	9	16.222	2	0*

* Significant difference ($p<0.05$)

Note: PIPS = Preintentional presymbolic gestures; IPS = Intentional presymbolic gestures; IS = Intentional symbolic gestures

Table 18

Results of Wilcoxon Signed Rank Test

Condition 1:Comparison of percentage occurrence of PIPS, IPS and IS gestures

	IPS - PIPS		IS - PIPS		IS - IPS	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
	1.766	0.077	6.393	0*	6.393	0*

Condition 2:Comparison of percentage occurrence of PIPS, IPS and IS gestures in Group I, Group II and Group III separately

	IPS - PIPS		IS - PIPS		IS - IPS	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group I	1.681	0.093	3.724	0*	3.724	0*
Group II	0.065	0.948	3.724	0*	3.724	0*
Group III	1.59	0.112	3.724	0*	3.724	0*

Condition 3:Comparison of percentage occurrence of PIPS, IPS and IS gestures in Group I, Group II and Group III separately

	IPS - PIPS		IS - PIPS		IS - IPS	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
Age group1	0.038	0.97	4.541	0*	4.541	0*
Age group 2	2.595	0.099	4.541	0*	4.541	0*

Condition 4:Comparison of percentage occurrence of PIPS, IPS and IS gestures in Group IA, Group IIA and Group IIIAs and Group IB, Group IIB and Group IIIBs separately

	IPS - PIPS		IS - PIPS		IS - IPS	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group IA	0.42	0.674	2.666	0.008*	2.666	0.008*
Group IIA	0.178	0.859	2.666	0.008*	2.666	0.008*
Group IIIA	0.178	0.859	2.666	0.008*	2.666	0.008*
Group IB	2.666	0.081	2.666	0.008*	2.666	0.008*
Group IIB	0.059	0.953	2.666	0.008*	2.666	0.008*
Group IIIB	2.429	0.019	2.666	0.008*	2.666	0.008*

*significant difference as set up with Bonferroni correction ($p<0.017$)

Note: PIPS = Preintentional presymbolicgestures ; IPS = Intentional presymbolic gestures ; IS = Intentional symbolic gestures

The results indicated significant effect of subcategories of gestures. The results on four conditions of Friedman's test followed by Wilcoxon sign rank test showed that there was no interaction effect between the three subcategories of gestures, groups and age groups.

Thus, within group comparison of the subcategories of gestures revealed similar results across age and groups. The trend indicated that the median percent

occurrence of PIPS gesture was significantly greater than IS gesture; median percentage of occurrence of IPS gesture was significantly greater than IS gestures; while the PIPS and IPS gestures did not show any significant difference in the median percent occurrence (PIPS>IS; IPS>IS; PIPS=IPS).

4.3. Vocal behaviours in children of the three groups

The total number of annotations for vocal behaviours including vocalization, protowords and words was 4,645. Means, medians, standard deviations and interquartile ranges for percentage occurrence of vocalization, protowords and words were calculated and the same is presented in Table 19.

Table 19

Means (M), Standard Deviations (SD), Medians (Mdn) and Inter quartile ranges (IQR) of subcategories of vocal behaviours

Types of vocal behaviours		Group I TD Children			Group II DD Children			Group III DS Children			Age Groups- Total	
		Group I -Tot	Group IA >6 to ≤12 months	Group IB >12 to ≤ 18 months	Group II -Tot	Group IIA >6 to ≤ 12 months	Group IIB >12 to ≤ 18 months	Group III -Tot	Group IIIA >6 to ≤ 12 months	Group IIIB >12 to ≤ 18 months	>6 to≤ 12 months	>12 to ≤18 months
% Vocalization (V)	M	24.23	25.37	23.08	28.31	25.24	31.39	28.38	26.46	30.3	25.69	28.26
	Mdn	23.2	25.47	20.79	31.76	24.71	35.8	27.57	25.97	29.35	25.47	29.47
	SD	10.94	10.1	12.23	12.2	10.85	13.31	17.02	14.16	20.17	11.38	15.48
	IQR	16.6	16.83	18.8	19.23	18.94	21.04	20.38	16.86	31.6	17.17	24.25
% Protoword (P)	M	4.09	0.14	8.04	0.81	0	1.61	0.15	0	0.3	0.05	3.32
	Mdn	1.94	0	6.15	0	0	1.23	0	0	0	0	1.59
	SD	5.4	0.41	5.15	1.38	0	1.61	0.45	0	0.61	0.24	4.58
	IQR	6.31	0	9.48	1.4	0	2.81	0	0	0.56	0	4.65
% Word (W)	M	3.2	0.54	5.87	2.02	0	4.05	0.42	0	0.84	0.18	3.59
	Mdn	1.62	0	3.37	0.47	0	3.49	0	0	0	0	2.3
	SD	4.62	0.66	5.38	2.8	0	2.73	0.99	0	1.3	0.45	4.02
	IQR	3.68	1.26	8.59	3.51	0	2.37	0	0	2.21	0	2.76

4.3.1. Comparisons of percentage occurrence of vocal behaviours between age groups.

Mann Whitney U test was used to compare the vocal behaviours between the two age groups in all the three groups of children (TD,DD and DS). Results of Mann Whitney U test are represented in Table 20. The results revealed that there was main effect of age and an interaction effect of age and groups.

Table 20

Results of Mann Whitney U test comparing subcategories of vocal behaviorsbetween age groups

Comparison of subcategories of vocal behaviours in %, between age groups in the 3 groups						
	Group I(TD)		Group II(DD)		Group III(DS)	
	Group IA Vs Group IB		Group IIA Vs Group IIB		Group IIIA Vs Group IIIB	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Vocalization	0.221	0.825	1.237	0.216	0.221	0.825
Protoword	3.742	.000*	2.84	.005*	1.455	0.146
Word	3.614	.000*	3.821	.000*	1.835	0.067

* Significant difference ($p<0.05$)

TD children

From Table 20, it is seen that younger TD children in Group IA (Mdn= 25.47) and older TD children in Group IB (Mdn= 20.79) did not show significant difference in median percent occurrence of vocalization, [/Z/= 0.221, p=0.825]. Older TD children in Group IB (Mdn= 6.15) revealed significantly greater median percent occurrence of protowords than younger TD children in Group IA (Mdn= 0.00), [/Z/= 3.742, p= 0.000]. Older TD children in Group IB (Mdn= 3.37) showed significantly greater median percentage of occurrence on words than younger TD children in Group IA (Mdn= 0.00), [/Z/= 3.614 p=0.000]. Figure 16 represents the median percent occurrence of the vocal behaviours in TD children.

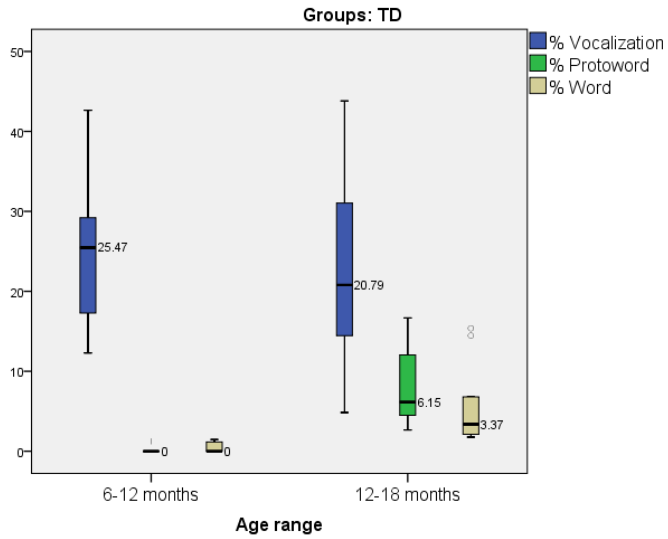

Figure 16. Median and IQR for % occurrence of vocalizations, words and protowords between the two age groups of TD children in Group I

DD children

From Table 20, it is seen that younger DD children in Group IIA (Mdn= 24.71) and older DD children in Group IIB (Mdn= 35.80) did not show significant difference between the median percent occurrence of vocalization[/Z/= 1.237, p=0.216]. Statistical analyses revealed that older DD children in Group IIB (Mdn= 1.23) showed significantly greater median percent occurrence of protowords than younger DD children in Group IIA (Mdn= 0.00) [/Z/= 2.840, p=0.005]. Older DD children in Group IIB (Mdn= 3.49) showed significantly greater median percentage occurrence of words than younger DD children in Group IIA (Mdn= 0.00), [/Z/= 3.821, p=0.000]. Figure 17 represents the median percent occurrence of the vocal behaviours in DD children in Group II.

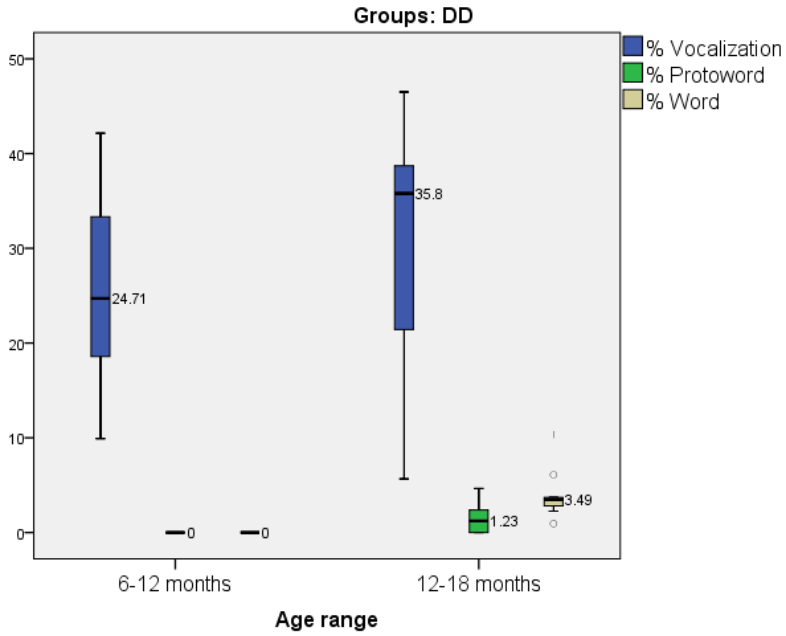

*Figure 17.*Median and IQR for % occurrence of vocalizations, words and protowords between the two age groups of DD children in Group II

DS children

From Table 20, it is seen that younger DS children in Group IIIA (Mdn= 25.97) and older DS children in Group IIIB (Mdn= 29.35) did not show significant difference in the median percent occurrence of vocalizations [/Z/= 0.221, p=0.825]. Statistical analyses revealed that younger DS children in Group IIIA (Mdn= 0.00) and older DS children in Group IIIB (Mdn= 0.00) did not show significant difference in the median percent occurrence of protowords /Z/= 1.455, p= 0.146. Younger DS children in Group IIIA (Mdn= 0.00) and older DS children in Group IIIB (Mdn= 0.00) did not show significant difference in the median percent occurrence of words [/Z/= 1.835, p= 0.067]. Figure 18 represents the percent occurrence of the vocal behaviours in DS children in Group III.

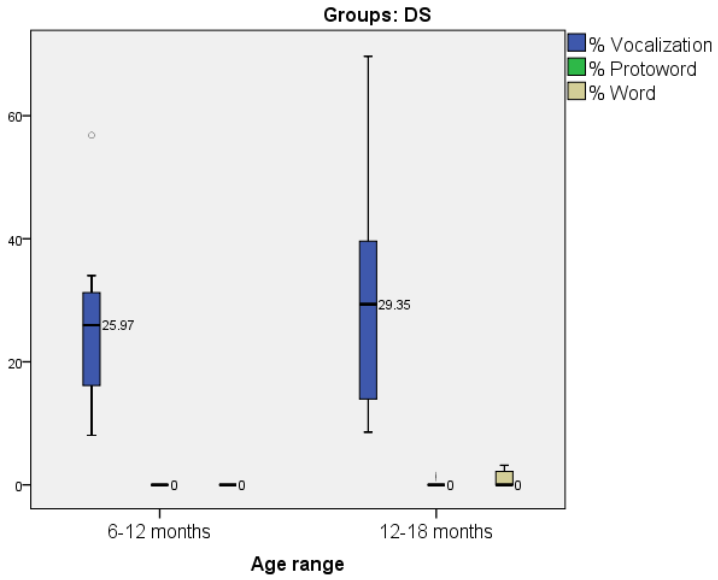

*Figure 18.*Median and IQR for % occurrence of vocalizations, words and protowords between the two age groups of DS children in Group III

In summary, comparison of vocal behaviours between younger and older children in the three groups showed significant differences. In TD children in Group I, there was no significant difference seen in the median percent occurrence of vocalization between younger and older TD children. Older TD children in Group IB showed significantly greater median percent occurrence on protowords and words than younger TD children in Group IA. Younger DD children in Group IIA and older DD children in Group IIB also showed similar trend. Younger DD children in Group IIA and older DD children in Group IIB did not show significant difference in median percent occurrence of vocalizations. Older DD children in Group IIB showed significantly greater median percent occurrence on protowords and words than younger DD children in Group IIB. Younger DS children in Group IIIA and older DS children in Group IIIB showed no significant difference in the median percent occurrence of vocalizations, protowords and words.

4.3.2. Comparisons of percentage occurrence of vocal behavioursacross groups.

Kruskal wallis H test was run to compare the median percent occurrences of vocalization, protowords and words across groups. On instances of significant difference on Kruskal Wallis H test, Mann Whitney U test was used for pairwise comparison. As main effect of age was observed in the three groups, the three groups were split into their respective age groups before subjecting to statistical analysis . Results of Kruskal wallis H test and Mann Whitney U test results are displayed in Table 21 and Table 22 respectively. The following section presents results for both conditions.

Table 21

Results of Kruskal Wallis Test for comparison of percent occurrence of subcategories of Vocal behavioursacross group

Comparison of subcategories of vocal behaviours in two age groups in %			
Across Group IA Vs Group IIA Vs Group IIIA (>6 to ≤ 12 months)			
	Vocalization	Protoword	Word
Chi-Square	0.00	2.00	8.97
df	2.00	2.00	2.00
Asymp. Sig.	1.00	0.37	0.01*
Across Group IB Vs Group IIB Vs Group IIIB (>12 to≤ 18 months)			
	Vocalization	Protoword	Word
Chi-Square	2.04	18.66	11.48
df	2.00	2.00	2.00
Asymp. Sig.	0.36	0.00*	0.00*
*significant difference (p<0.05)			

Table 22

Results of Mann Whitney U test for pairwise comparison between groups

Across group comparison of subcategories of vocal behaviours in two age groups separately						
Across groups in group A (>6to≤12 months) Group IA Vs Group IIA Vs Group IIIA						
	Group IA Vs Group IIA		Group IA Vs Group IIIA		Group IIA Vs Group IIIA	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
% Word	2.182	.029*	2.182	.029*	0.000	1.00
Across groups in group B (>12to≤18 months) Group IB Vs Group IIB Vs Group IIIB						
	Group IB Vs Group IIB		Group IB Vs Group IIIB		Group IIB Vs Group IIIB	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
% Protoword	3.230	.001*	3.684	.000*	2.133	.033*
% Word	.132	.895	2.743	.006*	3.150	.002*
* Significant difference (p<0.05)						

From Table 21 the Kruskal Wallis H test revealed that younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIA did not reveal statistically significant difference in median percent occurrence of vocalization [X^2 (2) = 0.00, p=1.00]. There was no significant difference in median percent occurrence of protowords across younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIAs [X^2 (2) = 2.00, p=0.37]. There was statistically significant difference across younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIAs on median percent occurrence of words [X^2 (2) = 8.97, p=0.01]. Figure 19 depicts median percent occurrence of vocalization, protowords and words in younger age group children in Groups I, II and III.

Results of Mann Whitney U test are represented in Table 22. Pairwise comparisons revealed that younger TD children in Group IA (Mdn=0.54) showed significantly greater median percent occurrence of words than younger DD children in Group IIA (Mdn= 0.00) [/Z/= 2.182, p= 0.29]. Younger TD children in Group IA (Mdn= 0.54) showed significantly greater median percent occurrence of words than younger DS children in Group IIIA (Mdn= 0.00) [/Z/= 2.182, p= 0.29]. Younger DD children in Group IIA (Mdn= 0.00) and younger DS children in Group IIIA (Mdn= 0.00) did not show statistically significant difference in median percent occurrence of words [/Z/= 0.00, p= 1.000].

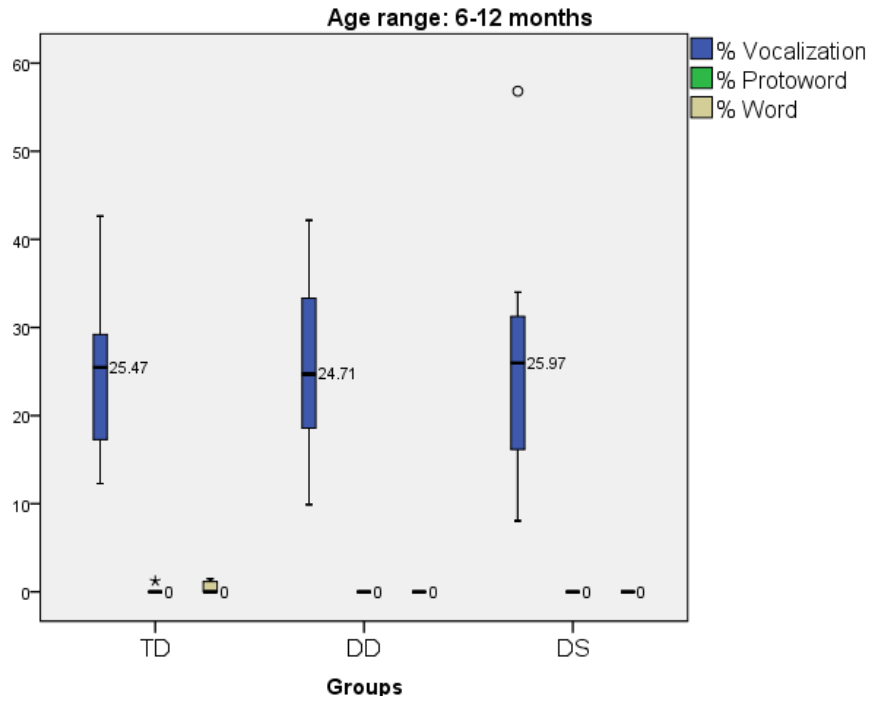

*Figure 19.*Median and IQR of Vocalizations, Protowords and Words across Group IA Group IIA and Group IIIA (>6 to ≤ 12 months)

From Table 21, it is seen that Kruskal Wallis H test revealed no statistically significant difference across the older TD children in Group IB, older DD children in Group IIB and older DS children in Group IIIB on median percent occurrence of vocalization [X^2 (2) = 2.04, p=0.36]. There was significant difference in the median percent occurrence of protowords [X^2 (2) = 18.66, p=0.00] across older TD children in Group IB, older DD children in Group IIB and older DS children in Group IIIB. There was statistically significant difference in median percent occurrence of words across older TD children in Group IB, older DD children in Group IIB and older DS children in Group IIIB [X^2(2) = 11.48, p=0.00].

Pair wise comparison of median percent occurrences of protowords revealed that older TD children in Group IB (Mdn= 6.15) showed significantly greater median percent of occurrence than older DD children in Group IIB (Mdn= 1.23) [/Z/= 3.230, P= 0.001]. Older TD children in Group IB (Mdn= 6.15) revealed significantly greater

median percent occurrence of protoword than older DS children in Group IIIB (Mdn= 0.00) [/Z/=3.684, p= 0.00]. Older DD children in Group IIB (Mdn= 1.23) showed significantly greater median percent occurrence of protowords than older DS children in Group IIIB (Mdn=0.00)[/Z/= 2.133, p= 0.033].

Pair wise comparisons of median percent occurrence of words revealed that, older TD children in Group IB (Mdn= 3.37) showed significantly greater median percent occurrence than older DS children in Group IIIB (Mdn= 0.00) [/Z/= 2.743, p= 0.006]. Older DD children in Group IIB (Mdn= 3.49) showed significantly greater median percent occurrence of words than older DS children in Group IIIB (Mdn= 0.00)[/Z/= 3.150, p= 0.002]. There was no statistically significant difference in median percent occurrence of words between older TD children in Group IB (Mdn= 3.37) and older DD children in Group IIB (Mdn= 3.49) groups [/Z/= 0.132, p= 0.895]. Figure 20 represents the median percent occurrence of the vocal behaviours in children in TD group, DD group and DS groups in the older age group.

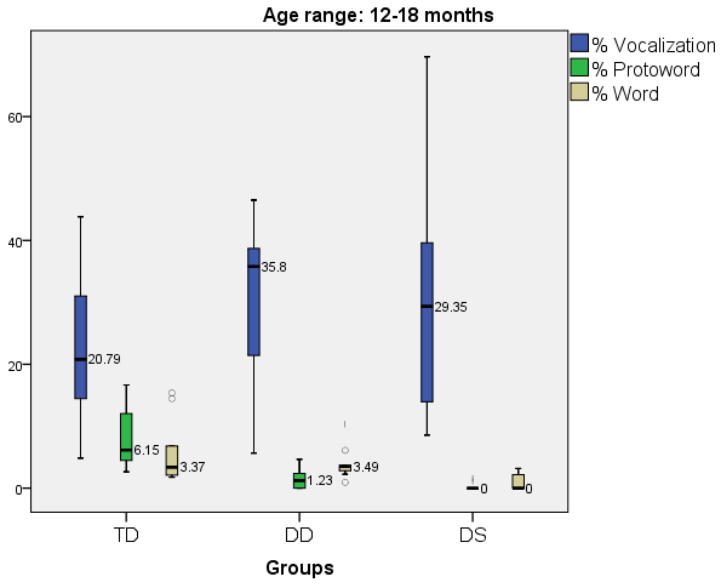

*Figure 20.*Median and IQR of Vocalizations, Protowords and Words across Group IB Group IIB and Group IIIB (>12 to ≤ 18 months)

In summary, there was no statistically significant difference observed across younger TD children in Group IA, younger DD children in Group IIA and younger DS children in Group IIIA on median percent occurrence of vocalization and protowords. Comparison of median percent occurrence of words across younger children showed that younger TD children in Group IA had significantly greater median percent occurrence of words than both younger DD children in Group IIA and younger DS children in Group IIIA. There was no significant difference in the median percent occurrence of words in younger DD children in Group IIA and younger DS children in Group IIIA.

In the older age group, there was no statistically significant difference across groups on vocalization. On comparison of median percent occurrence of protoword across the three groups in older age, results revealed that, older TD children in Group IB showed significantly greater median percent occurrence of protowords than both older DD children in Group IIB and older DS children in Group IIIB. In addition, older DD children in Group IIB showed significantly greater median percent occurrence of protowords than older DS children in Group IIIB. Older DS children in Group IIIB revealed significantly lesser median percent occurrence of words than both the older TD children in Group IB and older DD children in Group IIB. There was no significant difference in the median percent occurrence of words between older TD children in Group IB and older DD children in Group IIIB.

4.3.3. Comparison of percentage occurrencesof vocal behaviours within subcategories of vocal behaviours and across groups.

In order to compare the median percent occurrence within vocalization, protoword and word categories of vocal behaviours, Friedman's test was used to analyse the data, followed by Wilcoxon signed rank test with Bonferroni correction

resulting in a significance level set up at $p<0.017$. The Friedman's test was run four times. In the first condition, Friedman's test was run to determine if the median percent occurrence of vocalizations, protowords and words showed statistically significant differences irrespective of groups and age. In the second condition, percentage of occurrence of vocalizations, protowords and words were compared in each group. In the third condition, percentage of occurrence of vocalizations, protowords and words was compared between age group A (>6 to ≤ 12 months)and age group B (>12 to ≤18 months).In the last condition, percentage occurrence of vocalizations, protowords and words was compared in each of the groups in age group A and each of the groups in age group B. Table 23 and Table 24 represents the results of Friedman's test and Wilcoxon sign rank test respectively.

Table 23

Results of Friedman's test on comparison within subcategories of vocal behaviours

Condition 1: Comparison of percentage occurrence of Vocalizations, Protowords and Words				
	N	Chi-Square	df	Asymp. Sig.
Group I, Group II and Group III as a single group	54	86.238	2	.000*
Condition 2:Comparison of percentage occurrence of Vocalizations, Protowords and Wordsin Group I, Group II and Ds groups separately				
	N	Chi-Square	df	Asymp. Sig.
Group I	18	22.030	2	.000*
Group II	18	31.871	2	.000*
Group III	18	34.421	2	.000*
Condition 3:Comparison of percentage occurrence of Vocalizations, Protowords and Words in Group I, Group II and Group IIIs separately				
	N	Chi-Square	df	Asymp. Sig.
Age group A	27	51.070	2	.000*
Age group B	27	36.424	2	.000*
Condition 4:Comparison of percentage occurrence of Vocalizations, Protowords and Wordsin Group IA, Group IIA and Group IIIAs and Group IB, Group IIB and Group IIIBs separately				
	N	Chi-Square	df	Asymp. Sig.
Group IA	9	15.750	2	.000*
Group IIA	9	18.000	2	.000*
Group IIIA	9	18.000	2	.000*
Group IB	9	9.235	2	.010*
Group IIB	9	14.800	2	.001*
Group IIIB	9	16.800	2	.000*
* Significant difference ($p<0.05$)				

Table 24

Results of Wilcoxon Signed Rank Test

Condition 1:Comparison of percentage occurrence of Vocalizations, Protowords and Words						
	Protoword - Vocalization		Word - Vocalization		Word - Protoword	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group I, Group II, Group III	6.487	.000*	6.442	.000*	0.943	0.346
Condition 2:Comparison of percentage occurrence of Vocalizations, Protowords and Wordsin Group I, Group IIand Ds groups separately						
	Protoword - Vocalization		Word - Vocalization		Word - Protoword	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group I	3.641	.000*	3.579	.000*	0.735	0.463
Group II	3.778	.000*	3.778	.000*	1.540	0.123
Group III	3.998	.000*	3.998	.000*	1.604	0.109
Condition 3:Comparison of percentage occurrence of Vocalizations, Protowords and Wordsin Group I, Group II andGroup IIIs separately						
	Protoword - Vocalization		Word - Vocalization		Word - Protoword	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Age group A	4.862	.000*	4.862	.000*	0.813	0.416
Age group B	4.499	.000*	4.438	.000*	0.523	0.601
Condition 4:Comparison of percentage occurrence of Vocalizations, Protowords and Words in Group IA, Group IIA and Group IIIAs and Group IB, Group IIB and Group IIIBs separately						
	Protoword - Vocalization		Word - Vocalization		Word - Protoword	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
Group IA	2.666	.008*	2.666	.008*	1.214	.225
Group IIA	2.666	.008*	2.666	.008*	.000	1.000
Group IIIA	2.666	.008*	2.666	.008*	.000	1.000
Group IB	2.547	.011*	2.380	.016*	1.680	.093
Group IIB	2.666	.008*	2.666	.008*	2.100	.036
Group IIIB	2.666	.008*	2.666	.008*	1.604	.109
*significant difference as set up with Bonferroni correction (p<0.017)						

The results indicated a significant effect of subcategories of vocal behaviours. The results on four conditions of Friedman's test followed by Wilcoxon sign rank test revealed that there was no interaction effect between the three subcategories of vocal behaviours, groups and age groups. Thus statistical analyses for within group comparison of the subcategories of vocal behaviours revealed similar results across age and groups. The consistent trend observed in the study was that the median percent occurrence of vocalizations was the highest and there was no significant difference in the median percent occurrence of protowords and words.

SECTION 2

Communication behaviours of mothers in the three dyadic groups

Out of 5,816 annotations, 5,275 annotations were grouped as maternal gestures Intentional presymbolic (IPS) gestures and 541 annotations were grouped as gestures maternal Intentional symbolic (IS) gestures. Means, medians, standard deviations and interquartile ranges for percentage occurrence of maternal gestures IPS and IS gestures of mothers were calculated and the same is presented in Table 25. The interaction samples of 54 mother-child dyads were segmented into 4,677 mother's communication turns. As described in chapter 3 (Method section), each mother's communication turn was annotated under two categories: a) Maternal Gestures and b) Child-directed speech. The annotations under maternal gestures formed a complex in most communication turns. To breakdown the complex, in each communication turn, up to three gestures were annotated. 5,816 annotations in the maternal gestures and 4677 annotations under child-directed speech were considered.

The data obtained in the form of number of occurrences of: a) two subcategories of maternal gestures and b) child-directed speech which were then convertedto percentage occurrence scores. The conversion into percentage was done because the number of communication turns for each participant was different. The data was analysed using SPSS 20 software.

The results pertaining to maternal gestures and child-directed speech of mothers of children in Groups I, II and III are presented separately. Under each of these communication behaviours, comparisons were made between mothers of children in different age groups, across groups, and within behaviours.

4.4. Maternal Gestures

The gestures used by mothers were classified as deictic gestures, conventional gestures and representational gestures. Deictic gestures were considered as Intentional presymbolic gestures (IPS), conventional and representational gestures were considered as intentional symbolic gestures (IS). The percentage median occurrences of these two subcategories of gestures were analysed. Deictic gestures of mothers were considered as intentional presymbolic because they were directed towards children with the intent to communicate information and these gestures were presymbolic because, they did not represent any symbols for an object or event that was absent. These gestures could be understood only within the context of mother-child interaction. Conventional and representational gestures were considered as intentional symbolic because, these were intentionally directed to children in order to communicate information. These were symbolic because, they either indicated an iconic feature of the object or event being talked about or indicated culturally accepted gestures which represented an object or event that is absent.

A total of 5,816 annotations included a) 5,275 IPS gestures used by mothers and b) 541 annotations for IS gestures used by mothers. Means, medians, standard deviations and interquartile ranges for percentage occurrence of maternal gestures with the IPS and IS gestures of children were calculated and the same is presented in Table 25.

Table 25

Means (M), Medians (Mdn), Standard deviations (SD), Interquartile ranges (IQR) in Group IA, Group IB, Group IIA, Group IIB, Group IIIA, Group IIIB for Percentage occurrence of maternal IPS and IS gestures in mothers

Maternal gestures in %		Mothers of TD children			Mothers of DD children			Mothers of DS children			Age groups (total)	
		Gp (Tot)	Gp IA (>6 to ≤ 12 mths)	G IB (>12to ≤ 18 mths)	Gp II (Tot)	Gp IIA (>6 to ≤ 12 mths)	Gp IIB (>12to ≤ 18 mths)	Gp III (Tot)	Gp IIIA (>6 to ≤ 12 mths)	Gp IIIB (>12to ≤ 18 mths)	Tot (>6 to ≤ 12 mths)	Tot (>12to ≤ 18 mths)
		Group I	Group IA	Group IB	Group II	Group IIA	Group IIB	Group III	Group IIIA	Group IIIB	6-12 months	12-18 months
IPS	M	90.45	93.32	87.58	93.63	93.64	93.63	91.79	94.18	89.41	93.71	90.21
	Mdn	91.28	93.14	87.94	93.62	93.65	93.2	93.35	94.64	90	93.82	91.59
	SD	4.56	2.21	4.56	1.23	0.54	1.71	4.75	2.49	5.39	1.91	4.78
	IQR	6.17	4.43	7.76	1.64	0.7	3.2	6.46	4.32	10.78	2.15	8.7
IS	M	90.45	6.68	12.42	6.31	6.25	6.37	8.21	5.82	10.59	6.25	9.79
	Mdn	91.28	6.86	12.06	6.39	6.35	6.8	6.65	5.36	10	6.15	8.41
	SD	4.56	2.21	4.56	1.26	0.67	1.71	4.75	2.49	5.39	1.92	4.78
	IQR	6.17	4.43	7.76	2	1.08	3.2	6.46	4.32	10.78	2.15	8.7

Note:IPS- Intentional presymbolic gestures,IS- Intentional symbolic gestures

4.4.1. Comparisons of median percentage occurrence of maternal gestures between two age groups .

Mann Whitney U test was used to compare the maternal gestures between the two age groups of children in all the three groups of mothers (TDM,DDM and DSM). Results of Mann whitney U test are represented in Table 26.

Table 26

Results of Mann Whitney U test for comparison of maternal gestures between the two age groups

Ges-tures in %	Groups of mothers					
	Mothers of TD children in Group IA (>6 to ≤ 12 mths) Vs Group IB (>12 to ≤ 18 mths)		Mothers of DD children in Group IIA (>6 to ≤ 12 mths) Vs Group IIB (>12 to ≤ 18 mths)		Mothers of DS children in Group IIIA (>6 to ≤ 12 mths) Vs Group IIIB (>12 to ≤ 18 mths)	
	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
IPS	2.517	.012*	0.353	0.724	1.81	0.07
IS	2.517	.012*	0.442	0.659	0.81	0.07
* Significant difference (p<0.05)						
Note:	IPS- Intentional presymbolic gestures,IS- Intentional symbolic gestures					

Maternal gestures in mothers of TD children (TDM)

From the results reported in Table 26, it is seen that the median percent occurrence of maternal IPS gestures was significantly greater in mothers of younger TD children in Group IA (Mdn= 93.14) than in mothers of older TD children in Group IB (Mdn= 87.94) [/Z/= 2.517, p= 0.012]. The median percent occurrence of maternal IS gestures was significantly greater in mothers of older TD children in Group IB (Mdn= 12.06) than mothers of younger TD children in Group IA (Mdn= 6.86) [/Z/= 2.517, p=0.012)]. Figure 21 depicts the median percent occurrence of maternal gestures in mothers of TD children in Group IA.

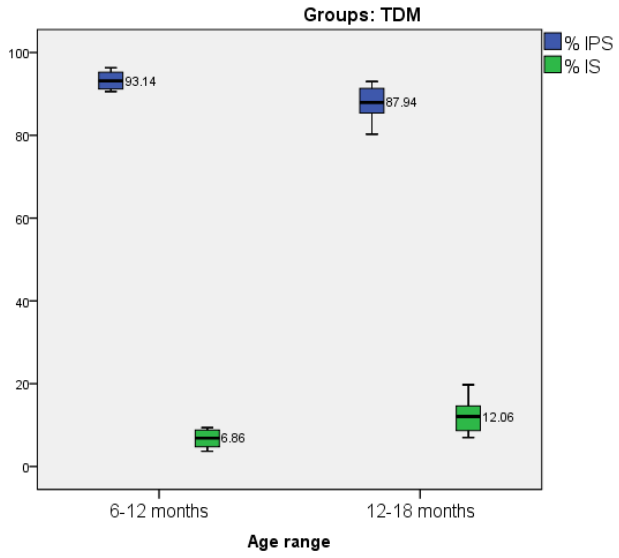

*Figure 21.*Median and IQR for percent occurrence of maternal IPS and IS gestures in two age groups of mothers in Group I (TDM)

Maternal gestures in mothers of DD children (DDM)

From the results in Table 26, it is observed that there was no significant difference between the median percent occurrence of maternal IPS gestures between mothers of younger DD children in Group IIA (Mdn= 93.65) and mothers of older DD children in Group IIB (Mdn= 93.20) [/Z/=0.353, p=0.724]. There was no

statistically significant difference in median percent occurrence of maternal IS gesture between mothers of younger DD children in Group IIA (Mdn= 6.35) and mothers of older DD children in Group IIB (Mdn= 6.80 [/Z/= 0.442, p= 0.659].Figure 22 depicts the median percent occurrence of maternal gestures in mothers of DD children in Group II (DDM).

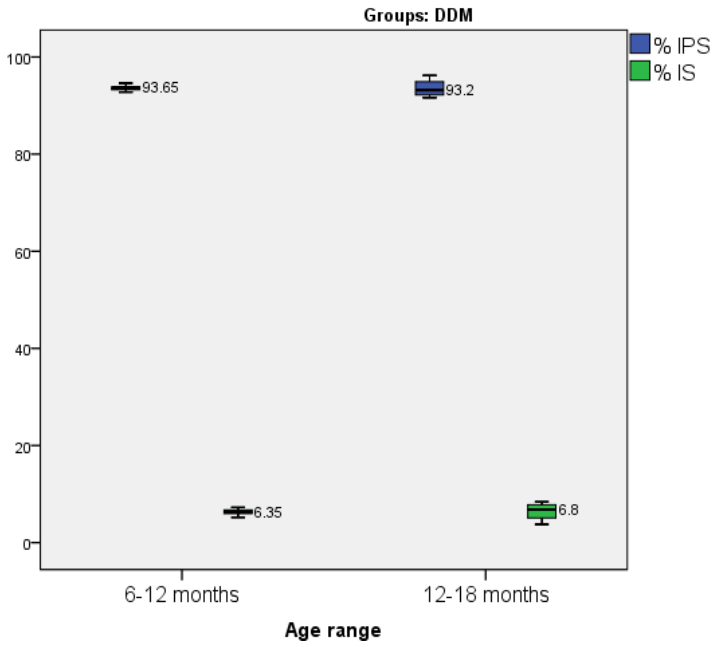

Figure 22. Median and IQR of percent occurrence of maternal IPS and IS gesture in mothers of children in Group IIA and Group IIB

Maternal gestures in mothers of DS children (DSM)

Results of Mann Whitney U test (Table 26) indicated that there was no statistically significant difference on median percent occurrence of maternal IPS gestures between mothers of younger DS children in Group IIIA (Mdn= 94.64) and mothers of older DS children in Group IIIB (Mdn= 90.00) [/Z/= 1.810, p= 0.070]. There was no statistically significant difference on median percent occurrence of maternal IS gestures, between mothers of younger DS children in Group IIIA (Mdn= 5.36) and mothers of older DS children in Group IIIB (Mdn= 10.00) [/Z/= 1.810, p=

0.070]. Figure 23 depicts the median percent occurrence of maternal gestures in mothers of DS children in Group III (DSM).

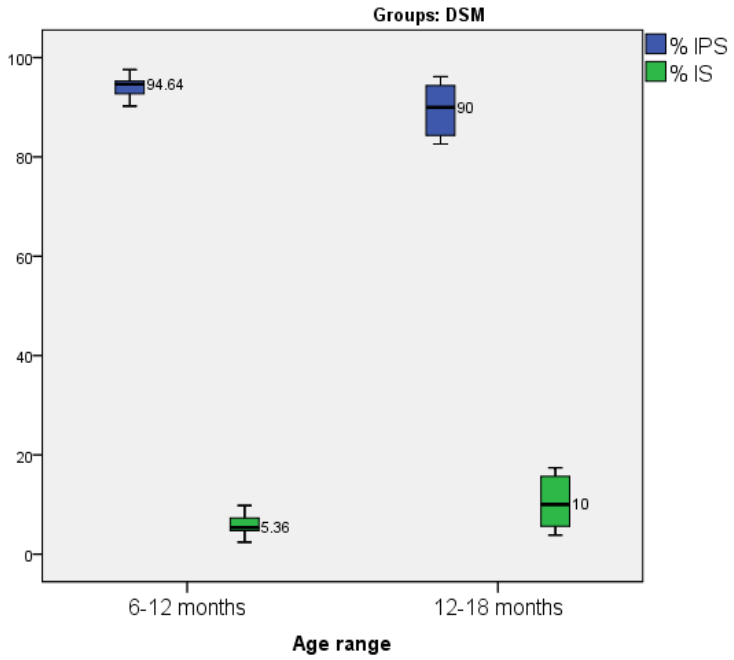

Figure 23. Median and IQR of percent occurrence of maternal IPS and IS gesture in mothers of children in Group III A and Group III B (DSM)

In summary, the Mann whintney U test supported the effect of age on the median percent occurrence of maternal IPS and IS gestures . Mothers of younger TD children in Group IA showed significantly greater median percent occurrence of maternal IPS gesture than mothers of older TD children in Group IB. Mothers of older TD children in Group IB showed significantly greater median percent occurrence of maternal IS gestures than mothers of younger TD children in Group IA . Mothers of younger DD children in Group IIA and mothers of older DD children in Group IIB did not show any significant difference in maternal IPS and IS gesture. This was also true in the case of mothers of younger DS children in Group IIIA and mothers of older DS children in Group IIIB.

4.4.2. Comparisons of percentage occurrence of maternal across the three groups.

The groups were divided into two age groups. Kruskal wallis H test was used to compare the maternal gestures across the three dyadic groups, as the comparison between age groups indicated main effect of age. Mann Whitney U test was used for pairwise comparison of the maternal gestures between the dyadic groups in both age groups.Results of Kruskal Wallis H test and Mann Whitney U test are presented in Table 27 and 28 respectively.

Table 27

Results of Kruskal wallis test for across group comparison of subcategories of maternal gestures

	Across group comparison of subcategories of maternal gestures in mothers of two age groups **in %**			
	Across mothers of younger children in Group IA(TD) Vs Group IIA (DD) Vs Group IIIA(DS		Across mothers of older children in Group IB (TD)Vs Group IIB (DD) Vs Group IIIB (DS)	
	IPS	IS	IPS	IS
Chi-Square	0.977	0.836	8.537	8.537
df	2	2	2	2
Asymp. Sig.	0.614	0.658	.014*	.014*

* Significant difference (p<0.05)

Note: IPS- Intentional presymbolic gestures; IS-Intentional symbolic gestures

Table 28

Results of Mann Whitney U test for pairwise comparison between groups

Comparison across groups for subcategories of maternal gestures in mothers of older children (12-18 months)

Mothers of older TD children in Group IB Vs Mothers of older DD children Group IIB Vs Mothers of older DS children in Group IIIB						
	Group IB Vs Group IIB		Group IB Vs Group IIIB		Group IIB Vs Group IIIB	
Gestures in %	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)	/Z/	Asymp. Sig. (2-tailed)
IPS	3.181	.001*	0.795	0.427	1.457	0.145
IS	3.181	.001*	0.795	0.427	1.457	0.145

* Significant difference (p<0.05)

Note: IPS- Intentional presymbolic gestures; IS-Intentional symbolic gestures

Maternal gestures across groups in mothers of younger age children

Kruskal Wallis H test revealed that there was no statistically significant difference in median percent occurrence of maternal IPS gesture across mothers of younger TD children in Group IA, mothers of younger DD children in Group IIA and mothers of younger DS children in Group IIIA [X^2 (2) = 0.977, p=0.614]. There was no statistically significant difference in median percent occurrence of maternal IS gesture across the three groups of mothers of children in younger age [X^2 (2) = 0.836, p=0.658], as shown in Table 27.Figure 24 represents the maternal IPS and IS gestures in mothers of younger age group children.

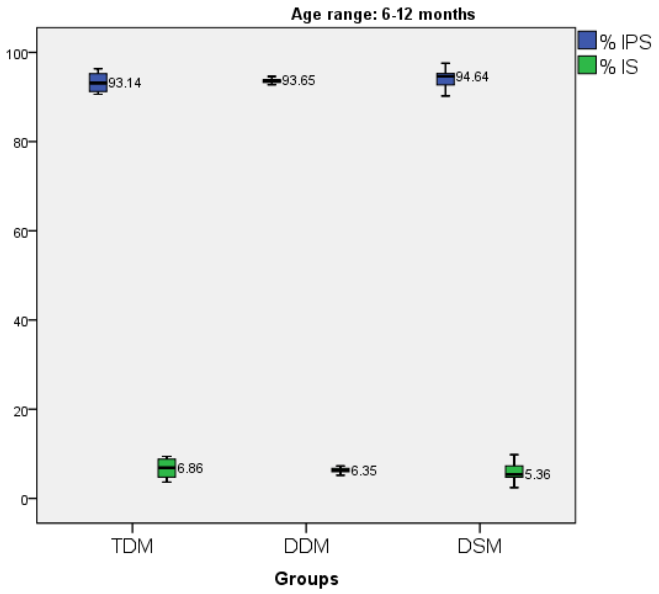

Figure 24.Median and IQR percentage of occurrence of maternal IPS and IS gestures in mothers of children in younger age group[Group IA, Group IIA and Group IIIA]

Maternal gestures across groups in mothers of older age children

Kruskal Wallis H test revealed that there was statistically significant difference in median percent occurrence of maternal IPS gestures, across mothers of older TD children in Group IB, mothers of DD children in Group IIB and mothers of DS children in Group IIIB [X^2 (2) = 8.537, p=0.014]. There was statistically

significant difference in median percent occurrence of maternal IS gestures, across the three groups of mothers of children in older age [X^2 (2) = 8.537, p=0.014].

Pairwise comparison for use of maternal gestures between mothers of older children using Mann Whitney U test results are presented in Table 28. Mothers of older DD children in Group IIB (Mdn= 93.20) showed significantly higher median percent occurrence of maternal IPS gestures than mothers of older TD children in Group IB (Mdn= 87.94) [/Z/= 3.181, p = 0.001. There was no significant difference in the median percent occurrence of maternal IPS gestures, between mothers of older TD children in Group IB (Mdn= 87.94) and mothers of older DS children in Group IIIB (Mdn= 90.00) [/Z/= 0.795, p= 0.427]. There was no statistically significant difference between mothers of older DD children in Group IIB (Mdn= 93.20) and mothers of older DS children in Group IIIB (Mdn= 90.00) [/Z/= 1.457, p=0.145] in the use of maternal IPS gestures.

Median percent occurrence of maternal IS gestures, in mothers of older TD children in Group IB (Mdn= 12.06) was significantly higher than mothers of older DD children in Group IIB (Mdn= 6.80) [/Z/= 3.181, p = 0.001]. There was no significant difference in median percent occurrence of maternal IS gestures, between mothers of older TD children in Group IB (Mdn= 12.06) and mothers of older DS children in Group IIIB (Mdn= 10.00) [/Z/= 0.795 , p= 0.427]. There was no statistically significant difference in median percent occurrence of maternal IS gesture, between mothers of older DD children in Group IIB (Mdn= 6.80) and mothers of older DS children in Group IIIB (Mdn= 10.00) [/Z/= 1.457, p= 0.145]. Figure 25 depicts median percent occurrence of maternal IPS and IS gestures in mothers of older age group children [Group IB, Group IIB and Group IIIB].

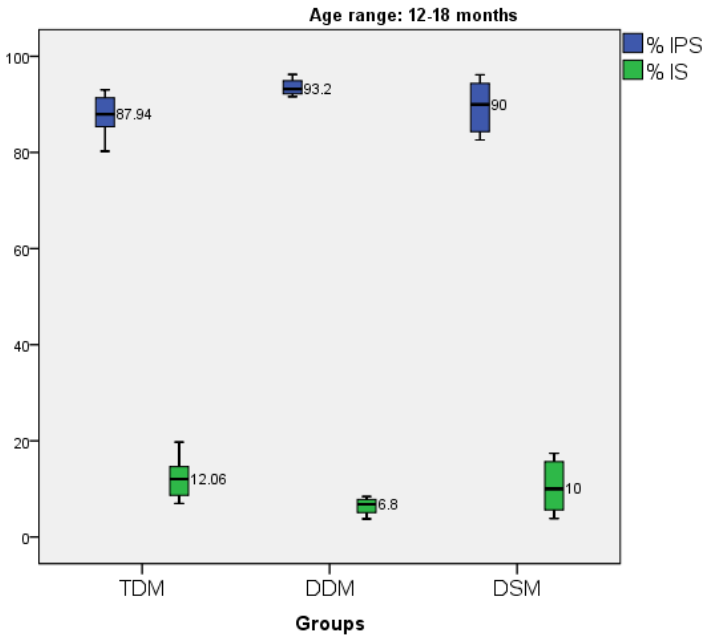

Figure 25. Median and IQR percentage occurrence of maternal IPS and IS gestures in mothers of children in older age group[Group IB, Group IIB and Group IIIB]

In summary, comparison across maternal gestures in the mothers of younger age group children revealed no significant difference in the median percent occurrence of maternal IPS and IS gestures. Mothers of older DD children in Group IIB showed significantly greater median percent occurrence of maternal IPS gesture than mothers of older TD children in Group IB. There was no significant difference in the median percent occurrence of maternal IPS gesture between mothers of older TD children in Group IB and mothers of older DS children in Group IIIB; mothers of older DD children in Group IIB and mothers of older DS children in Group IIIB. On comparison of median percent occurrence of maternal IS gestures across the three groups in older age range, it was observed that mothers of older TD children in Group IB showed significantly greater median percent occurrence of IS gesture than mothers of older DD children in Group IIB. There was no significant difference in the median percent occurrence of maternal IS gestures between mothers of older TD children in Group IB and mothers of older DS children in Group IIIB; mothers of older DD children in Group IIB and mothers of older DS children in Group IIIB.

4.4.3. Comparisons of percentage occurrence of maternal IPS and IS gestures.

To compare within median percent occurrence of maternal IPS and IS gestures, further statistical tests were run. Wilcoxon signed rank test was used in four conditions. In the first condition Wilcoxon signed rank test was run to determine if the median percent occurrence of maternal gestures in the dyadic communication context of children using IPS and IS gestures showed statistically significant differences irrespective of groups and age. In the second condition, percentage of occurrence of maternal gestures in the dyadic communication context of children using IPS and IS gestures were compared in each group by splitting the three groups. In the third condition, percentage occurrence of maternal gestures in the dyadic communication context of children using IPS and IS gestures was compared between age group A (younger children) and age group B (older children). In the last condition, percentage occurrence of maternal gestures in the dyadic communication context of children using IPS and IS gestures was compared in each of the groups in age group A and each of the groups in age group B. The reason for running the Wilcoxon signed rank test four times was to note the main effect of the subcategories of the maternal gestures and interaction between the subcategories of maternal gestures and groups, subcategories of maternal gestures and age groups and interaction between subcategories of maternal gestures, groups,and age groups together. Table 29 represents the results of Wilcoxon Signed Rank Test.

Table 29

Results of Wilcoxon Signed Rank Test for comparison of maternal IPS and IS gestures in mothers of younger children in Group IA, Group IIA , Group IIIA, and mothers of older children in Group IB, Group IIB, Group IIIB

% IS-%IPS		
i)	Irrespective of groups and age	
	/Z/	Asymp. Sig. (2-tailed)
	6.393	.000*
ii)	With respect to groups	
	/Z/	Asymp. Sig. (2-tailed)
Group I	3.724	.000*
Group II	3.724	.000*
Group III	3.724	.000*
iii)	With respect to age group	
	/Z/	Asymp. Sig. (2-tailed)
Age group A	4.541	.000*
Age group B	4.541	.000*
iv)	With respect to groups and age group	
	/Z/	Asymp. Sig. (2-tailed)
Group IA	2.666	.008*
Group IIA	2.666	.008*
Group IIIA	2.666	.008*
Group IB	2.666	.008*
Group IIB	2.666	.008*
Group IIIB	2.666	.008*
* Significant difference ($p<0.05$)		

Note: IPS- Intentional presymbolic gestures; IS- Intentional symbolic gestures

The results on four conditions of Wilcoxon signed rank test revealed significant main effect of subcategories. There was no interaction effect between the three subcategories of gestures, groups and age groups. The common trend of median percent occurrence revealed by the groups and age groups for within gesture comparison was that the IPS gestures showed significantly greater median percent occurrence than IS gestures.

4.5. Child-directed speech of mothers in the dyadic communication context

The mother's vocal behaviours were analysed for the presence or absence of child-directed speech in each communication turn. Out of 4,677 annotations, 3,905 annotations showed presence of child-directed speech and it was absent in 772 annotations. Means, medians, standard deviations and interquartile ranges for percentage occurrence of child-directed speech were calculated and the same is presented in Table 30.

Table 30

Means (M), Medians (Mdn), Standard deviations (SD), Interquartile ranges (IQR) of percentage occurrence of child-directed speech in mothers with children in Group IA, Group IB, Group IIA, Group IIB, Group IIIA, Group IIIB

	Group I TD children			Group II DD children			Group III DS children			Age Groups	
	Group Total	Group IA (TDM)	Group IB (TDM)	Group II Total	Group IIA (DDM)	Group IIB (DDM)	Group III Total	Group IIIA (DSM)	Group IIIB (DSM)	6-12 months	12-18 months
M	81.3	74.72	87.88	84.27	80.42	88.11	82.43	79.68	85.18	78.27	87.06
Mdn	85.53	74.36	91.92	85.15	81.94	88.37	85.68	81.69	89.66	77.01	90
SD	12.8	13.23	8.71	7.2	5.67	6.68	11.63	12.86	10.24	11.02	8.44
IQR	19.7	20.79	7.58	11.09	8.86	11.08	19.3	23.69	18.7	16.31	12.3

4.5.1. Comparisons of percentage occurrence of child-directed speech between mothers of children in two age groups.

Mann Whitney U test was used to compare the child-directed speech between the mothers of children in two age groups in all the three groups (TD,DD and DS). Results of Mann whitney U test are represented in Table 33.

Table 31

Mann Whitney U test for comparison of median percent occurrence of child-directed speech between age group

Test Statistic	Group IA Vs Group IB	Group IIA Vs Group IIB	Group IIIA Vs Group IIIB
/Z/	1.99	2.43	0.84
Asymp. Sig. (2-tailed)	.047*	.015*	.402

* Significant difference ($p<0.05$)

From Table 31, it is seen that the median percent occurrence of child directed speech was significantly greater in mothers of older TD children in Group IB (Mdn= 91.92) than mothers of younger TD children in Group IA (Mdn= 74.36), [/Z/= 1.99, p= 0.047]. The median percent occurrence of child-directed speech was significantly greater in mothers of older DD children in Group IIB (Mdn= 88.37) than the mothers of younger DD children in Group IIA (Mdn= 81.94) [/Z/= 2.43, p= 0.015]. There was no statistically significant difference in median percent occurrence of child-directed speech between mothers of younger DS children in Group IIIA (Mdn= 81.69) and mothers of older DS children in Group IIIB (Mdn= 89.66) [/Z/= 0.84, p= 0.402].

Kruskal Wallis H test was used to compare the child-directed speech of mothers across the mothers of children in the three groups in younger age group and older age group separately. Results are presented in Table 32.

Table 32

Results of Kruskal Wallis Test comparing median percent occurrence of child directed speech of mothers across group

	Across Group IA Vs Group IIA Vs Group IIIA	Across Group IB Vs Group IIB Vs Group IIIB
	% child directed speech present	% child directed speech present
Chi-Square	1.09	0.519
df	2	2
Asymp. Sig.	0.58	0.772

*significant difference (p<0.05)

The results of Kruskal Wallis H test revealed that there was no statistically significant difference in median percent occurrence of child directed speech across mothers of younger TD children in Group IA, mothers of younger DD children in Group IIA and mothers of younger DS children in Group IIIA [X^2 (2) = 1.090, p=0.580]. Figure 26 depicts the median percent occurrence of child-directed speech in mothers of younger age children in the three groups.

Comparison of mothers of older children in TD, DD and DS groups revealed that there was no statistically significant difference in median percent occurrence of child directed speech across mothers of older TD children in Group IB, mothers of older DD children in Group IIB and mothers of older DS children in Group IIIB [$X^2(2) = 0.519$, $p=0.772$].

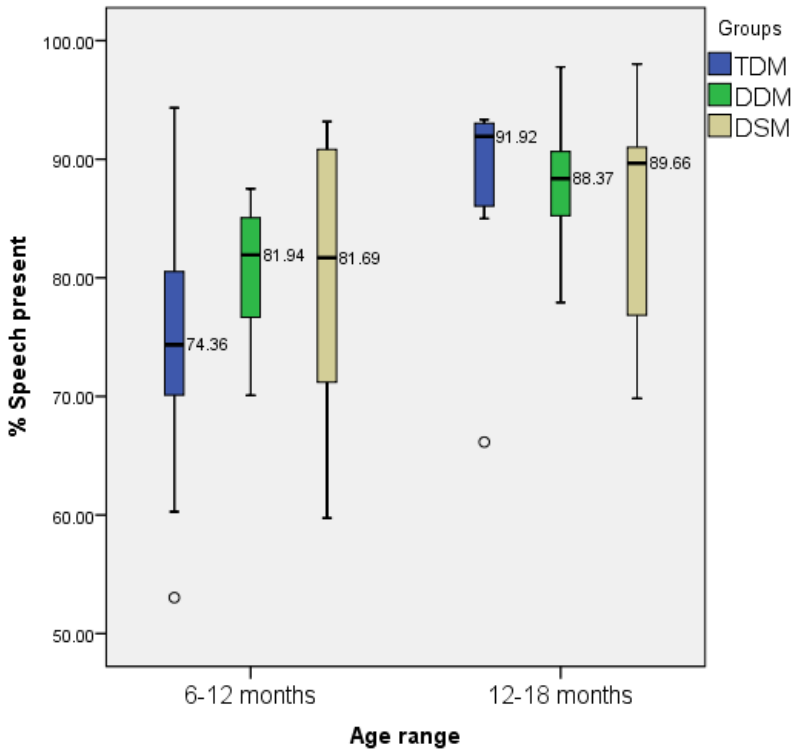

Figure 26. Mdn, IQR of percent occurrence of child-directed speech of mothers of children in Group IA, Group IIA, Group IIIA and mothers of children in Group IB, Group IIB, Group IIIB.

Chapter 5

DISCUSSION

Section 1: Communication Behaviours of the Children

1) Eye gaze orientation

The median percent occurrence of single, dual and triadic eye gaze orientation behaviours of children were compared between- age and across- groups. Significant difference between the younger and older Typically Developing children (Group I, TD group), Children with intellectual disability due to developmental disorders (Group II, DD group) and Children with intellectual disability due to Down Syndrome (Group III, DS group) was observed (Table 6, Figures 5,6 and 7).

Younger children in TD group showed significantly greater median percent occurrence of single eye gaze orientation behaviour than older children in TD group (Table 6, Figure 5). The single eye gaze orientation is considered as those eye gaze behaviours comprising of episodes of passive joint engagement (Bakeman & Adamson, 1984). According to Bakeman and Adamson (1984), there was no significant difference in the amount of time spent in passive joint attention in TD children from 6 months to 18 months of age. It is interesting to note that despite the similarities between the study by Bakeman and Adamson (1984) and the present study, the results are different. The similarities in both studies are in terms of the procedure used for data collection (Free play interaction with a standard set of toys); the scoring of the behaviours [study by Bakeman and Adamson (1984) considered percent of time in engagement state and this study considered percentage of

occurrence of eye gaze behaviours) and the age of children considered [Bakeman and Adamson (1984) considered children of 6 months and followed them to 18 months age; but this study considered two groups of children between 6-12 months and 12-18 months of age) and the study design [this study used a cross-sectional design whereas Bakeman and Adamson (1984) used a longitudinal study design]. Also, Bakeman and Adamson (1984) addressed three conditions: mother-infant interaction, peer-child interaction and child alone condition. In contrast, the present study had only one condition, mother-child interaction with toys.

Older children in TD group showed a significantly greater median percent occurrence of dual and triadic eye gaze orientation than younger children in TD group (Table 6, Figure 5). As the dual and triadic eye gaze orientation in the present study refers to the episodes of visual joint attention, the study supports the notion expressed by many studies that as TD children grow, the episodes of joint attention increases (Bakeman & Adamson, 1984; Carpenter, Nagell, & Tomasello, 1998; Legerstee & Fisher, 2008; Legerstee, Markova & Fisher, 2007; Scaife & Bruner, 1975).

Scaife and Bruner (1975) reported that in the longitudinal study of children from 2-4 months to 11-14 months of age, the visual joint attention measured in terms of gaze following improved from 30% to 100 %. Gaze following is not equivalent to dual and triadic eye gaze orientation. However, when the operational definition of dual and triadic eye gaze orientation is considered, gaze following can be thought of as a subset of dual eye gaze orientation as is defined in the present study.

Carpenter, Nagell and Tomasello, (1998), in a longitudinal study on mother-TD infant dyads reported that the number of joint engagement episodes increased

from 1.9 in 9 months to 4.3 in 15 months. That is, an increasing trend in the joint engagement with age was reported. Similar trend was observed in the present study. Similarly, in the longitudinal study by Legerstee, Markova and Fisher (2007), coordinated attention of TD infants were reported to increase from 5 months to 7 months to 10 months of age. The result observed in this study is also in line with the findings reported by Legerstee et al. (2007).

Thus a common notion that emerges from these studies is that in mother- TD child interaction, as children develop, the visual joint attention also increases. However, the passive joint attention is also a component which, with age reduces but continues to be a major part of the mother-child interaction.

There was no significant difference in median percent occurrence of single, dual and triadic eye gaze orientation in younger DD children and older DD children, indicating that in children with DD, the number of joint attention episodes remain constant over age (Table 6, Figure 6). That is, children in DD group did not show an ascending trend with age in the joint attention skills. Joint attention has been attributed to growing communicative competence (Bruner, 1975a, 1983; Werner & Kaplan, 1963) and the subsequent symbolically mediated conversations (Trevarthen & Hubley, 1978). Limitations in the growth of joint attention imply deficits in the growth of communication and symbolic representation skills in these children. Since these deficits are serious threats to children's future social, academic, cultural learning domains, it needs to be considered as a critical factor in the assessment and intervention.

There was no significant difference between the two age groups: the younger DS children and older DS children on single and dual eye gaze orientation (Table 6, Figure 7). However, older DS group showed a significantly greater median percent occurrence on triadic eye gaze orientation than the younger DS group (Table 6, Figure 7).

When the median percent occurrence of dual eye gaze orientation were observed in younger DS children and older DS children, it was observed that, older DS group (Mdn= 20.23) showed better scores than younger DS group (Mdn= 16.16). Children in DS group showed an increasing trend for triadic eye gaze orientation with age. The increasing trend observed in joint attention is in agreement with the outcome of the study by Legerstee and Fisher (2008), which reported that the frequency of coordinated attention increased across the four visits in 8-month longitudinal study in both low MA (0.86 years) and high MA (1.45 years) DS children. For Low MA children with DS the mean frequency was M=1.4 in the first visit and M=2.2 in the fourth visit. Similarly, for children with high MA group, the mean frequency was M= 2.18 and M=3.09 at first and fourth visits respectively. Hence the observations of the present study is in consonance with the results of Legerstee and Fisher (2008).

Thus, it can be noted that children in DS group followed similar trend as children in TD group across younger and older age group. The median percent occurrence on triadic eye gaze orientation, improved with age in both younger TD children and younger DS children. This increasing trend of joint attention was not seen in children in DD group. Thus, focus on joint attention in the early identification and early intervention of children with both clinical groups, especially DD group is warranted.

Thus, the null hypothesis of the study pertaining to eye gaze orientation which stated there is no significant difference in the median percent occurrence of subcategories of eye gaze orientation between the two age groups of children is rejected.

Analysis across groups revealed a main effect of groups on subcategories of eye gaze orientation (Table 7). In the younger age group, significant differences were evident across groups only on triadic eye gaze orientation. In older age group, significant difference was evident on single, dual and triadic eye gaze orientation (Table 7, Figure 9). *Thus the null hypothesis of the study pertaining to eye gaze orientation which stated there is no significant difference in the median percent occurrence of subcategories of eye gaze orientation across the three groups of children is rejected*.

The median percent occurrence of single eye gaze orientation across younger TD children, younger DD children and younger DS children in the younger age group was not significantly different (Table 7, Figure 8). As discussed earlier, single eye gaze orientation can be thought of as a subset of instances of passive joint attention (Bakeman & Adamson, 1984). Comparable scores on single eye gaze orientation in younger TD children and younger children in the clinical groups considered imply that all younger children in the study had no deficits in passive joint attention.

On triadic eye gaze orientation, younger TD children displayed significantly greater median percent occurrence than the younger DS children group (Table 8, Figure 8). In addition, younger DD children revealed significantly greater scores on triadic eye gaze orientation, indicating that younger DS children is the most deficient

in the triadic eye gaze orientation, than even the younger DD children (Table 8 Figure 8). These results are in agreement with that reported by Berger and Cunnigham (1981). Berger and Cunnigham (1981) attributed poor percentage eye contact and mean bout duration of mutual eye contact in children with DS to hypotonia of the eye muscles and delayed maturation of primary visual system. The authors also pointed out that impairments in information processing capacity and learning processes help in acquiring face schema and this may also have contributed to poorer scores in children with DS. Thus, the qualitative and quantitative developments in eye contact were linked to maturational and psychological processes, and their relationship with development of social interaction were speculated. In the present study, contribution of physiological factors on performance of triadic eye gaze orientation can neither be confirmed nor denied, as no objective evaluation was carried out to note these function. However, the mental age of the children with DS were matched and presence of visual defects were eliminated only through parent interview for all children. To further explore on the relationship of physiological deficits and visual joint attention skills in children with DS, more research is warranted.

One of the age groups considered by Legerstee and Fisher (2008) was children with mean MA of 0.86 years. These authors also reported poor coordinated attention in terms of frequency and duration of coordinated attention in children with DS with mental age-matched TD children. Thus, the results of present study is in line with the results of study by Legerstee and Fisher (2008).

Comparison between two younger age groups in the clinical groups (DD and DS) in the present study revealed that the younger DD children displayed greater median percent occurrence of triadic eye gaze orientation than younger DS children

(Table 8, Figure 8). As discussed in the earlier section, the low frequency of joint attention in younger age typically developing children has been attributed to inability to coordinate attention to multiple items due to motor limitations (Trevarthen, 1979). In the present study, it was observed that all younger children with DS had generalized hypotonia, whereas, only three children in younger DD group had hypotonia of the upper limbs. This could have contributed for poorer scores on triadic eye gaze orientation in younger DS children than in younger DD children.

Comparison between groups of older TD children and older DD children displayed significant difference on single, dual and triadic eye gaze orientation (Table 8 Figure 9) On single eye gaze orientation, older DD children revealed significantly greater median percent occurrence than older TD children. On Dual eye gaze orientation and triadic eye gaze orientation, older TD children revealed significantly greater median percent occurrence than older DD children. The scores of older DS children on both dual and triadic eye gaze orientation were comparable to that of older TD children (Table 8, Figure 9). Considering dual and triadic eye gaze orientation as indicative of joint attention, it can be inferred that children with DD in the older group had significant deficits in the skill.

No significant difference was found in the median percent occurrence of single dual and triadic eye gaze orientation, between older TD children and older DS children (Table 9, Figure 9). These results contradict that reported by Legerstee and Fisher (2008). Legerstee and Fisher (2008) considered one of the groups of children with DS with mean MA of 1.45 years, which is similar to the mean MA of children considered in the present study (Mean MA= 14.44 months). The authors reported that children in the DS group had a poorer frequency of coordinated attention than mental

age-matched TD children. Another interesting result reported by them was that the TD children in the older age group showed a reduction in coordinated attention at 18 months in relation to the previous measures taken at 12 months of age. They attributed this reduction in frequency and duration of coordinated attention to TD children's shift in the reliance from coordinated attention to the use of verbal skills for communication (Legerstee et al., 2002). Though it is observed in the present study that the joint attention in older TD children is significantly greater than younger TD children, one of the factors contributing to similar joint attention in older TD children and older children with DS could be attributed to their reliance on verbal skills for communication. In the present study, the verbal behaviours were also explored and results show that older TD children had significantly higher scores on use of protowords and words than younger TD children.

Harris, Kasari, and Sigman (1996) reported that caregivers of children with DS spent more time in joint attention than caregivers of TD children. Harris et al. (1996) followed Bakeman & Adamson's (1984) definition for passive joint attention, in which both partners attend to the same object without looking at each other's face. This definition can be thought of as a subset of single eye gaze orientation considered in the present study. However, there was no significant difference in the single eye gaze orientation between older TD children and older DS children. The reason for the variation in the results reported by Harris et al., (1996) and the present study could be the age of the children considered. While the study by Harris et al., (1996) considered children with DS in the age range of 13 to 41 months, the present study considered children with mean CA of 22.6 months.

There was no significant difference between older DD children and older DS children on single and dual eye gaze orientation (Table 8 Figure 9). This result is in consonance with the results reported by Calendrella and Wilcox (2000). The authors reported that there was significant difference in the gestures with visual joint attention in children with DS and children with DD due to undetermined origin. Hence, deficits in visual joint attention can be considered as a shared feature in children with DS and children with DD and may not be an attribute to the behavioural phenotype of children with DS only.

Median percent occurrence of single, dual and triadic eye gaze orientation, was compared. A universal trend that was followed by all children irrespective of age group or groups was that the median percent occurrence of single eye gaze orientation was the most significantly occurring subcategory followed by dual eye gaze orientation and lastly the triadic eye gaze orientation (Single>Dual; Single>Triadic; Dual>Triadic) (Tables 9, 10). Passive joint attention, as subset in the single eye gaze orientation is mostly dependent on the communication partner than the child. But, dual and triadic eye gaze orientations are skills that the child has to acquire over the initial months. Hence the instances of single eye gaze orientation in which child communicates with the mother directly or mother follows the child's attentional frame form a major portion of mother-child interaction samples. Joint attention is an emerging skill which requires a more matured visual system of the child, motor skills to support the child's shift in the eyegaze (in terms of head turn, head tilt, sitting etc.). These prerequisite resources for the development of visual joint attention emerge over the initial months. In addition, the dual eye gaze orientation and triadic eye gaze orientation requires the child to develop intentionality by observing the mother's

communication towards self. This focus of child towards mother gradually develops in relatively routine interactive sequences. Involving the child in these routine sequences and providing the child with the opportunity to comprehend the adult's behavioral and communicative intentions without the aid of language only takes time to develop (Bruner, 1975a, 1977, 1983). Hence, this could lead to lesser frequency of occurrence of dual and triadic eye gaze orientation in young infants below 18 months of age.

Thus, it can be inferred that children in both clinical groups presented significant difficulties in joint attention skills. Only on single eye gaze orientation, which is a subset of passive joint attention, children in both clinical groups irrespective of age presented similar skills. In instances of passive joint attention, the role of mothers takes an upper hand than that of children. This enables even younger infants sustained attention with ease. Also, this quality of passive joint attention makes it more possible for children in the clinical group to stay in that state as long as that of TD children. This can be explained by noting that mothers possess a shared memory system with the infant. So, they will be able to complement their infants' attention (Kaye, 1982). This relieves the infant from the need to visually attend simultaneously to both partner and object. It is reported that in instances of passive joint attention, mothers are most likely to provide language and communication stimulations that can strengthen the children's communication (Bruner, 1975; Kaye, 1982). So, passive joint attention can be considered as an excellent opportunity for the mother to mediate children's language learning and communication skills. This implies that measures of joint attention skills in clinical groups are an essential part of assessment protocol and also for early intervention planning. *Thus, the null hypothesis*

pertaining to the eye gaze orientation which stated that there is no significant difference between the subcategories of eye gaze orientation between two age groups in TD, DD and DS children is rejected.

2) Gestures

The median percent occurrence of Preintentional presymbolic (PIPS), Intentional presymbolic (IPS) and Intentional symbolic (IS) gestures were compared between-age groups and across groups. Statistical analysis revealed the significant difference between younger and older TD children, DD children and DS children (Table 12).

For between age group comparison, the three groups were further divided into sub age groups (younger group: > 6to $\leq$ 12 months and older group: > 12 to $\leq$ 18 months). The median percent occurrence of subcategories of gestures was compared between the age groups separately and the results revealed different trends in the TD group, DD group, and the DS group (Table 12, Figures 10, 12, 13).

Younger TD children revealed significantly greater scores on PIPS gestures than older TD children (Table 12 Figure 10). PIPS gestures was a complex that had alerting behaviours, mother assisted actions, toy exploration and toy manipulation as its constituents. So, further analysis of constituents of PIPS gestures was carried out. Statistical analyses revealed that alerting behaviours and toy exploration were significantly greater in younger TD children than in older TD children. The mother assisted actions, had comparable scores in both younger and older TD children. It was found that on toy manipulation, older TD children had significantly better scores than younger TD children. Yet the older TD group revealed significantly lesser PIPS

gestures overall compared to younger TD children. The constituents of PIPS which included alerting behaviours, mother assisted actions, toy exploration and toy manipulation are hierarchically ordered sensorimotor behaviours, based on the cognitive skills that emerge in the first six stages of sensorimotor period as reported by cognitive development theory (Piaget, 1954, 1962). Significantly greater median percentage of alerting behaviours and toy exploration behaviours and significantly poorer median percent occurrence of IS gestures in younger TD children implies that these children were yet to acquire advanced gestures and mostly their repertoire had primitive gestures. These results are in consonance with that reported by Rowland and FriedOken (2010). Accordingly, the behaviours that are grouped as constituents of PIPS gestures are similar to that enlisted in the first three levels of communication on the Communication Matrix (Rowland, 2011). The authors reported that the first three levels of communication emerge by 0-12 months of age. In the present study also, it is observed that these communication behaviours are predominant in the younger age group (6-12 months) than the older age group (12-18 months).

The better scores on median percent occurrence of toy manipulation in the older TD group than younger TD group can be explained on the basis of cognitive developmental theory (Piaget, 1954, 1962). Toy manipulation was defined as actions that demonstrated handling of the toy or controlling the toy in a skillful manner. E.g., pushing a toy train, playing toy drum/xylophone, shaking a rattle to produce sound, pushing the button on torch to turn it on etc. Thus toy manipulation is more complex and requires the cognitive skills such as object permanence, causality, and intentional imitative behaviours. These cognitive skills are reported to develop only by 8-12 months (Piaget 1954, 1962); and in the present study also, these constituent PIPS

gestures were observed to be more in the older TD children in the age range of 12-18 months.

The study also reported higher median percent occurrence of IS gestures in older TD children than younger TD children (Table14). In the present study, conventional gestures and representational gestures constituted IS gestures. Further analysis of these two constituents of IS gestures revealed that older TD children had significantly greater conventional and representational gestures than younger TD children. These results are in consonance with that reported by Rowland (2011). The study supports the existing evidence that symbolic skills emerge at the tertiary circular reaction stage of sensorimotor period, as proposed in the cognitive development theory (Piaget 1954, 1962), which is observed in the children between 12-18 months of age.

On comparing younger children and older children in DD group, there was no significant difference observed in the median percent occurrence of PIPS gestures and IPS gestures (Table 12, Figure 12). Older children in DD group had better scores on IS gestures than younger children, the same result demonstrated by TD children (Table 14, Figure 12). These results are in consonance with that reported by Crais et al. (2004).

It is interesting to note that the children with DS in the two age groups did not reveal the same trend as that of DD children. Thus, it can be inferred that children with DS have poorer symbolic skills than their mental age matched children with DD. It can be noted that infants with DS exhibit difficulties developing from Piaget's sensorimotor stage III to stage IV, and from stage IV to stage V (Dunst, 1988, 1990).

Stage III and IV are reported to be present in infants between 4-8 and 8-12 months respectively. The important cognitive skills acquired at these stages are space, object permanence and intentional and imitative actions (Piaget, 1954, 1962). It can be inferred that impairments in these are reflected as no improvement in the scores on IS gestures with age.

Hence the Null Hypothesis pertaining to gestures which stated that there is no significant difference in the median percent occurrence of gestures and subcategories of gestures between the two age groups of children is rejected.

Statistical analysis indicated no significant main effect of groups and no interaction between age and groups (Table 16). Comparison of children in younger age group children and children in older age group children across groups (TD Vs. DD Vs. DS) revealed that all the three groups in both age groups had similar median percent occurrence on PIPS, IPS and IS gestures (Table 16, Figure 14).

The use of comparable amount of gestures by DS children and TD children is supported by McCune, Kearney and Checkoff (1989); and Iverson, Longobardi, and Caselli (2003). The use of comparable amount of gestures by DD children and TD children is supported by the results of the study by Ramruttun and Jenkins (1998). The results can be explained on the premise that, gestures are representations in the visual modality. The most common gestures used by all three groups of children were preintentional presymbolic and preintentional symbolic subcategories. These are the earliest form of communication and is acquired at the beginning of the communication development hierarchy. Since the child's level of understanding is at a concrete level at younger age, the communication behaviors are also used to

communicate concrete concepts like the object itself, the location of the object, an event happening at the current time etc (Crimmins et al., 1995).. Since the concrete and physical world is always existent and has a visuo-spatial relation with the communicator, a physical relationship between the communicator and the message always exists. These qualities of presymbolic gestures, makes its use easier and extensive not only in typical children but also in the clinical population.

Hence the Null Hypothesis pertaining to gestures which stated that there is no significant difference in the median percent occurrence of gestures and subcategories of gestures across the three groups of children is accepted.

The common trend exhibited by all children in the study was that PIPS and IPS gestures were used almost to the same extent. IS gestures were used to a significantly smaller extent than both PIPS and IPS gestures. As discussed earlier, PIPS gestures included alerting behaviours, mother assisted actions, toy exploration and toy manipulation. One way to look at these behaviours is from the cognitive developmental perspective, where the child is trying to explore the world through sensorimotor explorations. The other way to look at these behaviours is through social-interactional theory perspective. These instances can be considered as episodes of passive joint attention, where the child and mother are focusing on a common object of interest. IPS gestures are the deictic gestures. PIPS gestures and IPS gestures together form the presymbolic gestures. So, it can be implied that all three groups of children considered in the study between the mental age of 6 to 18 months, irrespective of groups and age, are predominant users of presymbolic gesture. Comparable usage of presymbolic forms by both clinical groups and typical groups indicates that communication through presymbolic mode is not deficient. So, these

areas of strength in the clinical groups can be further utilized to build upon the language and communication skills of children in their early interventional program.

3) Vocal behaviours of children

In the present study, the vocal behaviours analyzed included vocalization, protowords and words. Comparison of median percent occurrence of vocalization, a form of presymbolic communication behaviour between age groups did not reveal any significant differences between the younger and older TD children. Similar observation was noted in both clinical groups as well. The same observation has been noted for the presymbolic communication behaviours in the gestural mode also, as discussed in the previous section. Hence integrating both the information, it can be inferred that presymbolic communication behaviours in the clinical groups (children with DD and children with DS) are on par with typical group when the mental age is matched.

Gestural mode of expression is closely coupled with language and speech in the process of communication development (Goldin-Meadow, 2003; Kendon, 2004; McNeill, 1992, 2005). The emergence of vocalization has always been reported after the emergence of gestures (Crais, et al. 2004; Masur, 1984) with a lag of 2 weeks to 3 months. Studies report that gestures emerge in isolation but vocalization emerge and is used with gestures in most instances (Crais, et al. 2004; Masur, 1984). The observation of comparable frequency of gestural use and use of vocalization in the present study strengthens the close relationship speculated between these two modes of expression and language.

It was observed that children in older TD group had significantly greater protowords and words than the children in younger TD group (Table 20, Figure 15). These findings were true for children in DD group as well; older DD children had better scores on protowords and words than younger DD children. However, children in DS group demonstrated a unique trend, there was no significant difference between younger DS children and older DS children in the production of protowords and words (Table 20, Figure 18). Comparable use of protowords and words which are symbolic forms of vocal behaviours means that children with DS in the present study showed poorer usage of symbolic forms. This finding was supported by the fact that comparison across groups revealed that older DS children had poorer scores than older TD children on these measures. Hence it can be inferred that, children with DS had deficits in the usage of symbolic communication behaviours in the vocal mode. Poorer symbolic skills in children with DS have also been reported in the literature (Ramruttun & Jenkins,1998). Since these children differed from the other clinical group, it can be speculated that poorer symbolic representational abilities is a behavioural phenotype of children with DS. It has been reported that children with DS have poorer expressive language abilities (Sigman et al. 1999) and these deficits are linked to a relatively slow development of articulatory skills in children with DS (Kumin 2001).

Hence the Null Hypothesis pertaining to vocal behaviours which stated that there is no significant difference in the median percent occurrence of subcategories of vocal behaviours between the two age groups of children is rejected.

Comparison of median percent occurrence of vocalization and protowords across groups in the younger age group in all children across the three groups revealed

similar frequency of occurrence on these two vocal behaviours (Table 21, Figure 19). However, in word production, younger children in typical group performed significantly better than younger children in both clinical groups. There was no significant difference in the median percent occurrence of words between the two clinical groups. Studies have reported that rate of acquisition of new words in children with DS is slower than that of TD children (Miller 1999). Children with DS demonstrate lexical retardation consequent to articulatory difficulties (Miller 1999). Also, semantic development is delayed in proportion to general cognitive impairment. However, the overall speech progression parallels TD children (Dodd & Leahy 1989). Rondal and Edwards (1997) reported a positive linear relation between early lexical development (both productive and receptive) and mental age (MA).

Comparison of median percent occurrence of vocalization in the older age group across all children in the three groups revealed similar scores on vocalization (Table 21, Figure 20). Older children with DS showed significantly poorer scores on both protowords and words. It was also observed that older children with DS showed poorer scores than that of children with DD. Older children in DD group revealed poorer scores in protowords and words than older children in TD group. That is, the DS children in the present study presented least skills in symbolic representation through vocal mode. It is interesting to note that though the children with DS were matched for the mental age with the TD children, they had poorer scores on production of protowords and words. As discussed earlier, one of the influencing factors for this trend of results may be attributed to the articulatory difficulties (Miller, 1999).

Hence the Null Hypothesis pertaining to vocal behaviours which stated that there is no significant difference in the median percent occurrence of subcategories of vocal behaviours across the three groups of children is rejected.

Results imply that presymbolic vocal behaviours are comparable not only across groups but between age as well, in both clinical and typical children. The difference in vocal behaviours exists in the symbolic forms. Whereas younger DD and younger DS children demonstrated significant deficits in production of words, older DS children had deficits in production of words. The deficits in symbolic representational skills with slow development of articulatory skills in children with DS, makes them the most vulnerable population to have expressive language deficits and also symbolic skills. This in turn influences their overall development in social and academic learning abilities. In addition, it should not be ignored that though children with DD revealed better skills than DS children in symbolic vocal behaviours, they still showed poorer scores than TD children. So, early identification and early intervention of symbolic vocal behaviours form the prime focus in these two clinical groups, depending on their individual profile of strengths and weaknesses in these areas.

The common trend of distribution of vocalization, protowords and words in all children irrespective of age and groups was that, vocalization occurred to the maximum extent, followed by protowords and words. There was no significant difference in the occurrence of words and protowords. This trend implies that children in the age considered as predominant users of vocalization, a form of presymbolic communication behaviour. The symbolic forms of vocal behaviours, use of

protowords and words form a minor portion of the vocal repertoire of children between 6 to 18 months age, irrespective of whether typical group or clinical group.

Section 2: Communication Behaviours of the Mothers

1) Maternal Gestures

The gestures used by mothers were classified as Deictic gestures, conventional gestures, and representational gestures. Deictic gestures were considered as Intentional presymbolic gestures (IPS), and conventional and representational gestures together were considered as Intentional symbolic gestures (IS). These two subcategories of gestures were expressed in median percent occurrence.

On comparing mothers of younger age group and older age group children with respect to the groups, the following results were found. Mothers of younger TD children had greater median percent occurrence on IPS gestures than mother of older TD children. Mothers of younger TD children had poorer median percent occurrence on IS gestures than mothers of older TD children (Table 26, Figure 21). A similar trend of maternal gestures was reported in Italian mothers of TD children in a study by Iverson, Caprici, Longobardi, and Caselli (1999). The study revealed that the mean frequency of deictic gestures produced by mothers (M=41.0) of children in younger age group (M=16 months) was greater than mean frequency of deictic gestures produced by mothers (M=39.67) of children in the older age group (M= 20 months). Similarly, the mean frequency of conventional gestures used by mothers of older age group (M=34) was greater than that of mothers of the younger age group (M=29.17). The mean frequency of representational gestures used by mothers of older age group (M= 6) was greater than that of mothers of the younger age group (M=4).

It may be noted that in the present study, deictic gestures were considered as Intentional presymbolic (IPS) gestures. Conventional and representational gestures were considered as intentional symbolic (IS) gestures. The difference between the study by Iverson et al. (1999) and the present study is in terms of the population considered. The study by Iverson et al. (1999) considered only TD children with a mean age of 16 months and 20 months. The Present study considered three groups of children (TD, DD, and DS) in younger (6-12 months) and older age groups (12-18 months). Thus, it can be inferred that deictic maternal gestures directed to younger TD children are greater than that directed to older TD children. The frequency of occurrence of combined conventional and representational gestures together that were directed towards older TD children is significantly greater than that directed to younger TD children.

Iverson et al. (1999) stated that the maternal gestures are sensitive to the developmental level of children and also reported similar findings in study carried out on American mothers by Bekken (1989). This trend is not only followed by mothers in Indian culture, but also by mothers in American and Italian cultures. To further examine these observations and its application to the present study, when the trend in the use of IPS and IS gestures by children was considered and compared between the two age groups of TD children, it was observed that older TD children used more IS gestures than younger TD children. However, no significant difference was found in the use of IPS gestures between the two age groups of TD children, thus supporting the explanation by Iverson et al. (1999).

In both the clinical groups, there was no significant difference in the median percent occurrence of IPS gestures and IS gestures used by mothers in the younger

age group and older age group (Table 26, Figure 23). Similar results were reported by Ozcaliskan and Golder-Meadow (2005). These authors carried out a longitudinal study on TD children and their mothers. Maternal gestures were explored when the children were 1.2; 1.6 and 1.10 years of age. Results revealed that there were no significant changes in the use of deictic, conventional and representational gestures used by the caregivers, across the three data points. The authors attributed the constancy in the use of gestures at the three data points to greater reliance of caregivers on verbal communication than gestures. The data revealed that only 10% of the communication repertoire of the caregivers was gestures and that children's repertoire of gestures and speech increased over age.

Comparable frequency of use of IPS and IS gestures by mothers of younger and older children in clinical groups reflects the general tendency of the mothers to simplify their communication by using simpler gestures more frequently. This inference is drawn based on the observation of Bekken (1989) who compared child-directed speech and adult directed speech and discussed that analogous to motherese in speech, there exists a gestural motherese. Hence, it is observed that mothers of typical children in the two age groups differed significantly in the use of both IPS and IS gestures. However, both the clinical groups did not follow this trend.

Mothers of children in the younger age group, showed no significant difference in the median percent occurrence between mothers of younger TD children, mothers of younger DD children and mothers of younger DS children, implying similar median percent occurrence of IPS and IS gestures (Table 27 Figure 23). In the older age group, mothers of older DD children revealed a significantly greater median percent occurrence of IPS gestures than mothers of older TD children. Mothers of

older DD children showed significantly lower median percent occurrence on IS gestures than mothers of older TD children. Comparable amount of IPS and IS gestures were produced by mothers of older typical children and mothers of older DS children.

Comparison of the results between mothers of older DS children and mothers of TD children contradict with that reported by Iverson, Longobardi, Spanpinato, and Caselli (2006), who studied maternal gestures in TD children matched with the expressive language of children with DS with a mean mental age of 22.4 months. The maternal gestures were classified into deictic gestures, conventional gestures, representational gestures, and emphatic gestures. Comparison between gestures of TD mothers and mothers of children with DS revealed that DS mothers used significantly greater deictic gestures than TD mothers. Conventional and representational gestures were used by mothers of TD children to a greater extent than mothers of DS children. The authors reasoned the differences by explaining that mothers of children with DS adjusted their communication to the developmental status of their child. In the present study, this trend was seen between mothers of older DS children and mothers of older TD children.

No significant difference observed in the median percent occurrence of IPS gestures and IS gestures between mothers of older TD children and mothers of older DS children contradict does not agree with the reported findings by Iverson, Longobardi, Spanpinato, and Caselli (2006). It is interesting to note that there was no significant difference in the median percent occurrence of IPS gestures and IS gestures between mothers of DD and DS in the older age groups (Table 28, Figure 24).

Comparison of median percent occurrence of IPS and IS gestures within the groups revealed the main effect of types of gestures was present (Table 29). There was no interaction effect between the groups and age on types of gestures or any of the combinations. Thus, the common trend that was followed by all mothers irrespective of their children's age group or groups was that the median percent occurrence of IPS gestures was significantly greater than that of IS gestures. These results are similar to that reported by Iverson et al. (1999); Ozcaliskan and Golden Meadow (2005); and Iverson et al. (2006), who reported that mothers used deictic gestures to the maximum extent followed by conventional gestures and representational gestures.

Hence, the Null Hypothesis pertaining to the use of maternal gestures which stated that there is no significant difference in the median percent occurrence of subcategories of maternal gestures between the two age groups and across the three groups of mothers was rejected.

2) Child-Directed Speech

Comparison of child-directed speech between the two age groups of the three groups of mothers, revealed that mothers of older TD children showed a significantly greater median percent occurrence of child-directed speech than mothers of younger TD children; Mothers of older DD children showed significantly greater median percent occurrence of child-directed speech than mothers of younger DD children (Table 31, Figure 21). It is reported that Joint attention is the key factor in the entire process of the children learning from child-directed speech (Tomasello, 1988; Tomasello & Farrar, 1986). As observed in the section on eye gaze orientation, with age, the median percent occurrence of dual and triadic eye gaze orientation improved, indicating better joint attention with age. This may be considered as an influencing

factor for the mothers to have more child-directed speech with older children than with the younger ones.

Comparison between mothers of younger DS children and mothers of older DS children revealed no significant difference in the median percent occurrence of speech (Table 31, Figure 22). The greater frequency of child-directed speech in mothers of older TD children and mothers of older DD children can be considered as the mother's responsiveness to the children's improved joint attention in the older age group. It has been reported that joint attention and nature of the mother's responsiveness has a critical role in the whole process of communication development of the child. Mother's not only used child-directed speech for referring to objects that were within the joint attention of the children but also talked about objects that were not present. It is also reported that mothers use child-directed speech to describe specific features of the object that is shared with child's joint attention (Tomasello, 1988; Tomasello & Farrar, 1986; Akhtar, Dunham & Dunham, 1991). Bruner (1999) argued that the progression from primary to secondary inter subjectivity as indicated by children's transition from dyadic to triadic engagements are facilitated through "narrative scaffolding" where caretakers treat infants as if "they have things in mind". Higher frequency of occurrence of child-directed speech by mothers of children in the older age group, is in line with the results reported by Iverson et al. (2006).

However, the results of the present study contradict the findings reported by Ozcaliskan and Golden-Meadow (2005), who reported that the caregivers remained relatively stable in their speech, showing no significant differences across the three data points at 1.2; 1.6 and 1.10 years in their use of communicative acts containing speech word tokens or word types. The difference in the results reported by

Ozcaliskan and Golden-Meadow (2005) and the present study may be attributed to the age range considered in the studies. While the present study considered children of mental age between 6-12 months and 12-18 months, the study by Ozcaliskan and Golden-Meadow 2005, considered children in the higher age groups.

Comparison across the three groups of mothers revealed no significant differences in the median percent occurrence of child-directed speech (Table 32, Figure 25). From the results on child-directed speech, it can be inferred that irrespective of age and groups, all mothers in the present study used comparable amount of child-directed speech in the mother-child interaction context.

The similarity in the child-directed speech of mothers of TD children, DD children and DS children can be explained by results reported by Mahoney (1988), who considered children with intellectual disability in three age groups: 1 year, 2 year and 3 years. The results indicated that patterns of mother-child communication relied on how children responded to their mothers' communication. These patterns were related to children's level of communicative functioning. In the present study, considering that there was no main effect of groups on production of gestures by children and no main effect of groups on vocalization by children, it implies that as the children were mental age-matched, the communication behaviours exhibited in terms of gestures and vocalization did not differ in terms of the frequency occurrence; and as a consequnce, the child-directed speech also did not show differences with respect to the groups.

Hence the Null Hypothesis which stated that there is no significant difference in the median percent occurrence of child-directed speech across groups is rejected.

Chapter 6

SUMMARY AND CONCLUSION

The study aimed to compare the median percent occurrence of presymbolic communication behaviours in children and corresponding communication behaviours in mothers in dyadic communication context of free play, using a descriptive analytical approach. Participants of the study included children in two age groups (>6 to ≤12 months and >12 to ≤18 months) in each of the three groups: Typically developing children (TD), Children with intellectual disability due to developmental disorders (DD) and Children with intellectual disability due to Down Syndrome (DS). The mental age (MA) of the children in the clinical groups of DD and DS were matched with the chronological age (CA) of TD children.

The video recordings of each mother-child dyad was annotated and analyzed for the percentage occurrences of the following in children and mothers in the dyads:

Section 1: Communication behaviours in children, which included analyses of three types of eye gaze orientations (single, dual and triadic); two types of gestures [Preintentional Presymbolic (PIPS) gesture, Intentional Presymbolic (IPS) gesture, and Intentional symbolic (IS) gesture]; and three types of vocal behaviours (Vocalization, Protoword, Word) that occurred in dyadic communication context.

Section 2: Communication behaviours of mothers, which included analyses of maternal gestures [Intentional Presymbolic (IPS) gesture, Intentional Symbolic (IS) gesture] and child-directed speech in mothers during dyadic communication context.

The percentage occurrences of each of the communication behaviours of children were compared: (a) Between children in the two age groups (>6 to ≤12 months and >12 to ≤18 months) in each group (TD, DD and DS) and (b) Across the three groups of children (TD, DD and DS groups). The percentage occurrences of the communication behaviours of mothers were compared: (a) Between the mothers of children in the two age groups (>6 to ≥12 months and >12 to ≤18 months) in each group (TDM, DDM, and DSM). (b) Across the three groups of mothers [Mothers of TD children (TDM), Mothers of children with DD (DDM) and Mothers of children with DS (DSM)]

The significant findings of the study were as follows:

Section 1: Communication behaviours in children

1) Eye gaze orientation behaviours

a) All children irrespective of groups or age revealed significantly higher single eye gaze orientation followed by dual eye gaze orientation and lastly triadic eye gaze orientation. This indicated that passive joint attention which is a subset of single eye gaze orientation, formed a significant portion of the mother-child interaction context.

b) Comparison across groups revealed that the younger children in DS group (>6 to ≤12 months) and the older children in DD group (>12 to ≤18 months) revealed significantly poorer scores on dual and triadic eye gaze orientation. From these individual trends shown by the clinical groups, it was inferred that there is a significant deficit in the joint attention skills in both the clinical population. On comparison, this deficit was more pronounced in DD group than in DS group.

c) Comparison of single, dual and triadic eye gaze orientation between the age groups revealed different trends of development in the three groups of children. Younger TD children (>6 to ≤12 months) revealed significantly higher scores on single eye gaze orientation than older TD children (>12 to ≤18 months). This trend was not followed by both the clinical groups considered. Both the clinical groups showed equal percentage occurrence scores on single eye gaze orientation.

d) On dual and triadic eye gaze orientation, older TD children (>12 to ≤18 months) revealed higher scores than younger TD children (>6 to ≤12 months). This trend was unique with respect to the TD group. The DD group did not differ with respect to dual or triadic eye gaze orientation with age. The older DS children (>12 to ≤18 months) revealed significantly greater scores in triadic eye gaze orientation than the younger DS group (>6 to ≤12 months).

e) The results of the present study implies that the measures of dual and triadic interactions in children can act as a clinical indicators to comment about the joint attention skills in young children who are at the presymbolic levels of communication.

2) Gestures

a) The distribution and trend observed in the percentage occurrence scores of PIPS, IPS and IS gestures was consistent across groups. The PIPS gestures occurred more frequently than the IPS gestures, with the least scores seen for IS gestures.

b) The trend observed for the distribution of PIPS IPS and IS gestures was similar for older TD group (>12 to ≤18 months) and older DS group (>12 to ≤18 months).

c) The DS group did not show any gestural advantage (as reported by earlier studies) when compared to TD children. Neither was there any significant difference in the gestures observed in DD and DS groups.

d) The emergence of gestures in clinical groups seemed to parallel the development of communication skills.

e) The TD children revealed a unique trend wherein increased scores on IS gestures and reduced scores on PIPS gestures were observed with age. This implied that there was a proportional increase in the symbolic gestures with age and a proportional reduction in the use of PIPS gestures with age.

f) The use of IPS gestures, which represented the deictic gestures was consistent in both age groups; in the typical group as well as the clinical groups.

g) Out of the two clinical groups, the DD group partially followed the trend seen in typical group which included higher scores on IS gestures with age and no change in the PIPS scores with age.

h) With age, the DS group did not reveal any change in the three subcategories of gestures.

i) Comparison across the three groups of children revealed no significant difference in the scores on PIPS, IPS and IS gestures.

3) Vocal behaviours

a) The vocal behavioural repertoire in children of all the three groups comprised of vocalization, protowords and words. Irrespective of the age and group, the most frequently occurring type of vocal behaviour was vocalization. There was no significant differences between the median percent occurrences of protowords and words.

b) Comparison between typical and clinical groups did not reveal significant differences in the scores on vocalization, indicating that all the three groups of children used vocalization to a similar extent.

c) The children in both the clinical groups demonstrated significant deficits in the production of protowords and words. These two vocal behaviours reflect the symbolic abilities of children in the vocal mode and deficits in this mode indicates deficits in the language of the children.

d) Comparisons between age groups revealed that older TD children (>12 to ≤18 months) revealed better scores on Protowords and words.

e) There was no significant difference between the younger (>6 to ≤12 months) and older groups (>12 to ≤18 months) of DD and DS children in the use of protowords and words.

f) The results on vocal behaviours in typical and clinical groups implied that the clinical groups revealed deficient production of symbolic vocal behaviours (protowords and words) reflecting that their communication is still in the presymbolic form.

Section 2: Communication behaviours in mothers

1) Maternal Gestures

a) The gestures used by mothers comprised of IPS gestures and IS gestures. All the three groups of mothers used IPS gestures to a significantly greater extent than the IS gestures.

b) Comparison of mother's gestures across groups revealed no main effect of groups. However, the mothers of older DD group (>12 to ≤18 months) revealed greater use of IPS gestures than mothers of older TD children (>12 to ≤18 months). In addition, it was also observed that mothers of older DD children revealed significantly poorer production of IS gestures than mothers of older TD group. In other words, mothers of DD group were different from mothers of DS group.

c) There was no significant difference in the scores of IPS and IS gestures of mothers of DS children compared to TD mothers.

d) Comparison between age groups of mothers of typical group and clinical group revealed that only mothers of typical children showed reduced IPS gestures and increased IS gestures with age. This trend was not observed in mothers of DD and DS clinical groups.

2) Child directed Speech

a) The mothers across the three groups demonstrated same percentage use of child-directed speech.

b) Mothers of older TD children (>12 to ≤18 months) showed higher scores than mothers of younger TD children (>6 to ≤12 months). The same trend was observed in mothers of DD children.

c) Mothers of DS children revealed similar percent occurrence of child-directed speech with respect to younger and older groups of children.

To conclude, the present study revealed that children in the clinical groups (children with DD and DS) demonstrated deficits in joint attention skills when compared to the TD children. Joint attention has a crucial role in the development of language and symbolic representation skills in children, especially in socio-cultural domain. Deficits in symbolic skills are often evidenced in the clinical groups. The IS gestures addressed in this study represents the symbolic skills and is comprised of conventional and representational gestures along with protowords and words. These skills were deficient in the clinical groups considered in the study. The measures of presymbolic behaviours addressed in the present study included PIPS gestures, IPS gestures and vocalization. Comparison of presymbolic skills in the clinical and typical groups revealed no significant difference between these groups. Hence, the intact potential of presymbolic communication behaviours in children belonging to clinical groups could be considered as the strength of these children based on which future behaviours can be worked on. In contrast, the study also revealed deficits in symbolic skills of children in the clinical groups. Thus, early intervention focused on shaping the presymbolic communication behaviours (which serve as the base) for developing higher symbolic skills in children in clinical groups needs to be considered.

Implications of the study

1. The study provides insight into the development of presymbolic communication behaviours in typically developing children in the age range of 6 to 18 months.
2. The information obtained on typically developing children will help in identifying the delay if any in the presymbolic communication behaviours of children with intellectual disability due to Developmental delay (DD) or Down syndrome (DS) in the mental age range of 6 to 18 months,.
3. The outcome of the study provides insight into similarities and differences in the communication behaviours of mothers of typically developing children, children with intellectual disability due to developmental disabilities (DD)and children with intellectual disability due to Down Syndrome (DS).

Limitations of the Study

1. Since purposive sampling technique was used in the study, generalization of the results to population from different geographical, language and cultural origins is limited.
2. A single digital camera was used for video recording and hence capturing behavioural interactions of the mother child dyads from multiple angles was not possible.
3. Six children in the DD group had hypotonia of the upper limb. All children with DS had generalized hypotonia. These motor impairments might have influenced the results.

Future directions

1. The study can be extended to include children with Autism spectrum disorders, as these children have significant difficulties in presymbolic communication behaviours.
2. The study can be replicated on TD infants below 6 months of age, in order to look for early emerging presymbolic communication behaviours.

REFERENCES

Abbeduto, L., & Murphy, M. M. (2004). Language and communication in fragile x syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, 7, 45–55.

Abrahamsen, A., Cavallo, M., & McCluer, J. (1985). Is the Sign Advantage a Robust Phenomenon? From Gesture to Language in Two Modalities. *Merrill-Palmer Quarterly, 31*(2), 177-209. Retrieved from http://www.jstor.org/stable/23086274

Adolph, K.E., Karasik, L.B., & Tamis-LeMonda, C.S. (2010). Motor skill. In M.H. Bornstein (Ed.), Handbook of cultural developmental science (pp. 61–88). New York: Taylor and Francis.

Aeir. J.D. & Wilcox, J., 2006. Cross-linguistic comparison of negative evidence in English, Hindi and Tamil. In: 2006 ASHA convention. 16-18 November. Miami, Florida, USA. Available

Aggarwal, S., Bagula, V. R., Mandal, K., Kumar, R., & Phadke, S. R. (2012). Aetiologic spectrum of mental retardation & developmental delay in India. *Indian Journal of Medical Research*, (September), 436–444.

Ainsworth, M. (1973). The development of infant-mother attachment. In B. Caldwell & H. Ricciuti (Eds.), Review of child development research (Vol. 3). Chicago: University of Chicago Press.

Akhtar, N., Dunham, F., & Dunham, P., (1991). Directive interactions and early vocabulary development: The role of joint attentional focus. *Journal of Child Language, 18(1),* 41-49. doi:10.1017/S0305000900013283

Astington, J.W., & Jenkins, J. (1995). Theory ofmind devel- opment and social understanding. Cognition and Emo- tion, 9, 151–165

Bakeman, R., & Adamson, L. B. (1984). Coordinating Attention to People and Objects in Mother-Infant and Peer-Infant Interaction. *Child Development*, *55*(4), 1278. https://doi.org/10.2307/1129997

Baron-Cohen, S. (1995). The eye detection detector and the shared attention mechanism: Two cases for evolutionary psychology. In C. Moore & P. Dunham (Eds.), *Joint attention: Its origins and role in development* (pp. 41-60). Hillsdale, NJ: Erlbaum.

Basavaraj, V., & Venkatesan, S. (2009). *Ethical guidelines for bio-behavioural research involving human subjects*. Mysore: All India Institute of Speech and Hearing

Basavarj, V., & Venkatesan. (2009).

Bates, E. (1976). Language and context. New York: Academic Press.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). The emergence of symbols: Cognition and communication in infancy. New York: Academic Press

Bates, E., Camaioni, L. & Volterra, V. (1975). The acquisition of performatives prior to speech. Merril Palmer Quarterly 21, 205-26.

Bekken, K. (1989). Is there motherese in gesture? Unpublished doctoral dissertation, The University of Chicago, Chicago, IL.

Bello, Arianna, Olga Capirci, & Virginia Volterra (2004). Lexical production in children with Williams syndrome: Spontaneous use of gesture in a naming task. *Neuropsychologia, 42,* 201–213.

Berger, J., & Cunningham, C. C. (1981). The development of eye contact between mothers and normal versus Down's syndrome infants. *Developmental Psychology*, *17*(5), 678–689. https://doi.org/10.1037/0012-1649.17.5.678

Bernstein, B. (1961). Social class and linguistic development. In A.H.Halsey, J.Flaud and C.A.Anderson (eds) Education, Economy and Society. London: Collier-Macmillan Ltd.

Bernstein, B. (1971). Class, Codes and Control Volume 1: Theoretical Studies Towards a Sociology of Language. London: Routledge & Kegan Paul.

Bernstein, V.J., Harris, E.J., Long, C.W., Iida, E. and Hans, S.L.,(2005). Issues in the multi-cultural assessment of parent-child interaction: An exploratory study from the starting early starting smart collaboration. *Applied developmental psychology. 26 (3),* 241–275.

Beuker, K. T., Rommelse, N. N. J., Donders, R., & Buitelaar, J. K. (2013). Development of early communication skills in the first two years of life. *Infant Behavior and Development, 36,* 71-83.

Bornstein, M.H. (2010). Handbook of cultural developmental science. New York: Psychology Press.

Brady, N. C., Fleming, K., Thiemann-Bourque, K., Olswang, L., Dowden, P., Saunders, M. D., & Marquis, J. (2012). Development of the communication complexity scale. *American Journal of Speech-Language Pathology, 21,* 16-28.

Bruner, J. (1975a). From communication to language. Cognition, 3, 255-287.

Bruner, J. (1975b). The ontogenesis of speech acts. *Journal of Child Language, 2,* 1-20

Bruner, J. (1977). Early social interaction and language acquisition. In H. R. Schaffer (Ed.), Studies in mother-infant interaction. New York: Academic.

Bruner, J. (1978). The role of dialogue in language acquisition. In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), *The child's conception of language: Springer series in language and communication* (pp. 242-256). New York: Springer-Verlag.

Bruner, J. (1983). Child's talk: Learning to use language. New York: Norton.

Bruner, J. S. (1981). The social context of language acquisition. L*anguage & Communication, 1,* 155–178.

Bruner, J. S. (1999). The intentionality of referring. In P. D. Zelazo, J. W. Astington, & D. R. Olson (Eds.), Developing theories ofintention: Social understanding and self-control (pp. 329–339). Mahwah, NJ: Erlbaum.

Buium N, Rynders J, Turnure J. Early maternal linguistic environment of normal and non-normal language-learning children. *American Journal of Mental Deficiency*. 1974; 79:52–58.

Butcher, Cynthia & Susan Goldin-Meadow (2000). Gesture and transition from one- to two- word speech: When hand and mouth come together. In David McNeill (Ed.), Language and gesture (pp. 235–258). Cambridge: Cambridge University Press.

Butterworth, G. (1991). The ontogeny and phylogeny of joint visual attention. In A. Whiten (Ed.), Natural theories of mind. Evolution, development, and simulation of everyday mindreading. Oxford: Blackwell

Bzoch, K., & League, R. (1971). Receptive-expressive emergent language scale. Gainesville, FL: Anhinga Press

Calandrella, A. M., & Wilcox, M. J. (2000). Predicting Language Outcomes for Young Prelinguistic Children With Developmental Delay. *Journal of Speech, Language, and Hearing Research, 43*, 1061–1072.

Camaioni, L. (1993). The development of intentional communication: A re-analysis. In J. Nadel & L. Camaioni (Eds.), New perspectives in early communicative development. New York: Routledge.

Camaioni, L., Aureli, T., Bellagamba, F. & Fogel, A. (2003). A longitudinal examination of the transition to symbolic communication in the second year of life. *Infant and Children Development, 12*, 1–26.

Capirci, Olga, Jana M. Iverson, Elena Pizzuto, & Virginia Volterra (1996). Gestures and words during the transition to two-word speech. *Journal of Child Language, 3*, 645–675.

Capone, N. C., & Mcgregor, K. K. (2004). Gesture Development : A Review for Clinical and Research Practices. *Journal of Speech, Language, and Hearing Research*, *47*(February), 173–186.

Cardoso-Martins, C., Mervis, B., & Mervis, C. (1985). Early vocabulary acquisition by children with Down syndrome. *American Journal of Mental Deficiency*, *90*, 177–184.

Carpenter, M., Nagell, K., Tomasello, M., Butterworth, G., & Moore, C. (1998). Social Cognition, Joint Attention ad Communicative Competence from 9 TO 15 Months of Age. *Monographs of the society for research in child development*, *63*(4), 179. https://doi.org/10.2307/1166214

Carpenter, R. L., Mastergeorge, A. M., & Coggins, T. E. (1983). The acquisition of communicative intentions in infants eight to fifteen months of age. *Language and Speech*, 26, 101–116.

Carr J. (1995) Down's Syndrome: Children Growing Up. Cambridge University Press, Cambridge. Carvajal

Caselli, m. C. & Casadio, p., 1995, Il primo vocabolario del bambino [The Child's Early Vocabulary] (Milan: Franco Angeli).

Caselli, M. C., Longobardi, E., & Pisaneschi, R. (1997). Gesti e parole in bambini con sindrome di Down. *Psicologia Clinica dello Sviluppo, 1*, 45–63

Caselli, M. C., Vicari, S., Longobardi, E., Lami, L., Pizzoli, C., & Stella , G., 1998, Gestures and words in early development of children with Down syndrome. *Journal of Speech, Language, and Hearing Research, 41,* 1125–1135

Chan, J. B., & Iacono, T. (2001). *Gesture and Word Production in Children with Down Syndrome*. *17*(June), 73–87.

Chapman, Pt. (1981). Exploring children's communicative in- tents. In J. Miller (Ed.), Assessing language production in children (pp. 111-136). Baltimore: University Park Press.

Chapman, R. S., 1995, Language development in children and adolescents with Down syndrome. In P. Fletcher and B. MacWhinney (eds), The Handbook of Child Language (Oxford: Blackwell), pp. 641–663.

Chomsky, N. (1957). *Syntactic Structures*. The Hague: Mouton.

Chomsky, N. (1959). Review of 'Verbal Behavior' by B.F.Skinner. *Language*, 35,

Chomsky, N. (1965). Aspects of the theory of syntax. Cambridge, MA: MIT Press.

Christiansen, M. H., & Charter, N. (1999). Toward a con- nectionist model of recursion in human linguistic performance. *Cognitive Science, 23(2)*, 157–205

Clark, Herbert H. (1996). Using language. Cambridge: Cambridge University Press

Cole, M. (1996). Cultural psychology: A once and future discipline. Cambridge, MA: Harvard University Press

Crain, W. (1992). *Theories of development: Concepts and applications* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Crais, E. R., Watson, L. R., & Baranek, G. T. (2009). Use of Gesture Development in Profiling Children's Prelinguistic Communication Skills. *American Journal of Speech-Language Pathology • Vol. 18 • 95–108* •, *18*(February), 95–109.

Crais, E., Douglas, D., & Campbell, C. (2004). The intersection of the development of gestures and intentionality. *Journal of Speech, Language, and Hearing Research*, 47, 678-695

Crimmins, D. B., Gothelf, C. R., Rowland, C., Stillman, R. D., Linam, A., & Williams, C. (1995). Communication. In Kathleen Mary Huebner, Jeanne Glidden Prickett, Therese Rafalowski Welch, & Elga Joffee. *Hand in hand: Essentials of communication and orientation and mobility for your students who are deaf-blind. Voume I* (pp. 159- 182). New York: AFB press.

Dodd, B., Leahy, J. (1989) Phonological disorders and mental handicap. In M. Beveridge, G. Conti-Ramsden, Y. Leudar (eds) L*anguage and Communication in Mentally Handicapped People*. London: Chapman & Hall, 35–56.

Dunst, C. J. (1988) Stage transitioning in the sensorimotor development of Down's syndrome infants. *J Mental- Defiency Research*, 32, 405–410.

Dunst, C. J. (1990) Sensorimotor development of infants with Down syndrome. In D. Cicchetti, M. Beeghly (eds) (1990) Children with Down Syndrome: A Develop- mental Approach. Cambridge UK: Cambridge University Press, 180–230.

Dykens, E. M. (1995). Measuring behavioral phenotypes: Provocations from the "new genetics." *American Journal on Mental Retardation, 99*, 522–532.

Engle, Randi A. (1998). Not channels but composite signals: Speech, gesture, diagrams, and object demonstrations are integrated in multimodal explanations. In Morton Ann Gerns- bacher & Sharon J. Derry (Eds.), Proceedings of the 20th Annual Conference of the Cognitive Science Society (pp. 321–326). Mahwah, NJ: Erlbaum.

Fantz, R., Fagan, J. & Miranda, S. (1975). Early visual selectivity as a function of pattern variables, previous exposure, age from birth and conception, and expected cognitive deficit. In L. Cohen & P. Salapatek (Eds.), *Infant Perception*. New York: Academic Press.

Fenson, L., Dale, P. S., Reznick, J. S., Thal, D., Bates, E., Hartung, J. P., Pethick, S., & Reilly, J. S. (1993). The MacArthur Communicative Development Inventories: User's guide and technical manual. San Diego: Singular Publishing Group.

Fernald, A., Taeschner, T., Dunn, J., Papousek, M., de Boysson-Bardies, B., and Fukui, I. (1989) A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants, *Journal of Child Language 16*, 477–501

Fidler DJ. 2006. The emergence of a syndrome- specific personality profile in young children with Down syndrome. *Downs Syndrome Reseach and Practice*. 10:53–60.

Fishler, K., & Koch, R. (1991) Mental development in Down syndrome mosaicism. *Am J Ment Retard, 96,* 345–351.

Flavell, J. H. (1985). *Cognitive development* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Franco, F., & Butterworth, G. (1996). Pointing and social aware- ness: Declaring and requesting in the second year of life. *Journal of Child Language, 23,* 307–336.

Franco, F., & Wishart J. (1995). The use of pointing and other gestures by young children with children with Down syndrome. *American Journal of Mental Retardation, 100(2),* 160–182

Furrow, D., Nelson, K., & Benedict, H. (1979). Mothers' speech to children and syntactic development: Some simple relationships. *Journal ofChild Language, 6,* 423–442

Furth, H. G. (1994). Representation in Piaget's theory. In N. V. Chavchavadze, G. Nodia & P. Peachey (Eds.), *National identity as an issue of knowledge and morality* (pp. 231-236). Washington, D.C: Paideia Press.

Gergely, G.,Nadasdy, Z., Csibra, G.,& Biro, S. (1995). Taking the intentional stance at 12 months ofage. Cognition, 56, 165–193.

Ginsberg, H. P., & Opper, S. (1988). Piaget's Theory of Intellectual Development, 3rd ed. Englewood Cliffs, NJ: Prentice-Hall.

Goldfield, B. (1990). Pointing, naming, and talk about objects: Referential behavior in children and mothers. First Language, 10, 231–242. doi:10.1177/014272379001003004

Goldin-Meadow S, & Butcher C. 2003. Pointing toward two-word speech in young children. In Pointing:Where Language, Culture, and Cognition Meet, ed. S Kita, pp. 85–107. Mahwah, NJ: Erlbaum Goldin-Meadow

Goldin-Meadow S, Goodrich W, & Sauer E, Iverson JM. 2007a. Young children use their hands to tell their mothers what to say. *Dev. Sci. 1, :*778–85

Goldin-Meadow, S. (2003). The Resilience of Language. New York: Psychology Press.

Goldsmith, D. F., & Rogoff, B. (1997). Mothers' and toddlers' coordinated joint focus of attention: Variations with maternal dysphoric symptoms. Developmental Psychology, 33, 113–119.

Goswami, U. (1998). *Cognition in children*. Hove: Psychology Press.

Greenwald, C., & Leonard, L. (1979). Communicative and sensorimotor development of Down's syndrome children. *American Journal of Mental Deficiency, 84,* 296-303.

Grieser, D. L., & Kuhl, P. (1988). Maternal speech to infants in a tonal language: Support for universal prosodic features in motherese. *Developmental Psychology, 24,* 14- 20.

Grynszpan, O., Martin, J.-C., & Oudin, N. (2019). On the annotation of gestures in multimodal autistic behaviour.

Guazzo, G., M. (2006). Learning Difficulties in Down Syndrome. In J. A. Rondal & J. Perera (Eds.). Downs syndrome: neurobehavioural specificity. (pp. 153-174). England: John Wiley & sons Ltd.

Gullber, M., & debot, Kees. (2010). *Gestures in Language Development*. Netherlands: john Benjamins B V

Harding, C. (1984). Acting with intention: A framework for examining the development of the intention to communi- cate. In L. Feagans, C. Garvey, & R. Golinkoff (Eds.), The origins and growth of communication (pp. 123–135). Norwood, NJ: Ablex

Harris, S., Kasari, C., & Sigman, M.D. (1996). Joint attention and language gains in children with Down syndrome. *American Journal of Mental Retardation, 100,* 608– 619

Harris,S,, N. G., Bellugi, U., Bates, E., Jones, W., & Rossen, M. (1997). Contrasting profiles of language development in children with Williams and Down syndromes. *Developmental Neuropsychology, 13,* 345–370

Hart, B., & Risley, T.R. (1995). Meaningful differences in the everyday experience of young American children. Baltimore, MD: Paul H Brookes Publishing.

Hauser-Cram, P., Warfi eld, M. E., Shonkoff, J. P., Krauss, M. W., Sayer, A., Upshurr, C. C. (2001) Children with disabilities: a longitudinal sudy of child development and parent well-being. Monogr Soc Res Child Dev, 66, 1–114.

Hodapp R. M., Evans D.W. & Gray F. L. (1999) Intellectual development in children with Down syndrome. *In: Down Syndrome: A Review of Current Knowledge* (eds J. A. Rondal, J. Perera & L. Nadel), 124–32. Whurr, London

Hodapp, R. M. (1997). Direct and indirect behavioral ef- fects of different genetic disorders of mental retarda- tion. *American Journal on Mental Retardation, 102,* 67–79

Hodapp, R. M., DesJardin, J. L., & Ricci, L. A. (2003) Genetic syndromes of mental retardation: should they matter for the early interventionist? *Infants and Young Children, 16,* 152–160.

Holland, D. C., & Valsiner, J. (1988). Cognition, symbols and Vygotsky's *Developmental psychology Ethos, 16(3),* 247-272**.**

Howes, C., & Tonyan, H. (1999). Peer relations. In L. Balter & C. S. Tamis-LeMonda (Eds.), Child psychology: A handbook of contemporary issues (pp. 143-157). Philadelphia, PA: Psychology Press. In A.M. Wetherby, S.F. Warren & J. Reichle (Eds.), Transitions in prelinguistic communication: Preintentional to intentional and presymbolic to symbolic (pp. 59-86). Baltimore: Paul H. Brookes

Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. Psychological Science, 16(5), 367-371

Iverson, J. M., Capirci, O., Longobardi, E., & Caselli, M. C. (1999). Gesturing in mother-child interactions. *Cognitive Development*, *14*(1), 57–75. https://doi.org/10.1016/S0885-2014(99)80018-5

Iverson, J. M., Longobardi, E., & Caselli, M. C. (2003). Relationship between gestures and words in children with Down ' s syndrome and typically developing children in the early stages of communicative development. *International Journal of Language & Communication Disorders*, *38*, 179–197. https://doi.org/10.1080/1368282031000062891

Iverson, J. M., Longobardi, E., Spampinato, K., & Caselli, M. C. (2006). Gesture and speech in maternal input to children with Down ' s syndrome. *International Journal of Language and Communication Disorders, 41*, 235–251. https://doi.org/10.1080/13682820500312151

Iverson, J.M. & Thal, D.J. (1998). Communicative transitions: There's more to the hand than meets the eye.

Iverson, J.M., & Thelen, E. (1999). Hand, mouth and brain: The dynamic emergence of speech and gesture. *Journal of Consciousness Studies, 6*, 19–40.

Kasari, C., Mundy, P., Yirmiya, N., & Sigman, M. (1990). Affect and attention in children with Down syndrome. *American Journal on Mental Retardation*, 95,55–67.

Kaye, K. (1982). *The mental and social life of babies*. Chi- cago: University of Chicago Press, 1982.

Kaye, K., & Fogel. (1980). The temporal structure of face-to-face communication between mothers and infants. *Developmental Psychology*, 16, 454–464.

Kendon, A. (2004). Gesture: Visible Action as Utterance. Cambridge: Cambridge University Press. Doi:10.1017/CBO9780511807572

Kim, S.K., Atkinson, D.R. and Yang, P.H., 1999. The Asian Values Scale: Development, factor analysis, validation, and reliability. *Journal of counselling psychology. 46 (3)*, 342–352

Kouri, T. (1989). How manual sign acquisition relates to the devel- opment of spoken language: A case study. Language, Speech, and Hearing Services in Schools, 20, 50–62.

Kumin, L. (2001) Speech intelligibility in individuals wi!th Down syndrome: a frame- work for targeting specifi c factors for assessment and treatment. *Down Syndrome Quarterly, 6*, 1–8.

L. A. Leavitt & D. B. Hall (Eds.), Social and moral development: Evidence on the toddler years (pp. 221–238). New Brunswick, NJ: Johnson & Johnson Pediatric Institute.

Labinowicz, E. (1980). The Piaget primer: Teaching, learning, teaching. Menlo Park, CA: Addison-Wesley

Labov, W. (1972). The transformation of experience in narrative syntax. In W. Labov, Language in the Inner City, 354-396. Philadelphia, Pennsylvania: University of Pennsylvania Press.

Labov, W. (1995). Can reading failure be reversed: a linguistic approach. In V.Gadsden and D.Wagner (eds) Literacy among African-American Youth: Issues in Learning, Teaching, and Schooling. Cresskill, N.J.: Hampton.

Legerstee, M. & Weintraub, J., (1997). The integration of person and object attention in infants with and without Down syndrome. *Infant Behavior and Development, 20*, 71–82.

Legerstee, M., & Fisher, T. (2008). Coordinated attention, declarative and imperative pointing in infants with and without Down syndrome: Sharing experiences with adults and peers. *First Language, 28*(3), 281–311. https://doi.org/10.1177/0142723708091045

Legerstee, M., Markova, G., & Fisher, T. (2007). The role of maternal affect attunement in dyadic and triadic communication. *Infant Behavior and Development, 30*(2), 296–306. https://doi.org/10.1016/j.infbeh.2006.10.003

Legerstee, M., Markova, G., & Fisher, T. (2007). The role of maternal affect attunement in dyadic and triadic communication. *Infant Behavior and Development, 30*(2), 296–306. https://doi.org/10.1016/j.infbeh.2006.10.003

Legerstee, M., Van Beek, Y. & Varghese, J. (2002). Effects of maintaining and redirecting infant attention on the production of referential communication in infants with and without Down syndrome. *Journal of Child Language, 29*(1), 23-48. doi:10.1017/S0305000901004895

Leslie, A. (1987). Pretense and representation: The origins of "theory of mind." Psychological Review, 94, 412-426

Leslie, A. M. (2002). Pretense and representation revisited In N. L. Stein & P. J. Bauer (Eds.), Representation, memory and development: *Essays in honour of Jean Mandler*. Mahwah, NJ: Lawrence Erlbaum.

Lillard, A. S., & Witherington, D. C. (2004). Mothers' behavior modifications during pretense and their possible signal value for toddlers. *Developmental Psychology, 40(1),* 95-113.

Lund, N. (2003). Language and thought. Ney York: Routledg Taylor & Francis group.

MacWhinney, B. (2004). A multiple process solution to the logical problem of language acquisition. *Journal ofChild Language, 31,* 883–914

Mahoney, G. (1988). Maternal communication style with mentally retarded children. *American Journal of Mental Retardation, 92,* 352-359.

Marcell, M., & Armstrong, V. (1982). Auditory and visual sequential memory of Down syndrome and nonretarded children. *American Journal of Mental Deficiency, 87,* 86–95.

Masataka N (1998) Perception of motherese in Japanese sign language by 6-month-old hearing infants. *Dev Psychol 34,* 241-246. doi:10.1037/0012-1649.34.2.241. PubMed: 9541776

Masur, E. F. (1983). Gestural development, dual-directional signaling, and the transition to words. *Journal of Psycholinguistic Research, 12*(2), 93–109. https://doi.org/10.1007/BF01067406

Masur, E.F. (1983). Gestural development, dual-directional signaling, and the transition to words. *Journal of Psycholinguistic Research*, 12(2), 93-109

McCollum, J.A., & Hemmeter, M.L. (1997). Parent-child interaction intervention when children have disabili- ties. In M.J. Guralnick (Ed.), *The effectiveness of early intervention* (pp. 249–268). Baltimore, MD: Brookes.

McCune, L., Kearney, B., & Checkoff, M. (1989). Forms and func- tions of communication by children with Down syndrome and nonretarded children with their mothers. In S. von Tetzchner, L. S. Siegel, & L. Smith (Eds.), The social and cognitive aspects of normal and atypical language development (pp. 113–127). New York: Springer-Verlag.

McDade, H. L., & Adler, S. (1980). Down syndrome and short-term memory impairment: A storage or retrieval deficit? *American Journal of Mental Deficiency, 84,* 561-567.

McLean, J., & Snyder-McLean, L. (1978). A transactional approach to early language training. Columbus, OH: Charles E. Merrill.

McNeill, D (1998). Speech and gesture integration. In Jana M. Iverson & Susan Goldin- Meadow (Eds.), *The nature and functions of gesture in children's communication* (pp. 11–27). San Francisco: Jossey-Bass.

McNeill, D. (1992). Hand and Mind: What Gestures Reveal About Thought. Chicago, IL: University of Chicago Press.

McNeill, David (2005). Gesture and thought. Chicago: University of Chicago Press

Miller, J. (1999). Profiles of language development in children with Down syndrome. In J. Miller, M. Leddy, & L. Leavitt (Eds.), Improving the communication of people with Down syndrome (pp. 11–40). Baltimore: Brookes.

Miller, J. F., 1987, Language and communication characteristics of children with Down syndrome. In S. Pueschel, C. Tingey, J. Rynders, A. Crocker and D. Crutcher (eds), New Perspectives on Down Syndrome (Baltimore: Paul Brookes), 233–262.

Moore, C, & Corkum, V. L. (1994). Social understanding at the end of the first year of life. Developmental Review, 14, 349-372.

Moore, C. (1996). Theories of mind in infancy. *British Journal of Developmental Psychology, 14,* 19-40.

Moore, C., & Dunham, P. (1995). *Joint attention: Its origins and role in development*. Hillsdale, NJ: Erlbaum.

Morissette, P., Ricard, M., & Gouin-Decarie, T. (1995).Joint visual attention and pointing in infancy: A longitudinal study of comprehension. *British Journal of Developmental Psychology, 13(2),* 163-177

Mundy, P., & Newell, L. (2007). Attention, Joint Attention, and Social Cognition. *Social Cognition*, *16*(January 2008), 269–274. https://doi.org/10.1111/j.1467-8721.2007.00518.x.Attention

Mundy, P., & Sigman, M. (1989). The theorectical implications of joint attention deficits in autism. *Development and Psychopathology*, 1, 173-183.

Mundy, P., Kasari, C., Sigman, M., & Ruskin, E., 1995, Nonverbal communication and early language acquisition in children with Down syndrome and in normally developing children. *Journal of Speech and Hearing Research, 38*, 157–167.

Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/bf02206861

Nicolosi, L., Harryman, E., & Kresheck, J. (1989). Terminology of Communication Disorders: Speech-Language- Hearing, 3rd ed. Baltimore: Williams & Wilkins.

Nielsen, M., & Christie, T. (2008). Adult modelling facilitates young children's generation of novel pretend acts. *Infant and Child Development*, 17(2), 151-162.

Ninio, A., & Bruner, J. (1978). The achievement and an tecedents of labeling. *Journal of Child Lan- guage, 1978, 5*, 1-15.

Ninio, A., & Snow, C. E. (1996). Pragmatic development. Boulder, Colorado: Westview Press. Oostra, B. A. (1996). FMR1 protein studies and animal model for fragile X syndrome. In R. J. Hagerman & A. C. Cronister (Eds.), Fragile X syndrome: Diagnosis, treatment, and research (2nd ed., pp. 193–209). Baltimore: Johns Hopkins University Press.

Nokony, A. (1978). Word and gesture usage by an indian child. In A. Lock (Ed.), Action, gesture and symbol: *The emergence of language* (pp. 291-308). London: Academic Press.

Ohr, P. S., & Fagen, J. W. (1994). Contingency learning in 9-month-old infants with Down syndrome. *American Journal on Mental Retardation*, 99, 74–84.

Opitz, J. M. (1985) Editorial comment: the developmental fi eld concept. *Am J Med Genet, 21,* 1–11.

Owen, R. E. (2012). *Language development: an introduction.* Boston: Pearson Education.Inc.

Owens, R.E. (2001) Language Development: an introduction (5th edn). Needham Heights, Mass: Allyn and Bacon.

Ozcaliskan, S., & Goldin-Meadow, S. (2005). Gesture is at the cutting edge of early language development. Cognition, 96, B101–B113.

Parten, M. B. Social participation among preschool children. *Journal of Abnormal and Social Psychology, 1932, 27,* 243-269.

Perera, J. (1999) People with Down syndrome: quality of life and future. In J. A. Rondal, J. Perera, L. Nadel (eds) *Down Syndrome. A Review of Current Know ledge*. London: Whurr Publishers, pp. 9–26.

Perera, J. (2004) Siblings in the family of a person with Down syndrome. In J. A. Rondal, A. Rasore Quartino, S. Soresi (eds). *The Adult with Down Syndrome. A New Challenge for Society*. London: Whurr, pp. 194–204.

Piaget, J. (1954). The Construction of Reality in the Child. New York: Basic Books. http://dx.doi.org/10.1037/11168-000

Piaget, J. (1962). Play, dreams and imitation in childhood. New York, NY: W. W. Norton.

Piaget, J., & Inhelder, B. (1962). The Psychology of the Child. New York: Basic Books.

Pye,C. (1986). Quiché Mayan speech to children. Journal of Child Language, 13, 85–100.

Rakoczy, H. (2006). Pretend play and the development of collective intentionality. *Cognitive Systems Research*, 7(2-3), 113-127.

Ramruttun, B., & Jenkins, C. (1998). Prelinguistic communication and down syndrome. *Down Syndrome Research and Practice*, *5*(2), 53–62.

Rogoff, B. (1990). Apprenticeship in thinking. Oxford: Oxford University Press

Rogoff, B. (2003). The Cultural Nature of Human Development. Oxford: OUP

Roizen, N.J. and Patterson, D. (2003) Down's Syndrome. The Lancet, 361, 1281-1289. https://doi.org/10.1016/S0140-6736(03)12987-X

Rondal, J. A., & Edwards, S. (1997). Language in mental retardation. Philadelphia, PA, US: Whurr Publishers.

Rondal, J.A. (1993). Down's syndrome. In: D.V.M. Bishop & K. Mogford (eds.), *Language development in exceptional circumstances*. Hove: Erlbaum.

Rondal, J.A., Nadel, L. and Perera, J. Down's Syndrome: Psychological, Psychobiological and Socio-educational Perspectives. London: Whurr, pp. 205–16

Rowland, C., & Fried-oken, M. (2010). Communication Matrix : A clinical and research assessment tool targeting children with severe communication disorders. *Journal OfPediatric Rehabilitation Medicine:*, *3*, 319–329. https://doi.org/10.3233/PRM-2010-0144

Rowland, C., & FriedOken, M. (2010). Communication Matrix: A clinical and research assessment tool targeting children with severe communication disorders. *Journal of Pediatric Rehabilitation Medicine: An Interdisciplinary Approach, 3,* 319–329.

Rowland, C., & Ph, D. (2011). Handbook : Online Communication Matrix, 1–26.

Sameroff, A., & Chandler, M. (1975). Reproductive risk and the continuum of caretaking casualty. In M. Horowitz, M. Hetherington, S. Scarr-Salapatek, & G. Siegel (Eds.), *Review of child development research* (pp. 187–44). Chicago: University Park Press

Scaife M, Bruner J. The capacity for joint visual attention in the infant. Nature. 1975; 253:265–266. [PubMed: 1113842]

Scaife, M., & Bruner, J. S. (1975). The capacity for joint visual attention in the infant. *Nature*, *253*, 265–266. https://doi.org/10.1038/253265a0

Shaughnessy, J. J., & Zechmeister, E. B. (1997), Single case research designs. p. 305-335. *In Research Methods in Psychology*, 4th edition. New York, NY: McGraw Hill, 1997.

Siegler, R. S., & Ellis, S. (1996). Piaget on childhood. *Psychological Science*, 7(4), 211- 215.

Sigman, M., Ruskin, E., Arbeile, S. Corona, R., Dissanayake, C., Espinosa, M., et al. (1999) Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the* Society *for Research in* Child *Development, 64*, 1–114.

Singer Harris, N., Bellugi, U., Bates, E., Jones, W., & Rossen, M. (1997). Contrasting profiles of language development in children with Williams and Down syndrome. *Developmental Neuropsychology*, 13, 345–370

Sinha, K. (2018). Found: Way to fix Down's syndrome. The Times of India. Retrieved from http://articles.timesofindia.indiatimes.com

Sloetjes H and Wittenburg P (2008) Annotation by category— ELAN and ISO DCR. In: *Proceedings of the 6th International Conference on Language Resources and Evaluation (LREC),* Marrakech, Morocco, 28–30

Smith, B. L., Oller, K. (1981) A comparative study of pre-meaningful vocalizations produced by normally developing and Down's syndrome infants. *Journal of Speech and Hearing Disorders*, 46, 46–51.

Smith. L., & von Tetzchner, S. (1986). Communicative, sensorimotor and language skill of young children with Down syndrome. *American Journal of Mental Deficiency, 91*, 57-66.

Snow, Catherine. 1972. Mothers' speech to children learning language. *Child Development 43,* 549–565.

Snow, Catherine. 1977. The development of conversation between mothers and babies. *Journal of Child Language 4,* 1–22.

Stefanini, S., Caselli, M. C., & Volterra, V. (2007). Spoken and gestural production in a naming task by young children with Down syndrome. *Brain and Language*, 101 (3), 208–221.

Stone, S. J., & Stone, W. L. (2010). Symbolic play and emergent literacy. Retrieved 1st March, 2011, from http://www.iccp-play.org/documents/brno/stone1.pdf

Strapp, C., M. & Federico, W., O. (2000). Imitations and repetitions: what do children say following recasts?. *First language*. 20 (60), 273–290.

Super, C. M., & Harkness, S. (1986). The developmental niche: A conceptualization at the inter- face of child and culture. *International Journal of Behavioral Development, 9(4),* 545–569.

Swapna, Jayaram, Prema, & Geetha, (2010). Checklists to assesss different domains in preschool children with communication disorders (0-6 years). Unpublished departmental project. AIISH, Mysore

Thal, D., & Tobias, S. (1992). Communicative gestures in children with delayed onset of oral expressive vocabulary. *Journal of Speech and Hearing Research, 35*, 1281–1289.

The Rights of Persons with Disabilities Act, The Gezzette of India, Part II Section 1 (2016). retrieved from http://www.disabilityaffairs.gov.in/upload/uploadfiles/files/RPWD%20ACT%202016.pdf on 30.03.2019

Thorgrimsson, G. B., Fawcett, C., & Liszkowski, U. (2014). Infants ' expectations about gestures and actions in third-party interactions, *5*(April), 1–7. https://doi.org/10.3389/fpsyg.2014.00321

Tomasello, M. & Farrar, M. J. (1986). Joint attention and early language. *Child Development, 57,* 1454-1463.

Tomasello, M. (1995). Language is not an instinct. *Cognitive Development, 10,* 131-156

Tomasello, M. (2003). Child language acquisition: A usage-based approach. Cambridge, MA: Harvard University Press.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. Behavioural and Brain Sciences, 28, 675–735.

Tomasello,M. (1988). The role of joint attentional process in early language development. *Language Sciences, 10,* 69–88.

Trevarthen, C. (1979). Communication and cooperation in early infancy: A description of primary intersubjectivity. In M. Bullowa (Ed.), Before speech: The beginning ofinterpersonal communication (pp. 321–347). New York: Cambridge University Press.

Trevarthen, C., & Hubley, P., (1978). Secondary intersubjectivity: Confidence, confiding and acts of meaning in the first year. In A. Lock (Ed.), Action, gesture, and symbol. London: Academic Press,

Uzgiris, I. C. & Hunt, J. McV. (1975). Assessment in Infancy: Ordinal Scales of Psychological Development (Urbana, IL: University of Illinois Press).

Vandereet, J., Maes, B., Lembrechts, D., & Zink, I. (2011). The role of gestures in the transition from one- to two-word speech in a variety of children with intellectual disabilities, 714–727. doi: 10.1111/j.1460-6984.2011.00050.x

Venkatesan S. (2004). Toy kit for kids with developmental disabilities: User manual. Mysore: All India Institute of Speech and Hearing.

Venkatesan, S. (2011). Socio-economic status scale. Revised version of NIMH Socio Economic Status Scale-1993. Mysore: AIISH.

Vibbert, M., & Bornstein, M. (1989). Specific associations between domains of maternal- child interaction and toddler referential language and pretense play. *Infant Behavior and Development, 12*, 163-184.

Vicari, S., Carlesimo, A., & Caltagirone, C. (1995). Short- term memory in persons with intellectual disabilities and Down syndrome. *Journal of Intellectual Disabilities Research*, 39, 532–537.

Vicari, S., Caselli, M., & Tonucci, F. (2000). Asynchrony of lexical and morphosyntactic development in children with Down syndrome. *Neuropsychologia, 38,* 634–644

Vygotsky, L. (1986). Thought and language. (A. Kozulin, Ed.). Cambridge, MA: MIT Press. (Original work published 1934)

Vygotsky, L. S. (1962). Thought and language. Cambridge MA: MIT Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press

Vygotsky, L. S. (1987). Thinking and speech. In R.W. Rieber & A.S. Carton (Eds.), The collected works of L.S. Vygotsky, Volume 1: Problems of general psychology (pp. 39–285). New York: Plenum Press. (Original work published 1934.)

Werner, H. & Kaplan, B. (1963). Symbol formation: An organismic developmental approach to language and the expression of thought. New York: John Wiley.

Wetherby, A. M., & Prizant, B. M. (2002). Communication and Symbolic Behavior Scales: Developmental Profile (lst normed ed.) Baltimore: Paul H. Brookes.

Wetherby, A. M., Yonclas, D. G., & Bryan, A. A. (1989). Commu- nicative profiles of preschool children with handicaps: Implica- tions for early identification. *Journal of Speech and Hearing Dis- orders, 54,* 148–158

Wetherby, A., Goldstein, H., Cleary, J., Allen, L., & Kublin, K. (2003). Early identification of children with communication disorders: Concurrent and predictive valid- ity of the CSBS Developmental Profile. *Infants and Young Children*, 16, 161–174.

Whiting, B.B., & Whiting, J.W. (1975). Children of six cultures: A psycho-cultural analysis. Oxford: Harvard University Press

Wilcox, M., & Shannon, M. (1998). Facilitating the transition from prelinguistic to initial linguistic communi- cation. In A. Wetherby, S. Warren, & J. Reichle (Eds.), Transitions in prelinguistic communication (pp. 385–416). Baltimore: Brookes.

Wilcox, M., Kouri, T., & Caswell, S. (1990). Partner sensitivity to communication behavior of young children with developmental disabilities. J*ournal of Speech and Hearing Disorders, 55,* 679–693

Wishart, J. (1998), Development in children with Down syndrome: facts, findings, the future. *International Journal of Disability, Development and Education, 45,* 343–363.

Woodward, A. L., & Guajardo, J. J. (2002). Infants' understanding of the point gesture as an object-directed action. *Cogn. Dev. 17, 1061–1084.* doi: 10.1016/S0885-2014(02)00074-6

Yoder, P. J., & Warren, S. F. (1999). Facilitating Self-Initiated Proto-Declaratives and Proto-Imperatives in Prelinguistic Children with Developmental Disabilities. *Journal of Early Intervention*, *22*(4), 337–354. https://doi.org/10.1177/105381519902200408

Young, J. M., & Hauser-Cram, P. (2006). Mother-Child Interaction as a Predictor of Mastery Motivation in Children with Disabilities Born Preterm. *Journal of Early Intervention*, *28*(4), 252–263. https://doi.org/10.1177/105381510602800402

Zinober, B., & Martlew, M. (1985). The development of commu- nicative gestures. In M. Barrett (Ed.), Children's single-word speech (pp. 183–215). London: John Wiley & Sons.

Appendix 1

Questionnaire for Parents

Section A: Preliminary details

Name of the child _____	Date when the information is collected_____
Date of birth of the child _____ Age/Sex of the child _____ Case number assigned at AIISH/ other centers_____ Phone number and Address _____ Approximate number of hours the child is awake in a day (hrs/day)_____	Age of the mother _____ Educational qualification of mother _____ Occupation of the mother _____ E-mail id of the parent _____ Approximate number of hours the child sleeps in day time (hours/day)_____

Section B

Note: Please go through each statement carefully; choose your answer from the options given by placing a tick mark in the appropriate space under 'Yes' 'No' for few of the questions and for the rest of them provide details in few sentences.

Sl.No	Questions	Response	
		Yes	No
1.	Do you live in a nuclear family?		
2.	Does the child included in the study have siblings? If yes, How many?		
3.	Are you a working mother?		
4.	Who takes care of the child in your absence?		
5.	How many hours is the child awake in a day?		
6.	How is the time distributed across activities when the child is awake? (Please specify the duration in number of hours)		
	A) How often is the child played with your child with toys spoken to or /read/sung/ told stories etc.?		
	B) How often is the child involved in routine activities like feeding, dressing, bathing etc.?		
	C) How often is looking after the child carried out simultaneously with carrying household chores?		
7.	What is your native language?		
8.	How many languages other than native language is used with the child?		
9.	How often do you use language other than native language with the child? Please specify in %		

Appendix 2

Informed Consent Form

Research Fellow: Yashaswini R, Dept. of Speech Language Pathology, AIISH, Mysore

Informed Consent: I have been informed about the aims, objectives and the procedure of the study. I understand that I have a right to refuse participation of my child or myself as subject or withdraw my consent at any time without adversely affecting my ward's treatment at AIISH. I am also aware that by subjecting to this investigation, I will have to give more of my and my ward's time for assessments by the investigator and that these assessments may not result in any monetary benefits to me or my ward.

I_____, the undersigned, give my consent to be a participant of this study with my ward.

Signature of Parent/Guardian Address and phone number

Appendix 3

Data Editing, Annotations and Operational Definitions

Data extraction

The free-play interaction context for 60 minute duration of each mother-child dyad was captured in. The interaction sample of 60-70 second from each of the nine toys, making a total duration of 540 to 630 second (9-10.5 min) per dyad was considered. The editing of the videos was done in three levels using Corel video studio X4 pro software.

Level 1: As the study used a single camera fixed in front of the mother-child dyad, not all portions of the video samples had clear visibility of the interaction between the dyads. So, the first step was to separate the interaction samples which had clear visibility of the child's and mother's upper body profile from those which did not and eliminate the latter in each mother-child dyad free play interaction video. Then, the interaction samples of 2-3 sittings were combined into a single video file.

Level 2: The interaction chains were aligned in a uniform order on three separate tracks in corel video studio X4 Pro software. Mother-child interactions elicited through use of toys resembling living creatures/miniature objects (toys ABC) were arranged in the first track, interaction with toys which could be mechanically manipulated (toys DEF) were aligned in the second track and interaction with toys that produced noise/light on manipulation (toys GHI) were aligned in the third track. Table A provides the details of toys and the codes used for toys. Finally, these three tracks were combined into a single track retaining the same sequence. Thus, a single track contained the videos of mother-child interaction in a standard order across the dyads. However, the duration of the interaction with each toy remained uneven and

the number of toys with which the interaction was carried out also varied across dyads at this level. This difference across dyads was standardized in level 3.

Table A

Toys used in the study

Toys resembling living creatures/miniature objects (ABC)	Toys which could be mechanically manipulated (DEF)	Toys that produce noise/light on manipulation (GHI)
A. Doll/ Mickey mouse B. Hand puppet C. Push along Car/ push along train	1. Stack of rings 2. Blocks/ Connector set 3. Soft/ colored Ball	1. Rattles, Office bell 2. Drum, Xylophone 3. Torch

Note: any of the three toys in each set was used by the dyad based on the child's preference and mother's decision. The letters were not fixed to the specific toy, rather the letter indicated the toy set with which the interaction took place and the beginning and ending of the interaction with a particular toy set.

Level 3: To bring in uniformity in the duration of mother-child interaction with each toy, 60-70s was fixed as standard duration. To maintain homogeneity in the number and type of toys with which the dyads interacted, three toys from each category of toy set was fixed. Thus, for further analyses, interaction using nine toys was considered and a sample of 9-10.5 min was considered from each dyad. The process of selection of the 60-70s 'good interaction chains' in the communication of the dyads was based on the following criteria:

a) Interaction samples with both mother and child attending to the same toy were considered.

b) An interaction with a specific toy with maximum number of communication acts of the child was selected [A communication act is defined as a

vocalization or gesture that is directed toward the communication partner and which serves a communicative function (Wetherby & Prizant, 1993)]

c) Interaction chain per toy ranging in duration of 60 to 70 seconds was considered for analyses. This resulted in the sample of 540 to 630 second (9-10.5 min) duration for each dyad.

d) When a good interaction chain did not last for 60s, then the next two best interaction chains were combined together to form a minimum of 60 second duration video sample.

e) The interactions were chosen in such a way that it contained a clear beginning of the communication act initiated by a mother or child.

The process of selection of the 'good interaction chains' also resulted in elimination of portions of video which had:

a) Samples in which mother discussed with the researcher in the middle of an interaction chain.

b) The child noticed the presence of researcher in the room and tried to communicate with the researcher in the middle of an interaction.

c) The child cried uncontrollably due to any reason (hunger, discomfort, toilet, sleepy, tired) or threw a tantrum for more than 5s

d) Child attended to any one of the primary reflexes sneezes/coughs/hunger/ thirst (eating/drinking).

e) Samples in which no toys were used.

f) Solitary play of the child for more than 5s.

g) Interaction of the child with other family member, other than the mother.

h) Mother took a toy from the child, searched and selected another toy from the toy kit for the interaction.

i) Interaction which had the dyad interacting with more than three toys from the same category of toy set

j) Child used more than one toy for interaction at a time.

k) The interaction contained child's focus and mother's focus on two separate toys simultaneously.

Thus, the process of data extraction resulted in 9-10.5 min duration video sample from each dyad. These video samples were further segmented, coded and annotated in ELAN version 4.7.3.

Use of ELAN version 4.7.3- Linguistic Annotator for segmentation, coding and annotation of data

a) About ELAN: ELAN software ELAN (EUDICO Linguistic Annotator) is an annotation tool that allows to create, edit, visualize and search annotations for video and audio data. It was developed at the Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, with the aim to provide a sound technological basis for the annotation and exploitation of multi-media recordings. ELAN is specifically designed for the analysis of languages, sign languages, and gestures, but it can also be used by anyone who works with media corpora, i.e., with video and/or audio data, for purposes of annotation, analysis and documentation. The software was used for coding and annotation of the mother-child interaction samples and for performing interjudge and intra judge reliability.

b) Segmentation : The communication interactions of each mother-child dyad was viewed and segmented into child's communication turns and mother's communication turns on two separate tiers in the software. The communication turn was segmented based on the following criteria:

i. The segments were alternately mother's communication turn and child's communication turn. Every act of the mother or child was followed by a response by the communication partner.

ii. Though the segments were alternative, they overlapped on the time line.

iii. Each segment was facilitated by the toy and the interactions led to back and forth action and reaction.

Mother's communication turn: The beginning of mother's communication turn was identified by any one or combination of the following a) end of the child's communication turn b) pause in the child's communication act c) introduction of a new toy by the mother into the interaction. The end of mother's communication turn was identified by either or any combination of a) pause in mother's communication act, as if giving an opportunity to the child to respond b) initiation of the child's communication act c) the moment just before the introduction of a new toy by the mother to the child.

Child's communication turn: The beginning of the child's communication turn was identified by any or combination of the following a) pause in the mother's communication act b) initiation of the child's communication act. The end of the child's communication turn was determined by change in any or combination of a) pause in child's communication act, b) initiation of the mother's communication act c) the moment just before the child shifts to another toy d) the moment just before mother introduces another toy to the child.

c) Coding : Each child's and mother's communication turn was assigned seven and six codes respectively. The last three of child's communication turn and last two of mother's communication turns were annotated. Fig A provides details of the codes used and their meaning.

The first four characters in the code corresponded to the information on the location of the communication turn in the communication interaction video.

i. *Type of the toy (A/B/C/D/E/F/G/H/I)*: Each mother-child dyad was engaged in communication interaction with nine toys, from three toy sets. Table A summarizes the specific toys considered in each of the three set. E.g., In the annotation "F3C2 E- toy; G- take toy from mother; Vo-a, F signifies that, the communication interaction between mother and child was with one of the toys from the set of toys which could be mechanically manipulated.

ii. *Serial number of the communication interaction (Integer)*: communication interaction was annotated on two tiers namely mother's communication turn and child's communication turn. Although there were overlaps in the communication turns of both on the timeline, the communication turns were sequential almost all the times. To code the sequence of the communication turns integers starting from 1 was used. The numbers followed the same sequence as the communication turns. If the mother began the communication turn with a particular toy, then it was coded as 1, if the child's response was the consecutive communication turn then it was coded 2 and so on. Interaction with each toy had a series.

In the example, "F3C2 E- toy; G- take toy from mother; Vo-a". The number 3, the second character in the code signifies that, it was the third communication turn in the communication interaction between mother and child with the toy F.

iii. *Communication turn (M/C):* the segments on the mother's communication turns were coded as M and the child's communication turns were coded as C.

In the example "F3C2 E- toy; G- take toy from mother; Vo-a", C signifies that the segment is one of the child's communication turns.

iv. *Serial number of the communication turn (Integer):* Separate series of numbers were given to the mother's communication turns and child's communication turns. The series began for each toy. The difference between the Serial number of the "communication interaction" and "communication turn" is that, the former is a continuous series for the communication interaction sequence of both mother and child's communication turns and the latter is an exclusive series for either child's communication turns or mother's communication turns alone. In the example F4M2 E- toy; G- take toy from child; V- 1, number 2, which is the forth character of the annotation signifies that it is the second mother's communication turn in the series of mother's communication turns.

v. The next three codes E, G and V corresponded to the components of child's and mother's communication behaviours. Each of these three codes were further annotated in each child's communication turn, each of G and Vo code was annotated in each mother's communication turn.

d) Annotation of the communication behaviours: Annotations done under each of the three communication behaviours eye gaze orientation, use of gestures, use of vocal behaviours were done using a single key word or a short phrase or a sentence to describe the communication behaviour. These annotations were done by prefixing the code and hyphen for each communication behaviour. The annotations were separated by semicolon and space. The explanation of annotations and illustration is provided in the section below. E.g., F3C2 E- toy; G- take toy from mother; Vo- a

i. Eye gaze orientation was coded as 'E'. This component was annotated as the communication partner or object on which eye gaze was fixed or the eye gaze shifted between any two or three points E.g., If the child's eye gaze alternated between a toy and the communication partner, annotation was 'E-toy-mother'. This code was annotated only for child's communication turns and not for mother's communication turns.

ii. Use of gestures was coded as 'G'. In each communication turn up to three gestures were annotated. The absence of gesture in any communication turn was annotated as '0'. This code was annotated as a short keyword or a phrase describing the action or naming the gesture E.g, G- mouth toy in mother's hand- reach. In the example, the child is performing two gestures; firstly the child is mouthing the toy and secondly reaching for the toy.

iii. Use of Vocal behaviours was coded as 'V'. The annotations for vocalization, production of protoword, production of true word was done using broad IPA for child's communication turns. Absence of vocal behaviour in child's communication turn was annotated as '0'. As the Child-Directed speech comprised of phrases and sentences and not vocalization or protowords in isolation, for mother's communication turns presence or absence of speech were annotated. Annotation of '0' was used to indicate absence of child directed speech and '1' for presence of child directed speech.

Criteria used to categorize the annotated samples into groups

The annotations for child's communication turns and mother's communication turns under each code were then categorized into the following groups as shown in Figures A and B.

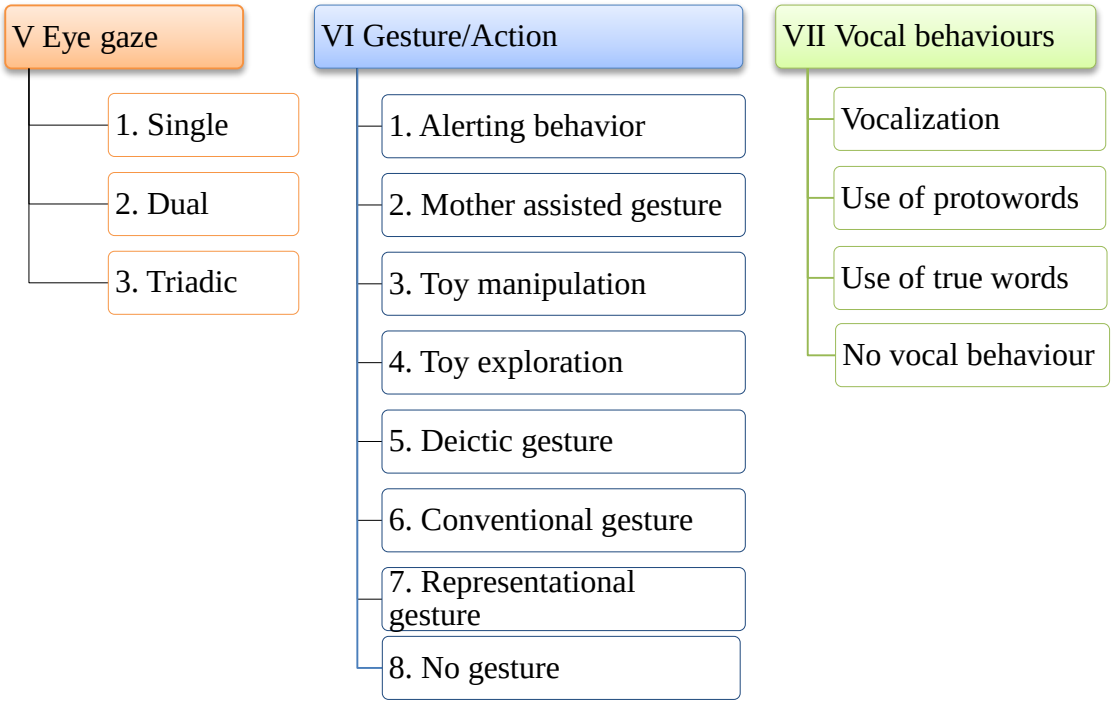

Figure A: Categories of annotations for the communication behaviors of children

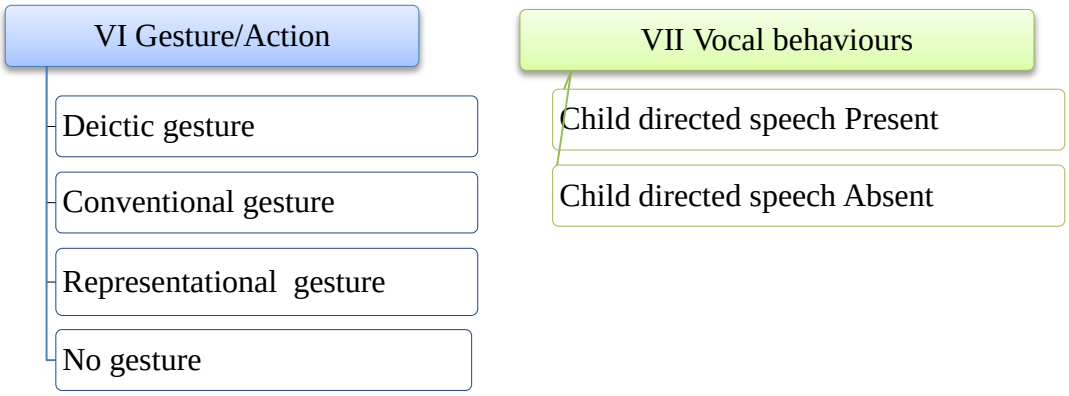

Figure B: Categories of annotations for the communication behaviors of mothers

V. Eye gaze orientation 'E'

In each communication turn, E was classified into three type viz single eye gaze orientation, dual eye gaze orientation and triadic eye gaze orientation. The eye gaze patterns which did not fit into the three categories were annotated under other orientation.

a. *Single eye gaze orientation*: if the eye gaze of the child is on the toy or on the communication partner throughout the given segment of communication turn, E was annotated and categorized to single eye gaze orientation.

   E.g., F3C2 E- toy; G- take toy from mother; Vo- a. In this example the child's eye gaze is on the toy and hence the annotation is grouped under single eye gaze orientation.

b. *Dual eye gaze orientation:* if the child shifted eye gaze from either toy to the communication partner or vice versa in the given segment of communication turn, E was annotated and categorized to Dual eye gaze orientation.

   E.g., B10C5 E- toy-mother; G- give toy; Vo-0. In this example the child's eye gaze shifted from toy to mother and hence was grouped under dual eye gaze orientation.

c. *Triadic eye gaze orientation:* if the child shifted eye gaze from either toy to communication partner and back to toy or vice versa in the given segment of communication turn, E was annotated and grouped under triadic eye gaze orientation. E.g., G13C7 E-mother-toy-mother; G- reach toy; Vo-0. In this example the child's eye gaze shifted from mother to toy and back to the mother, thus was grouped under triadic eye gaze orientation.

VI. Gesture 'G'.

Actions produced with communication intent are gestures by definition. These actions are typically expressed using the fingers, hands, and arms but can also include facial features (e.g., lip smacking for "eating") and body motions (e.g., bouncing for "horsie"; Iverson & Thal, 1998). As represented in the Figure B, the annotations done under G for child's communication turns were grouped under seven subcategories namely alerting behaviours, mother assisted gestures, toy exploration, toy

manipulation, deictic gestures, conventional gestures and representational gestures. On the other hand, annotations done under G for maternal gestures were grouped under three categories as depicted in the Figure B. In both child's and mother's communication turns if a communication turn did not contain use of any gesture then it was annotated as '0' and was considered under no gesture category.

a) *Alerting behavior:* These behaviors are actions or responses to specific stimulus without an accurate orientation to the stimulus. E.g., changing a position because of discomfort, flap hands and legs- to show joy/discomfort, search/localize source of sound, stop activity- cry/vocalize.
b) *Mother assisted gestures/ Actions for child assistance:* Action or gesture that mother physically assist the child to perform. E.g. mother physically assist child to form pointing gesture and make the child point, mother physically assist child to attaining comfortable posture. These were annotated under mother assisted gestures in child's communication turns and under actions for child assistance in mother's communication turns.
c) *Toy exploration*: Action with the toy that involved examining the toy by touch or by looking the toy closely or scrutinizing the toy by turning the toy up and down was considered as toy exploration. E.g., mouth toy, touch and feel the toy.
d) *Toy manipulation*: Action that demonstrated handling of the toy or controlling the toy in a skillful manner. E.g., pushing a toy train, playing toy drum/xylophone, shaking rattle to produce sound, pushing the button on torch to turn it on.
e) *Deictic gestures*: Actions that refer to an object or event by directly touching or indicating the referent. E.g., Pointing, showing, pushing away toy.

f) *Representational gestures*: Actions that established reference and also indicate a particular semantic content of the reference. These could be object-related gestures depicting some feature of the referent (Crais, Doughlas & Campbell, 2004). Eg., rocking to pretend riding on a horseback with hands held like holding the reins of the horse, Holding hand to the ear to pretend using a phone.

g) *Conventional gestures:* Actions that have culturally determined forms and meanings (Crais, Doughlas & Campbell, 2004). E.g, All gone hand gesture, Head shake to indicate 'no', Hug .

In child's communication turns, based on the intentionality and symbolic nature of these seven subgroup of gesture were clubbed under three. The first four namely, alerting behaviour, mother assisted gesture, toy exploration and toy manipulation were clubbed under preintentional presymbolic gesture (PIPS). Deictic gesture was clubbed under intentional presymbolic gesture (IPS); conventional gesture and representational gesture were clubbed under intentional symbolic (IS) gesture.

In mother's communication turns the three subcategories of gesture were clubbed into two Deictic gestures as intentional presymbolic (IPS) gestures. Conventional and representational gestures formed the Intentional symbolic (IS) gestures.

VII. Vocal behaviours 'V'

These are non-distress sounds produced by the use of voice. These were annotated using broad IPA for child's communication turns. The child's communication turns were grouped under three vocal behaviours namely vocalization, use of protoword and use of true word.

a) *Vocalization:* Any vocal behaviour marked by presence of quasi-vowels and glottal stops; sounds such as "gooing"; sounds with pitch, amplitude, and voice quality contrasts, e.g., squeals, growls, and yells; well-formed production of syllables containing both consonant and vowel sounds, such as "dada" or "baba" (Oller, 2000) were considered vocalization. Vo was annotated in broad IPA for vocalization and '0' for absence of vocalization.

b) *Proto-word*: Any sound with a specific meaning for a mother–child dyad, and is associated to a specific referent through an iconic relationship. E.g., 'aei' <*an idiosyncratic word used to drive away cow*>.

c) *True word*: Single words were included in this category E.g. 'aana' (elephant); 'illa' (no); 'paapu' (<*child*>). Criteria for true word included sound sequences that (a) were in a phonetically consistent form and were used to convey a consistent sound-meaning relationship, (b) shared at least one consonant found in the adult form of the word or a consonant identifiable on the basis of phonological processes that characterize children's early word productions Wilcox, Kouri, and Caswell (1991). True words used in a single context was also considered.

List of annotations used for gestures and their operational definitions

Annotation	Operational Definition
Alerting behavior	
Change position	Changing the posture from sitting to standing/ from on fours to sleeping/from on stomach to left or right side, usually from an uncomfortable to more comfortable posture
Flap hands and legs	Moving palms of hands up and down/side to side at the shoulder level as an expression of joy or discomfort.
Rub face	Moving hand back and forth on one's face.
Search for person/toy	Trying to seek something by looking carefully and thoroughly.
Startle	Sudden movement of the body in response to toy noise.
Stiffen body	Making the body tight/rigid because of fear towards a particular toy.
Stop activity	Ceasing any activity such as reaching/toy manipulation/crying/picking toy/crawling away etc. in response to toy noise or introduction of a new toy.
Touch and feel toy	Bring one's hand in contact with the toy or contact the toy with face to feel the touch/sensation of the toy .
Turn away from mother	Moving one's head or torso or complete body away from mother.
Turn towards mother	Moving one's head or torso or complete body towards mother.
Withdraw hand	Taking one's hand from holding a toy or touching a toy with fear.
Toy exploration	
Bite toy	Use teeth to cut the toy.
Drop toy	Let the toy in hand fall down on ground.
Mouths toy	Putting the toy in hand to mouth or touch toy with mouth.
Pick toy	Taking hold of the toy on the ground and lifting it up.
Spread toy on floor	Disperse toys on the floor.
Squeeze toy	Firmly press the toy with fingers.
Touch and feel toy	Bring one's hand in contact with the toy or contact the toy with face to feel the touch/sensation of the toy. Bring toy to the cheeks and press gently on the cheeks.
Toy exploration general	Turning toy up and down looking at the toy.
Toy manipulation (Only when actions are not directed towards mother)	
Play with Car	Pushing along a toy car/train. Sitting on the toy train and moving along.
Play with rings	Stacking the rings to the stand.
Play with blocks	Building tower, blowing the tower off
Play with connecting toys	Connecting the connectors, ripping apart the connected blocks
Play with ball	Rolling ball on ground.
Play with rattle	Shaking the rattle to make noise.
Play with office bell	Hitting on the office bell to make noise.
Play with drum	Beating the drum with sticks or hand to make noise.

Play with Xylophone	Beating on the xylophone with sticks to make noise.
Play with torch	Switching on the light, switching off the light
Deictic gestures used by children	
Bang toy	Striking on the toy/ striking the toy forcefully on the floor.
Climb on mother	Move up on the mother's lap to sleep/ Move up on the mother and sleep on mother's shoulder.
Cover face	Putting palms over the face/ Putting the face on mother's lap to hide from mother or toy
Extend arms to be picked	Spreading out both arms forward, facing the communication partner with the intention to be picked up.
Give toy/offer toy	Holding a toy in hand and extending it forward towards the communication partner and/or releasing the hand grasp on toy.
Hit mother/toy	Striking hand on mother or on toy.
Hold mother/toy	Grasping mother's arm.
Index finger point	Action of extending the index finger and curling up the other fingers and directing at the desired object.
Kick in air/kick toy	Striking toy with foot or striking foot in air.
Move away from mother/toy	Crawling/walking away from mother or from toy.
Move towards mother/toy	Crawling/walking towards mother or towards toy.
Other point -whole hand point/holding/head point/ point using stick	Action of extending open hand towards the desired object/ bending head in the direction of the desired object or holding stick in hand and directing it towards the desired object.
Pat mother	Touching mother gently with the flat of a hand to draw her attention.
Pinch mother	Gripping mother between fingers to draw her attention.
Place toy elsewhere	Putting toy in another location in order to make it unavailable to the mother.
Poke mother	Prodding mother with finger.
Push away toy/mother	Exert force through hand to move toy away from self.
Reach for toy/mother	Extend arm and hand towards communication partner/ toy
Release toy to mother's grasp	Allow mother to take toy from grasp.
Remove toy from mouth	Taking away the toy in mouth.
Resist/protest mother's action	Objecting mother's actions or suppressing mother's action by taking off one's hand from mother's grasp when mother physically assist the child to perform an action or by taking off mother's hand or by pushing away mother's hand or holding toy tighter so as to prevent mother from taking off the toy or pulling the toy towards oneself.
Searching with an intention	Trying to seek something by looking carefully and thoroughly in response to name call of the desired object or person.
Show toy manipulation/show toy	Holding a toy up towards mother to draw her attention to the toy. Displaying one's skills to manipulate a toy with the intent to draw mother's attention.
Take toy/pull toy from mother's hand	Reaching, holding toy which is with the mother and/or exerting force to bring it towards oneself.

Throw away toy	Forcing toy in hand away from oneself.
Withdraw hand of fear	Take hand towards self in an attempt to take hand out of mother's grasp.
Conventional gestures used by children	
All gone	Fingers of both hands spread and held with palm facing the sky at chest level.
Beckon	Calling someone at a distance by hand.
Blow raspberries	Spit bubbles to express protest.
Bounce with joy	Moving one's body up and down enthusiastically.
Clap	Striking palms.
Dances to the music	Rocking to the rhythm with flapping hands in synchrony with the beats.
Fold hands	Placing both palms against each other at one's chest level.
Give it to me hand gesture	Extending arm forward with palm facing sky with or without opening and closing of palm.
Handshake (offer hand)	Extending palm towards communication partner in response to the same behavior from the mother.
Head nod	Moving head vertically (up and down) once or several times (often to indicate approval).
Head shake	Moving head side to side (often to indicate disapproval).
Hi-five with mother	Holding palm high up facing the communication partner and allowing the partner to touch the palm.
Hold ears	Holding the ear lobule with two finger grasp to indicate that one's sorry/ as a punishment for bad behavior.
Hug mother/toy	Squeeze tightly with one's arms to show affection.
Kiss mother/toy	Touching someone with lips to show affection.
Pat toy to put it to sleep	Touching toy once or several times to induce sleep.
Raise hands with joy	Extending arms above head to express joy.
Rocking with joy	Move gently to and fro or side to side to express joy.
Scare	Extending curled fingers and closing it across mother's face.
Shrugs shoulder in excitement	Raising shoulders momentarily to express excitement to see a new toy.
Touching heads	Facing the communication partner and gently bending to touch the partner's forehead with one's forehead.
Wave bye	Hold hand with palm facing communication partner and moving it right to left gently.
Representational gestures used by children	
Catching gesture	Pretending to catch an imaginary object thrown towards oneslef.
Eating gesture	Bringing all five finger tips together as if to hold food and moving it from palm (imaginary plate full of food) to mouth.
Feed toy	Pretend holding an imaginary spoon and move it from palm to toy’s mouth
Pretend horse riding	Holding fists as if to hold imaginary reins of the horse and rocking as

	riding on an imaginary horseback.
Pretend to apply cream	Taking cream from imaginary box and smearing it on the toy's body as part of social game.
Push along imaginary train on floor	Holding an imaginary toy in hand close to the ground and pushing it along on the floor.
Rock the toy on lap	Holding toy on one's lap and move to and fro gently.
Taking bath gesture	Using an imaginary body scrub and pretending to scrub one's own arms and legs.
Deictic gestures used by Mothers	
Bang on toy/ toy on floor	Striking on the toy/ striking the toy forcefully on the floor.
Close both eyes/ears with hands	Covering eyes/ears with one's own hands.
Extend arms to pick up the child	Extending both arms forward in the direction of child to pick up the child.
Gently rub child's forehead	Gently rubbing child's forehead in response to child banging head to one of the toys and getting hurt.
Give toy/offer toy	Holding a toy in hand and extending it forward towards the communication partner and/or releasing the hand grasp on toy.
Hide toy	Placing a toy behind oneself to keep the toy out of sight.
Hit child	Striking hand on child.
Hold child	Grasping child's arm.
Index finger point	Action of extending the index finger and curling up the other fingers and directing at the desired object.
Move towards child/pull child nearer	Drag oneself nearer to the child or pull child closer to oneself.
Other point whole hand point/holding/head point/ point using stick	Action of extending open hand towards the desired object/ Holding a desired object and releasing it once or several times/ Bending head in the direction of the desired object or holding stick in hand and directing it towards the desired object.
Pat child	Touching child gently with the flat of a hand to draw her attention.
Pick up child	Holding the child and lifting child from the ground.
Place toy elsewhere	Picking up toy and putting it in another location to make It unavailable to child.
Push away toy	Exert force through hand to move toy away from self.
Reach for toy/child	Extend arm and hand towards communication partner/ toy
Release toy to child's grasp	Allow child to take toy from grasp.
Remove toy from child's mouth	Grasping toy from child's mouth and taking it out.
Resist/protest child's action	Objecting child's action or suppressing child's action by taking away a toy or Holding the child tightly to prevent the child from moving away.
Searching for person/toy	Trying to seek something by looking carefully and thoroughly in response to name call of the desired object or person.
Show toy	Holding a toy up towards mother to draw her attention to the toy.

manipulation/show toy	Displaying one's skills to manipulate a toy with the intent to draw mother's attention.
Take toy/pull toy	Reaching, holding toy which is with the mother and/or exerting force to bring it towards oneself.
Throw away toy	Forcing toy in hand away from oneself.
Tickle child	Touching the child gently to elicit laughter from the child.
Touch child's nose/face	Touching child's nose or face while naming the same.
Turn toy towards child	Positioning the toy in hand to face the child.
Conventional gestures used by mothers	
All gone	Fingers of both hands spread, palm facing the sky and held at chest level.
Beckon	Calling someone at a distance by hand.
Clap	Striking palms
Finger on lips	Placing one's index finger on one's lips to indicate to be silent.
Fold hands	Placing both palms against each other at one's chest level.
Give it to me hand gesture	Extending arm with palm facing sky forward with or without opening and closing of palm.
Handshake (offer hand)	Extending palm towards communication partner in response to the same behavior.
Head movement to question	Momentarily raising head as if to question the child.
Head nod	Moving head vertically once or several times (often to indicate approval).
Head shake	Moving head side to side (often to indicate disapproval).
Hi-five with child	Holding palm high up facing the communication partner and allowing the partner to touch the palm.
Hit gesture	Raising one's arm as if to hit the child, but does not hit.
Index finger no	Extending index finger while other fingers curled and moving it left to right while holding it in the vertical position to indicate disapproval for an action.
Kiss child/toy	Touching someone with lips to show affection.
Rocking to the music	Move gently to and fro or side to side to express joy.
Scare with five fingers spread gesture	Extending curled fingers and closing it across child's face.
Show index finger to warn the child	Extending index finger while other fingers curled and moving it forward and backward while holding it in the vertical position to warn the child.
Stop hand gesture	Holding the palm facing the child and pausing.
Thumb up to question	Extending the thumb up while curling the other fingers and slightly raise the hand up, to question the child.
Touching heads	Facing the communication partner and gently bending to touch the partner's forehead with one's own forehead.
Wave bye	Hold hand with palm facing communication partner and moving it right to left gently.

Representational gestures used by mothers	
Flying gesture	Extending both arms sideways and flapping to imitate flying.
Catching gesture	Pretending to catch an imaginary object thrown towards oneslef.
Eating gesture	Bringing all five finger tips together as if to hold food and moving it from palm (imaginary plate full of food) to mouth.
Fake cry	Pretending to be sad by rubbing one's eyes and producing sad vocal sounds.
Gesture to show big	Extending both arms sideways.
Giving a bath gesture	Using an imaginary body scrub and pretending to scrub on arms and legs of the child.
Hand as phone	Holding an open palm facing one's face near ear to pretend to use phone.
Pat toy as if putting toy to sleep	Touching toy once or several times to induce sleep.
Push along imaginary train on floor	Holding an imaginary toy in hand close to the ground and pushing it along on the floor.
Rock the toy on lap	Holding toy on one's lap and move to and fro gently.
Scaring cow away hand gesture	Striking closed fist in air to indicate holding an imaginary stick and beating an imaginary cow.

List of annotations used for protowords and words

Protoword
a <refers to elephant cry>
aa <refers to aane, meaning elephant>
aanu <refers to aane, meaning elephant>
aap <refers to the sound of swallowing>
aatu <refers to haaku, meaning put the toy here>
achi <refers to jesi, meaning throw it>
aei! <refers to shooing away a cow>
am am <refers to the sound of chewing>
amate <refers to aamele, meaning aftwerwards>
amba <refers to mooing of cow>
ayyo <an expression of surprise>
bau <refers to dog bark>

bo <refers to dog bark>
chi chi < an expression of disgust>
chin chin <refers to the sound xylophone produces on playing>
dadum <refers to the sound of blocks collapsing on striking on it>
drrr <refers to the sound that a toy car in action produces>
dze <refers to teddy moving>
dzo dzo dzo <refers to lullaby>
dzui <refers to the sound that a toy train in action produces>
gurr <refers to tiger roar>
haha <refers to the last line of the rhyme johny johny>
hey <refers to scaring mother>
illu <refers to illa, meaning no>
ka <refers to crow's cry>
klick <refers to the sound of chewing>
kuku <refers to a bird cry>
la < refers to tale, meaning head>
me <refers to doll>
ta <refers to tale, meaning head>
tlak tlak <refers to sound of horse shoe while riding on horseback>
to to <refers to no more frendship between you and me>
trr <refers to the sound that a toy car in action produces>
waa! <surprised expression>
yai <an expression of anger>

Word
aaku <refers to haaku, meaning put the toy here>
adu <that one>
adzdzi <grandmother>
akka <sister>
alli <there it is>
amma <mother>
anna <brother>
aepal <apple>
avva <mother>
ba <come here>
beja <refers to /beda/ meaning I do not want>
kar <car>
kiem <refers to cream>
hoytu <all gone>
huli <tiger>
illa <no>
kachchu <bite>
kannu <eye>
key
kum kum <vermilion>
ma <mother>
mella <slowly>
paapu <baby>
pappa <father>
taa <give it to me>
uta <food>

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Pre-Symbolic and Symbolic Communication Behaviors of Typically Developing Children (1.6 Years) in Dyadic Communication Context Using Adapted Communication Complexity Scale

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Abstract:-Communication complexity scale (CCS)Brady et al., 2012 [1]was developed to assess the communication of individuals with intellectual disabilities and developmental disabilities who are mostly presymbolic communicators in the context of examiner-child scripted interaction. In the present study, CCS was adapted to assess communication oftwo typically developing children of 1.6 years age in unscripted free-play interaction context with their mothers. The communication of both children were analyzed to find the types of presymbolic and symbolic communication behaviors that occurred as a single entity with the three orientation patterns namely single, dual and triadic orientation. Results revealed predominant use of intentional communication by both children. On analyses of the patterns of combination of pre-symbolic and symbolic communication behaviors with single, dual and triadic orientation, for child K most combinations occurred with dual orientation (5 combinations) followed by equal number of combinations (3 combinations each) in single and triadic orientation. In contrast, for child S most combinations occurred with triadic orientation (5 combinations) followed by dual orientation (3 combinations) and finally single orientation (2 combinations). Considering that the behavior complexes that occurred with dual and triadic orientation were categorized as intentional communication, both children were mostly intentional communicators. Thus the present study demonstrates successful adaptation of CCS for typically developing children who are mostly intentional communicators.

Key words: *Communication Complexity Scale (CCS), Conventional gestures, Deictic gestures, Presymbolic, Proto-words, Symbolic, Vocalization, Words*

I. INTRODUCTION

One of the most important and challenging tasks in the field of communication disorders is to aptly describe communication behaviors in infants and children.For precise and objective description of communication behaviors, several assessment tools and protocols have been developed. These protocols are primarily based on the development of communication in typically developing (TD) children.In the developmental continuum of TD children, initially presymbolic behaviors emerge and is followed by symbolic communication behaviors. Presymbolic communication behaviors predominantly include vocalization and deictic gestures.Vocalizations are present at birth and continue to develop change its form till the 7 months of age (Oller, 2000 [2]). Emergence ofword like sounds or proto-wordsand deictic gestures emerge by 9-12 months of age (Bates, Benigni, Bretherton, Camaioni, &Volterra, 1979 [3];Bates, Camaioni, &Volterra,1975 [4]; Bruner, 1975 [5]; Masur 1983 [6]), followed by representational or symbolic gestures by 12 - 15 months of age (Acredolo&Goodwyn, 1988 [7]; Iverson, Caprici, & Caselli,1994 [8]). Use of combination of symbolic gestures and speech utterances is seen at around 12 months of age (Acredolo& Goodwyn, 1988 [7]; Bates, Benigni, Bretherton, Camaioni, &Volterra, 1979 [3]). At the same age, children produce their first words to label objects (Nelson, 1974 [9]) or to regulate social interaction (Bloom, 1973 [10]). To express their intentions, 12-month-olds primarily use gestures and/or vocalizations, 18-month-olds use a combination of gestures, vocalizations, and words or word approximations, and 24-month-olds use primarily words or word combinations (Wetherby, Cain, Yonclas, & Walker, 1988 [11]). Thus in children, in any stage of development, the communication behaviors can be a single behavior or combination of various components to form a complex.

The most researched deictic gestures are 'reaching', 'showing', 'giving', and 'pointing'. Typically, by the age of 8 or 9 months, open-hand 'reaching' develops. This is followed by development of 'showing' and 'giving' between 9 and 13 months (Masur, 1983 [6]). Specifically, 'showing' emerges at 10.7 months and 'giving' at 12.1 months age (Carpenter, Nagell, &Tomasello, 1998 [12]). Pointing to close objects is reported to emerge between 9 and 10 months, while distal pointing emerges at 13–14 months (Masur, 1983 [6]; Zinober &

Martlew, 1985 [13]). Crais, Douglas and Campbell (2004) [14] reported an earlier mean age of emergence of the deictic gestures. Accordingly the mean age of emergence of open handed 'reaching' was reported as 7.42 months (range = 6–10 months), 'giving' as 9.33 months (range = 8–11 months), 'showing' as 9.55 months (range = 8–13 months), and 'pointing' as 10.64 months (range = 9–12 months).The earlier age of emergence in the latter study was reasoned as the use of naturalistic observation as the data collection setting in contrast to parental report in laboratory settings used in the former studies.

Eye gaze fixation on the target object and alternation of eye gaze between the target and communication partner are important components of communication. Infants engage in face-to-face interactions with their caregivers at birth (Bigelow, 2003 [15]). By six to nine months of age, infants become increasingly capable of sharing experience about objects and events by directing or following the visual gaze of social partners (Bigelow, 2003 [15]; Mundy &Jarrold, 2010 [16]; Reinhartsen, 2000 [17]). Around this age, there is an important shift from dyadic to triadic or referential communicative interactions (Mundy & Willoughby, 1998 [18]). The cognitive development of the child explainsthe developmentfrom eye gaze fixationon mother or object of interest to alternation of eye gaze between the mother or object of interest or vice versa. The development of eye gaze alternation leads to the shift from pre-intentional to intentional communication (Beuker, Rommelse, Donders, &Buitelaar, 2013 [19]; Mundy & Newell, 2007 [20]; Mundy, Sigman, &Kasari, 1990 [21]).

Thus, different components of presymbolic communication develops simultaneously in a parallel fashion and so are the components of symbolic communication. At a given point in time, the child may use one or a combination of components of presymbolic communication behaviors (each component in a different stage of development) and/or symbolic communication behaviors as a complex behavior. This tendency to use combination of communication behaviors is explained by Local homology model. Local homology model tries to explain the relationship between the language and non-linguistic cognition. Accordingly, different aspects of language and gesture are likely to be associated only at specific points in time, when each draws on the same underlying processes or processing mechanisms(Thal & Tobias, 1994 [22]). It also proposes that different aspects of language may be dissociated in the early stages of development because they rely on different processing mechanisms (Bates, Benigni, Bretherton, Camaioni, &Volterra, 1979 [3]; Bates, Bretherton, Shore, &McNew, 1983 [23]). As per the model between 18-20 months there is a growth in vocabulary size and its resultant word combinations, growth in multiword utterances and this growth correlates with the multi-scheme gestural combinations (Brownell, 1988 [24]; Fenson& Ramsay, 1981[25]; McCune-Nicolich, 1981[26]; McCune-Nicolich&Bruskin, 1982 [27]; Shore, 1986 [28]).

For the purpose of precise and objective description of communication behaviors, parental interview protocols such as McArthur Bates Communication Developmental Inventory (CDI) words and gestures form (Fenson, Dale, Reznick, Bates&Hartung, 1993 [29]); Communication and Symbolic Behavior Scales (CSBS) Developmental profile (Wetherby &Prizant, 2002 [30]); Checklists for preschool children with communication disorders (0-6 years) (Swapna, Jayaram, Prema, &Geetha, 2010 [31]); Communication Matrix (Rowland, 1990, 1996, 2004 [32]; Rowland & Fried-Oken, 2010 [33]) have been developed. Although the information obtained through parental reports is extensive, there are several concerns such as challenge in eliciting information from parents on context and components of presymbolic communication that occur as a complex; possibility of parents to over-attribute intentionality to behaviors they report as a result of their familiarity (Petrovich-Bartell, Cowan, & Morse, 1982 [34]). In light of eliminating these concerns, several direct assessment procedures for evaluating the behavioral samples were proposed. These include the behavior sample section of the Communication and Symbolic Behavior Scale (CSBS) by Wetherby and Prizant (1993) [30], Early Social Communication Scales (ESCS) by Mundy et al. (2003) [34], Communication matrix (Rowland, 1990, 1996, 2004 [32]; Rowland & Fried-Oken, 2010 [33]), Communication complexity scale (CCS) (Wetherby &Prizant, 1993 [30]) and so on.

The behavioral sample section of Communication and Symbolic Behavior Scale (CSBS) Wetherby and Prizant (1993) [30]uses scripted play tasksto evaluate the use of eye gaze, gestures, sounds and words for communication in addition to child's use of objects and understanding of words. Early Social Communication Scales (ESCS) by Mundy et al.(2003) [35] also uses highly structured observation context and the elicited behaviors are classified into functions. The documentation of communication in infants and children using CSBS and ESCS aid in categorizing the communication behaviors into forms and functions.

Communication Matrix (Rowland, 1990, 1996, 2004 [32]; Rowland & Fried-Oken, 2010; [33]) has the provision for arranging communication forms and functions in a hierarchy based on age of occurrence. Communication matrix allows for recording forms like body movements, vocalizations, facial expression, gestures, symbol use and language. In addition, it also allows for recording the functions of the communication behaviors ('Refuse', 'Obtain', and 'Social interaction' and 'Provide information') andclassifies the forms into seven main levels beginning from the pre-intentional pre-symbolic behaviors to use of symbolic communication behaviors and language.

Communication Complexity scale (CCS) by Brady et al. (2012) [1], is a criterion referenced scale unlike Communication matrix which is a norm referenced scale. CCSwas developed to compare communication behaviors across children with intellectual and developmental disabilities who were primarily pre-symbolic communicators. CCS allows for an expressive communication summary score, based on the most sophisticated communication behaviors demonstrated by an individual, independent of the contexts. CCS addresses subtle developmental aspects to grade presymbolic and symbolic communication forms in a hierarchical continuum like a) succession of eye gaze and other orientation behaviors from single orientation followed by dual orientation and ultimately triadic orientation. b) Developmental sequence of the use of communication behaviors such as vocalization, gestures to the use of symbolic communication behaviors such as words, signs and multi-symbol communication behaviors. c) Use of a single potentially communicative behavior followed by use of multiple communicative behaviors. Thus the scale has specific gradations for presymbolic communication behaviors which most of the contemporary scales lack.

Brady et al, (2012) [1] used CCS to assess communication behaviors in three groups of children, a) preschool-age children with intellectual and developmental disabilities (identified candidates for use of AAC; n = 93); b) Infants 10–36 months of age with moderate-to-severe motor impairments (candidates for directed eye gaze intervention; n = 28); c) Individuals with severe and multiple disabilities and suspected vision impairments of various ages (n = 43). Twelve scriptedcommunication opportunities between examiner and child were coded and the responses to the opportunities were scored using CCS. The same participants were also assessed using the Mullen Scales of Early Learning (MSEL) (Mullen, 1995 [36]) and Expressive scale of preschool language scale (PLS) (Zimmerman, Steiner, & Pond, 2011 [37]) to establish concurrent validity. In addition, concurrent validity between the CCS and Communication matrix (Rowland &Fried-Oken, 2010 [33]) was also demonstrated. The study concluded that the CCS is useful for describing the levels of pre-symbolic and symbolic communication in clinical groups of children.

Christensen (2014 [38]) assessed intentional communication in thirty typically developing infants ina longitudinal study using the CCS. Children's interaction with the examiner were video recorded twice at 7 and 11 months of each child. Because the procedures used to present opportunities varied from those used during the development of the CCS (Brady et al., 2012 [1]), necessary modifications to the original coding guidelines were madeincluding a) Further codification of "physical orientation" and "potentially communicative behaviors" (PCBs) b) Addition of more PCBs (For example, banging toys on the table, shaking the toy, handing the toy to the examiner) in addition to behaviors demonstrating physical orientation. c) A score of 1 (i.e., alerting) to 5 (i.e., dual orientation) was used to indicate pre-intentional communication, while a score of 6 (i.e. triadic orientation) or higher was used to indicate intentional communication. A single score representing the child's overall communication status was arrived at by taking an average of the three highest scale scores recorded in a scripted protocol, as described by Brady et al. (2012) [1]. However, the study failed to demonstrate construct validity for CCS, as there was no significant difference in the means of three highest scores on CCS between the two age groups. Neither was there any significant difference in the mean scores between the two age groups, when all the communication opportunities were considered. Christensen (2014) partially reasoned the poor construct validity of CCS to extraneous variables like interest of the participants' family in communication, inconsistency in administration procedures of scripted protocol.

Poor construct validity of CCS as indicated by Christensen (2014) [38] could also be reasoned based on noprovision in CCS to record deictic gestures and symbolic gestures separately (Deictic gestures are reported to occur prior to symbolic gestures by Rowland and Fried-Oken, 2010 [33]). In the CCS, pantomime gestures, for example, turning one's hand as if unscrewing a lid is considered as PCB. Pantomime gestures indicate a particular semantic content (action of unscrewing the lid) similar to actions such as cupped hand to mouth to represent "drinking" which are considered as symbolic gestures (Crais, Douglas & Campbell , 2004 [14]). Hence, pantomime gestures need to be considered as symbolic gestures and not as pre symbolic gestures. However, in the CCS, there is no provision for differentiating deictic gestures as pre symbolic communication behaviors and symbolic gestures as symbolic communication behaviors. This could be one of the reasons why the results in Christensen (2014) [38] did not support good construct validity of CCS.

Brady, Thiemann-Bourque, Fleming, & Matthews (2013) [39] used CCS to investigate a model of language development for nonverbal preschool-age children learning to communicate with augmentative and alternative communication (AAC). The scale was used in the analyses of communication behaviors in scripted communication samples.Twelve communication opportunities were presented to each child, six to 'request' and six to 'comment'. The average of the three opportunities with highest scores was used as each participant's CCS score in the analyses. The study showed the usefulness of CCS in assessing early symbolic development in children with intellectual disabilities learning AAC.

In summary, early communication in children and infants can be measured through parent report measures, measures of overall development, and behavioral language measures and so on. CCS by Brady et al., (2012) [1] modified by Christensen (2014) [38] is a behavioral measure and is advantageous over the

othersbecause: [a] there is provision to document single communication behaviors, as well as different patterns of pre-symbolic communication behaviors that can occur as a behavioral complex. [For example, Score 2- single orientation (such as looking for the sound source) Score 4 - single orientation with more than 1 PCB (such as looking for the sound source and vocalizing and reaching towards the object). [b] There is scope to code two aspects of communication behaviors: (i) Orientation behaviors in any of the four modalities; visual, tactile, physical and proximity. All these can be assessed/coded at three levels of orientation: single, dual and triadic orientation. (ii) PCBs can be coded at two levels of occurrences: single PCB and more than one PCB. The CCS provides scope for combining these two aspects in a hierarchy for the pre symbolic communication behaviors. (E.g., score 2- single orientation, score 3- single orientation with 1 PCB, score 4- single orientation with >1 PCB, score 5- dual orientation, score 6- triadic orientation, score 7- dual orientation with 1 PCB, score 8- dual orientation with >1 PCB, score 9- triadic orientation with 1 PCB, score 10- triadic orientation with >1 PCB). Considering the unique features of the scale to describe the communication behaviors of children, Communication Complexity Scale (CCS) by Brady et al., (2012) [1] modified by Christensen (2014) [38]was adapted and used in the present study. In the present study, the CCS is adapted to analyze the communication behaviors in two TD children of 1.6 years chronological age in free-play interaction context between mother and child dyad.

1. Need for the study

CCS was developed for assessment of communication in individuals with intellectual disabilities and developmental disabilities who are mostly presymbolic communicators, but is not used successfully with TD children. So the present study aims to use CCS to score TD children of 1.6 years age.

CCS is used to analyze communication behaviors in the interactions between the examiner and child in scripted interaction context (Brady et. al., 2012 [1]; Brady, Thiemann-Bourque, Fleming, & Matthews, 2013 [39]; Christensen, 2014 [38]). Scripted interactions of child with the examiner are "highly structured" (Vandereet, Maes, Lembrechts, & Zink, 2010 [40]) and are appropriate in group research designs, to maintain internal validity and minimize extraneous variability caused by differences in the communication partner's inherent nature and manner of communication with children. However, in clinical practice, scripted interactions need not be a pre-requisite, as parents under guidance are often considered good and reliable "elicitors" of their children's behaviors (Crais et al., 2004 [14]). It can be reasoned that parents are familiar with the contexts in which a particular communication behaviors is exhibited by the child, so they are capable of creating similar contexts to elicit the behaviors. In the process, the children are provided an opportunity to show a behavior in familiar context (Werner &Kaplan, 1963), even if the children have not learnt to de-contextualize and use the gesture in novel contexts. Thus considering the lack of research using CCS involving mother-child dyads, studies in this direction is warranted. The present study is one of the first attempts to adapt modified CCS (Brady et al., 2012 [1]; Cristensen, 2014 [38]) for analyzing communication behaviours in free-play interaction between TD children and their mothers.

2. Present study

The aim of the study was to analyze the pre-symbolic and symbolic communication behaviors of two typically developing children with mean age of 1.6 years in unscripted free-play interaction context with their respective mothers adapting the communication complexity scale (Brady et al., 2012 [1]; Christensen, 2014 [38]).To achieve the aim of the study the following objectives were considered:

a) To represent the communication behaviors of 1.6 year typically developing children elicited in free-play mother child interaction on adapted Communication Complexity Scale (CCS).

b) To analyze the types and frequency of occurrence of single PCBs or single symbolic communication behaviors with single, dual and triadic orientation.

c) To analyze the types and frequency of occurrence of combination of different types of PCBs or symbolic communication behaviors with single, dual and triadic orientation.

II. METHOD

***2.1 Participants*:** Two typically developing female children (Child K and Child S) with their respective mothers participated in the study. The demographic details of the mother child dyad is shown in table 1.

Table 1: Demographic details of mother-child dyads

Socio-demographic details	Mother-Child K dyad	Mother-Child S dyad
Age of the child as on the first day of video recording	1 year 6 months 5 days	1 year 5 months 20 days
Age of the mother as on the first day of	30 years, 2 months	29 years, 8 months

recording		
Educational status of the mother	Post graduate	Post graduate
Occupation	Pursuing doctoral degree	Pursuing doctoral degree
Native language to which the child was exposed since birth	Kannada	Kannada
Socio-economic status of the dyad, assessed as per the Socio-economic status scale	Middle socio-economic status	Middle socio-economic status

The participants of the study were recruited from Mysore, as the study was conducted in Mysore city of Karnataka state, India. Data collection from the dyad was initiated after following the ethical guidelines for bio-behavioral research involving human subjects prescribed by All India Institute of Speech and Hearing, and written consent was obtained from the participating mothers. Through interview, it was ensured that the mothers did not have any sensory, motor and intellectual impairment. The High Risk Register (developed at All India Institute of Speech and Hearing, Mysore) was administered on the children to identify risk factors if any in the prenatal, natal or post-natal periods for developing communication disorders. Assessment across domains such as self-help, social, motor, cognitive, sensory, speech and language and play was carried out using the checklists to assess preschool children with communication disorders (0-6 years) (Swapna, Jayaram, Prema, &Geetha, 2010 [31]). Both the children obtained age appropriate scores corresponding to 1.4 to 1.6 years in all the domains evaluated. They were also screened using the Receptive Expressive Emergent Language Scales (REELS) (Bzoch& League, 1971 [42]) for language comprehension and expression and the children scored in the range of 15 to 18 months for comprehension and expressive language abilities. A brief oral motor examination on the children ruled out the presence of structural or functional oral abnormalities.

A questionnaire was developed to elicit the information regarding the language environment of the children. The responses of the mothers were obtained on a 4 point rating scale as: [1] rarely occurring = 0 to <25% of the total time; [2] occurring sometimes = $\geq$ 25% to < 50% of the total time; [3] occurring most often = $\geq$ 50% to < 75% of the total time; [4] occurring always = $\geq$ 75% to < 100% of the total time. The responses of the mothers are listed in Table 2.

Table 2: Responses of the mothers to the questionnaire on language environment of the children

Sl. No.	Questions	Mother-child K dyad		Mother-child S dyad	
		Response	% of time spent	Response	% of time spent
1.	Are you working for a job/otherwise?	Yes		Yes	
2.	How much time do you spend with the child when the child is awake?	8 hours			12 hours
3.	Who takes care of the child in your absence?	Day care		Grand parents	
4.	How is your time distributed across the activities when the child is awake? Provide details				
a)	Playing with the child with toys, reading or singing to the child, storytelling to the child etc.	Mostly	50-75% (5 hours 55.6%)	Mostly	50-75% (4 hours 50%)
b)	Involving the child in routine activities like feeding, dressing, bathing.	Sometime	25-50% (2 hours 22.2%)	Sometime	25-50% 3 hours 43.7%)
c)	Carrying out household chores and looking after the child	Rarely	0-25% (2 hours 22%)	Rarely	0-25% (30 mins 6.3%)
5	Do you speak in any other language than the native language with the child? If yes, Name the language(s)	English, Telugu		English	
6	If you use more than one language with your child, please specify how often the other language is used.	Rarely	0-25%	Rarely	0-25%
7	How often is the child spoken to, when	Mostly	50-75%	Mostly	50-75%

	awake?				

2.2 Setting

The data was collected from the dyad's respective homes. A silent room in the house with minimal auditory and visual distractions and optimal lighting and ventilation was chosen for data collection. The seating of the participants was on the matted floor. The mother and child were seated on the floor facing each other. A single camera was placed in front of them at a distance of 1.5 to 2 meter on the tripod stand to record the video samples. The movement of the child or mother if any was also captured by adjusting the camera height and position appropriately. It was ascertained that the area of data collection had no distracting objects placed within the child's reach.

2.3 Instruments

A handy-cam (Sony DCR-SR88 with 60X optical zoom and 120 GB memory model) with a tripod stand was used to record audio-visual data. Corel draw graphic suite X6 was used to edit the video samples. The software package EUDICO Linguistic Annotator, ELAN (in short) version 4.9.1 (Sloetjes&Wittenburg, 2008 [43]) was used to annotate the data.

2.4 Task

The task employed was semi-structured, unscripted free play interaction. Mothers were instructed to interact with the child as naturally as possible using one toy at a time. Four toys from the toy kit for infants with developmental disabilities (Venkatesan, 2004 [44]) with additional five age appropriate toys were used. The toys were categorized into three groups 1) Toys which resemble miniature items e.g., toy cheetah, colored elephant, mickey mouse 2) Toys which change physical forms on manipulation –rings that could be stacked on a stand, cubes that could be built into tower and other forms, colored blocks which could be joined or detached 3) Toys which produced noise on manipulation-xylophone, drum with sticks, office bell.

2.5 Recording

The video recording was carried out through overt observation method and using a non-participatory design. The interaction between the mother and child dyad was recorded in three sittings (minimum of 20 minutes in each sitting) with different toys.

2. Procedure

The initial part of the data collection involved collecting the socio-demographic details from the participants and administering the questionnaire for documenting the language environment of the children, determining the language age of the child and skills in cognitive, motor, sensory and communication domains. Following this, a 20 minute video recording of the interaction between mother and child was collected in the first sitting. A break of 10 minutes was given before the second recording, which was carried out on the same day. The third recording was carried out the next day. Overall, a 60 minutes duration video sample was obtained from each mother child dyad.

3.1 Analysis

Video samples were edited to select interaction samples with most meaningful interaction occurring between the mother and child. Attempt was also made to select similar interaction samples from both dyads. Following this criteria, the final analysis of mother-child interaction samples of both the dyads was reduced to approximately 9 minutes. The analysis of the samples was carried out in three levels: In the first level videos with instances of no interaction between mother and child due to crying of the child, moving of the child out of the camera focus were eliminated. In the second level the most meaningful interaction samples elicited using the 9 different toys were arranged in a single track using a common sequence of interaction. In the third level of analysis, the best interaction between mother and child dyad were chosen, thus a 9 minute long sample was retained for further analyses from each dyad (details of level 1,2,3 of analyses available from the author on request)

3.2Data Annotation

The video samples of the mother-child interaction were annotated using EUDICO Linguistic Annotator (ELAN) version 4.9.1(Sloetjes&Wittenburg, 2008 [43]) software and scored based on the adapted CCS. Prior to annotation, the data was segmented as mother's communication turns and child's communication turns, based on the definition of potentially communicative behaviors (PCB) in the Communication complexity scale (Brady, et al, 2012; Christensen in 2014). Each child's communication turn was annotated using a multidimensional annotation framework whichincludedannotation of: a) Eye gaze b) Gesture (body movements, ritualized

gestures, deictic gestures, representational gestures) and/or facial expression c) vocalizations and d) verbal behaviours occurring in each child's communication turns. The annotated communication turns was assigned scores as in the CCS manual (Brady et al., 2012) with appropriate adaptations.

3.3 Adaptations made in the present study in the CCS (Brady et al., 2012 [1]) protocol for the analysis of scripted free-play interaction between mother and child.

In the study by Brady et al., (2012) [1], each script contained at least twelve communication opportunities to elicit a target communication behavior from the child. The average time for each opportunity was about 30s. In the present study, meaningful free-play interaction samples were elicited using 9 different toys. A total duration of 9 minute mother-child interaction sample (with 60 second interaction for each toy) was considered for analyses. A total of 69 and 66 communication turns of child K and child S respectively were scored on adapted CCS.

Brady et al., (2012)[1] summed the scores from 12 scripted assessment protocol, which was considered the highest scored communication behavior observed in each opportunity. To arrive at a single score, an average of the three highest scores from the scripted protocol was considered for each participant. In the present study, no measure of central tendency is used, the scores are represented on bar graph with abscissa representing the 13 scores of adapted CCS and the ordinate representing the frequency of occurrence of scores on CCS. This was carried out because the raw scores provided a better opportunity to compare the frequency of occurrence of the behavior, the forms of communication behaviors used and the combinations used by the two children.

The salient adaptations made in the scoring of the behaviours in CCS (Brady et al 2012) [1], in this study are as follows:

1. The gestures listed as PCBs in the CCS (Brady et al., 2012) [1]mostly comprised of deictic gestures. However, pantomime gestures are also considered as PCB and the occurrence of these pantomime gestures are considered as pre-intentional or intentional nonsymbolic rather than symbolic communication behaviours. There is no demarcation for deictic and symbolic gestures. Therefore in the present study only deictic gestures (ritualized behaviours) and vocalizations were considered as PCBs. Symbolic gestures were not considered as PCBs and were accounted for with scores of 11, 12 or 13 under intentional symbolic (IS) communication behaviours.
2. The term nonsymbolic is replaced by the term presymbolic in the CCS (Brady et al., 2012) [1]. The reason for this replacement is that in the literature it has been demonstrated that nonsymbolic communication behaviors proceed symbolic communication behaviors. The term nonsymbolic is more suitable for children with developmental disabilities or intellectual disabilities as some may never reach symbolic communication but it is not the case in typically developing children.
3. As the present study considered typically developing children, the augmentative and alternative mode of communication was not used. So, the sections in the CCS (CCS (Brady et al., 2012 [1]) which describe the use of SGDs, PECS or any other AAC symbol selection strategies, were ignored.
4. In CCS (Brady et al., 2012 [1]) score 11 is assigned for the use of speech to communicate and score 12 for the use of multiple words. As per the instructions in CCS, there is no scope to represent accompanying deictic or symbolic gesture with speech. Both the children in this study produced deictic gestures in combination with the words. This is in line with the observations made by few investigators that children produce their first gesture + word sentences before their first word + word sentences (Goldin-Meadow, Goodrich, Sauer, & Iverson, 2007 [45]). There is no provision in CCS to document such combinations. In order to report use of symbolic or deictic gestures along with speech or symbolic gesture the operational definition was modified for score 11 and score 12. Score 11 was re-defined as use of one or more speech utterance or symbolic gesture with one or more PCBs. Score 12 was re-defined as use of single speech utterance or a single symbolic gesture. To record the use of combination of two or more spoken words or use of spoken words with symbolic gestures or use of two or more symbolic gestures, score 13 was introduced. Thus, a child's use of combination of both symbolic and presymbolic patterns of communication behaviours, a single symbol use and a combination of symbolic only patterns of communication behaviours were scored separately.
5. In order to document the scores, a standard multidimensional protocol for the annotation of child's communication turns was used. Once the communication turns were annotated, scores were assigned to each of the communication turns based on the adaptations made as shown in points 1 to 5 above.

3.4Inter-judge reliability:The video samples were annotated and coded by the first investigator as the first coder for various communication forms. The reliability of the annotations and codes were checked by another /coder, who was a speech language pathologist. The second coder was trained by the investigator to annotate the video samples and assign scores on the 13 point rating scale of the adapted CCS in this study. The training lasted for

approximately three hours using sample videos which were not part of the data. The annotations of the first and second coder were compared for each communication turn and a point-by-point agreement and disagreement was marked on each aspect annotated for each communication turn. Remarks on any disagreement of the communication turn were noted. For communication behaviors of child K, a 94.047% agreement was obtained and 5.052% disagreement was noted. For child S, an agreement of 92.307% was obtained and 7.692% of the annotations were not agreed upon. In the next step, the scores (on a 13 point rating scale) offered for annotations by the investigator were compared with the scores offered by the second coder. Point-by-point agreement and disagreement was marked for each communication turn. There was 90.47% agreement for child K's ratings and 9.53% were disagreements; for child S there was 87.69% agreement and 12.31% disagreement.

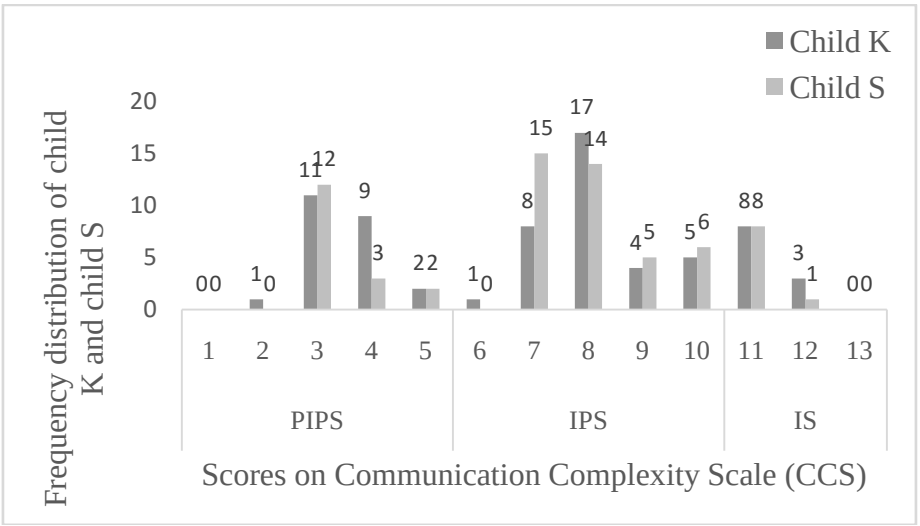
III. RESULTS AND DISCUSSION

The annotated communication turns of the children were scored on the 13 scores of adapted CCS. The communication behaviours of the children (communication turns) which occurred in dyadic context with their respective mothers were considered for scoring. Description of scores on the adapted CCS is given in table 3.

Table 3: Adapted Communication Complexity Scale

Scores	Description
Score 0	No Response
Score 1	Alerting behaviors
Score 2	Single object/event/person orientation
Score 3	Single object/event/person orientation with 1 PCB
Score 4	Single object/event/person orientation more than 1PCB
Score 5	Scanning between objects/events Or Dual orientation between a person and an object or event
Score 6	Triadic orientation
Score 7	Dual orientation with 1PCB
Score 8	Dual orientation with more than 1PCB
Score 9	Triadic orientation with 1 PCB
Score 10	Triadic orientation with more than 1 PCB
Score 11	Combination of Presymbolic and symbolic behaviors
Score 12	Single symbolic behaviors
Score 13	Multi symbolic behaviors

4.1 Representation of the communication behaviors of child K and child S on adapted CCS



[*PIPS- Pre-intentional presymbolic communication behaviors; IPS- Intentional presymbolic communication behaviors, IS-Intentional symbolic communication behaviors]

Figure 1: frequency of occurrence on 1 through 13 scores of adapted CCS for child K and child S in free play mother-child interaction

4.1.1 Pre-Intentional Pre-symbolic (PIPS) Communication Behaviors (Score 1 through score 5)

From fig 1, Child K displayed 'Single object/event/person orientation plus 1 PCB (score 3) in eleven instances and child S in twelve instances.Child K displayed Single object/event/person orientation and more than 1PCB (Score 4) in nine instances. Child S displayed the behavior in three instances. Both children displayed'Dual orientation' (score 5) in two instances. Child K showed 'single orientation' (score 1) once. There were no behaviors that could be scored as alerting behaviors by child K or child S.

4.1.2 Intentional Pre-Symbolic (IPS) Communication Behaviors (Score 6 through Score 10)

Child K displayeddual orientation accompanied with more than 1 PCBs(Score 8) in seventeen instances and 'Dual orientation with single PCB' (score 7) in eight instances. On the other hand, child S displayed 'Dual orientation with single PCB' (score 7) in fifteen instances and 'Dual orientation with more than 1PCB' (score 8) in fourteen instances. Child K and S displayed 'Triadic orientation with more than 1 PCB' (score 10) in five and six instances respectively. Child K and S displayed 'Triadic orientation with single PCB' (Score 9) infour and five instances respectively. Child K displayed 'Triadic orientation' (Score 6) only once.

4.1.3 Intentional Symbolic (IS) Communication Behaviors (Score 11 through Score 13)

Both the children, showed 'Combination of Presymbolic and symbolic behaviors' (Score 11) in eight instances. Child K displayed 'single symbolic communication behavior' (Score 12) in three instances and child S displayed only once. The behavior of 'combination of one or more symbolic communication behaviors' (Score 13) were not seen to occur in both the children.

From Figure 1 and the above results, it can be inferred that among the 13 scores on adapted CCS, frequency of occurrence in Child K and child S were similar (difference in the frequency on a score for child K and child S was 1) for 7 different behaviors/complexes. The 7 communication behaviors/complexes of CCS were; Single object/event/person orientation (Score 2); Single object/event/person orientation with 1 PCB (Score 4); Scanning between objects/events or Dual orientation between a person and an object or event (Score 5); Triadic orientation (Score 6); Triadic orientation with 1 PCB (Score 9); Triadic orientation with more than 1 PCB (Score 10); Combination of Presymbolic and symbolic behaviors and Multi symbolic behaviors (Score 11). The 4 behaviors/complexes on CCS which children had dissimilar frequency of occurrence (the difference in the frequency on a score for child K and child S was 2 to 7) were Single object/event/person orientation with more than 1 PCB (Score 4); Dual orientation with 1 PCB (Score 7); Dual orientation with more than 1 PCB (Score 8) and Single symbolic behaviors (Score 12). There were no behaviors/complexes that could be scored as Alerting behaviors (Score 1) and Multi symbolic behaviors (Score 13) in both children.

In PIPS category, both children had single orientation with 1PCB (Score 3) as the most frequently occurring complex. Child K displayed 11 instances and child S, 12 instances on this complex. Child K displayed Single orientation (Score 2) only once. Both children did not display alerting behaviors (Score 1). Thus single orientation (Score 2)was the least occurring behaviors among PIPS category. In IPS category, Child K displayed a frequency of 17, as the highest frequency on Dual orientation with more than 1PCB (Score 8) and child S a frequency of 15, as the highest frequency on dual orientation with 1 PCB (Score 7). These frequencies were the highest not only in IPS category but also among the three categories namely PIPS, IPS and IS and 13 behaviors/complexes of adapted CCS. Child K displayed triadic orientation (Score 6) only once and child S did not display any. Thus triadic orientation only was the least frequently occurring behavior in IPS category for child K and triadic orientation with 1 PCB (Score 9) for child S. In IS category, both children displayed combination of presymbolic and symbolic behaviors (Score 11) as the most frequently occurring complex. This complex was observed in 8 instances in both children. Both children did not display combination of multiple symbolic behaviors (Score 13). Single symbolic behaviors (Score 12) was the least occurring for both child K and child S in IS category.

Thus from the above results, two interesting observation may be noted, both children displayed mostly similar trend in the frequency distribution across adapted CCS. The behavioral complexes comprising PCBs were the most frequently occurring in all the three categories (PIPS, IPS and IS). In contrast complexes without PCBs were least occurring. This observation supports Wetherby et al, 1988 [11], who demonstrated that 18 months olds use a combination of gestures, vocalizations and words or word approximations. The similarity in the frequency distribution of communication behaviors/complexes in the two children can be attributed to the similarity in the different domains of development in both the children such as social, cognition, motor, sensory, speech and language, play which corresponded to 1.4 to 1.6 years as evaluated by checklists to assess preschool children with communication disorders (0-6years) (Swapna, Jayaram, Prema, &Geetha, 2010 [31]) and similar socio-demographic backgrounds of the mothers (Table 1) and the language environment of the children (Table 2). These domains of development, socio-demographic backgrounds and language environment have influence on communication as a whole. In addition, both the children did not display behaviors that could be categorized

under alerting behaviors (Score 1). The probable reason could be that the children have outgrown the stage of exhibiting alerting behaviors and have developed to the further stages of communication. In the further stages of communication, the reason for use of PCBs with orientation pattern could be that, use of any PCB makes the communication more specific in the context of its occurrence than orientation patterns without PCBs.

From the above results it can also be inferred that, the adapted CCS can be used not only with children with developmental disabilities as demonstrated by Brady et al., (2012) [1] or with nonverbal preschool-age children learning to communicate with augmentative and alternative communication (AAC) as demonstrated by Brady et al. (2013) [39] but can also be successfully adapted to use with typically developing children. The adaptation can be for the use of CCS in the context of free play unscripted mother child interaction, in contrast to the former studies, which were done in the context of scripted examiner-child interaction. CCS can not only be used in primarily presymbolic communicators but also with communicators who use a combination of both presymbolic and symbolic communication behaviors like TD children in the age of 1.6 years. However, as the present study was done on only two typically developing children, and both mothers were educated and came from the middle socio-economic status, more studies with greater number of participants and mothers with different socio-economic backgrounds is warrantied to confirm the usefulness of adapted CCS for free play mother child interaction.

4.2 Types and frequency of occurrence of single PCBs and single symbolic communication behaviors with single, dual and triadic orientation.

The types and frequency of occurrence of single PCBs (deictic gestures,conventional gestures, and vocalization) or single symbolic communication behaviors (proto-words, words) with the three orientation patterns- single, dual or triadic orientation were analyzed and presented in figure 2. The orientation patterns need not be specified on the three IS behaviors (combination of presymbolic and symbolic communication behaviors, single symbolic communication behaviors and combination of symbolic communication behaviors which is score 11, 12 and 13 respectively) as per the adapted CCS. However, in this study thesingle symbolic communication behaviors are classified under three orientation patterns.

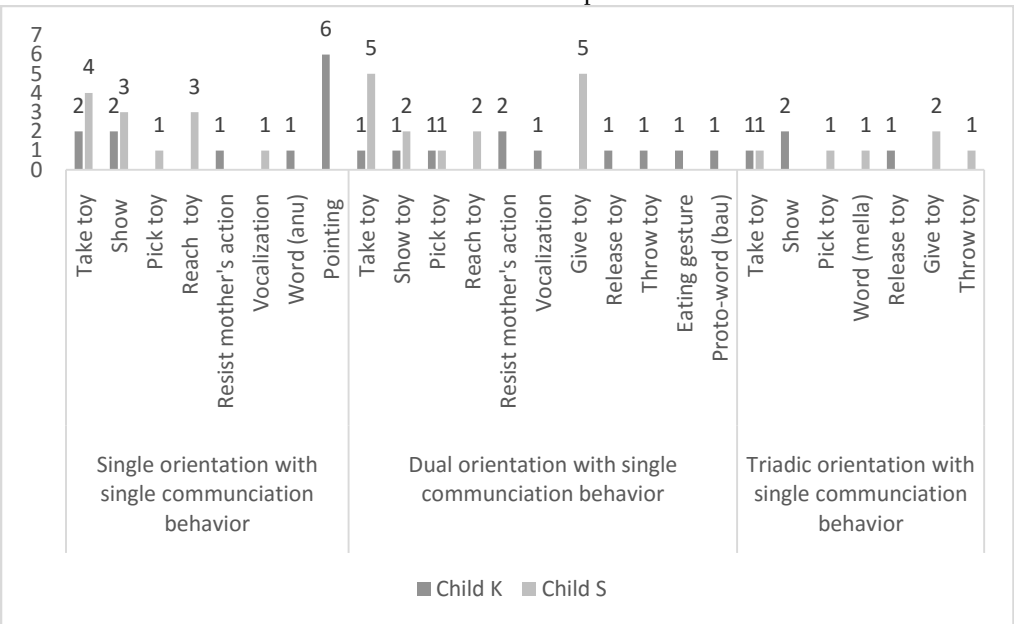


Figure 2: Types and frequency of occurrence of single PCBs (single symbolic communication behaviors) with different gaze orientation patterns in child K and child S

As seen from the fig 2, Out of eight different types of communication behaviors considered under PIPS, (Take toy, show, pick toy, reach toy, resist mother's action, vocalization, 'a:nu' <elephant>, pointing) used by both the children in single orientation category, three types were used exclusively by child K (resisting mother's action, 'a:nu'<elephant> and pointing) in 8 instances, and three types were used exclusively by child S (pick toy, reach and vocalization) in 5 instances. Two types were used by both the children (take toy, show), child K used in 4 instances and child S in 7 instances. Out of the eight types of communication behaviors only one type was symbolic and it was used by child K ('a:nu'<elephant>) in a single instance.

The types of communication behaviors observed with dual orientation were more than that noted in single orientation. Out of the 11 types(Take toy, show, pick toy, reach toy, resist mother's action, vocalization, give, release, throw toy, eating gesture, 'bau'<dog bark>) of communication behaviors considered as IPS anddisplayed by both children, three types (take, show, pick toy) were used commonly by both the children, child K used the three types in 3 instances and child S in 8 instances. Six types (resist mother's action,vocalization, release toy, throw toy,eating gesture, 'bau' <dog bark>) were seen exclusively in child K in 7 instances and two types (reach, give toy) were seen exclusively in child S in 7 instances. Thus, it is interesting to note that overall in dual orientation category, Child K displayed more types than child S (Child K -9 types and child S -5 types). However, the frequency of occurrence of single communication behaviors for child S was greater than for child K (Child K- frequency of 11; child S frequency of 25).Out of the 11 types of communication behaviors, nine were presymbolic and the rest two types were symbolic communication behaviors and were displayed by child K.

In triadic orientation considered under IS, the total types of communication behaviors observed in both the children were seven (take, show, pick toy, 'mella' <slowly>, release toy to mother's grasp, give toy, throw toy). Out of seven, two types (show, release toy) were exclusively seen in child K and four types (pick toy, 'mella'<slowly>, give toy, throw toy) were exclusively seen in child S and only one type (take toy) wasused commonly by both the children. Overall, in triadic orientation category, child S showed more types and greater frequency (5 types with a frequency of 6) compared to child K (3 types with a frequency of 4).

From the above observations, it can be inferred that child K displayed a total of seven deictic gestures (take, show, pick, reach, resist, release, throw) a vocalization, a conventional gesture (eating gesture), a proto-word ('bau'<dog bark>) and a word ('a:nu'<elephant>). In contrast child S displayed six deictic gestures (take, show, pick, reach, give, throw), a vocalization and a word ('mella'<softly>). The common communication behavior displayed by both child K and child S were four deictic gestures (take, show, pick, throw) and vocalization. On analyses of the use of the communication behaviors with respect to the orientation, child K displayed five communication behaviors in twelve instances in single orientation, nine communication behaviors in eleven instances in dual orientation and three communication behaviors in triadic orientation. Whereas child S displayed five communication behaviors in twelve instances in single orientation, five in fourteen instances in dual and five in six instances in triadic orientation. Thus, with respect tosingle, dual and triadic orientation categories, both children displayed a greater variety of communication behaviors and with greater frequency of occurrence with dual and triadic orientation put together than in single orientation. This tendency indicates that both children are mostly intentional communicatorsas the dual and triadic orientation patterns and combination of communication behaviors with symbolic component are listed under intentional presymbolic (IPS) and intentional symbolic (IS) respectively.However, it cannot be ignored that both children have not completely stopped the use of pre-intentional communication, though the type and frequency of occurrences are lower.

4.3 Types and frequency of occurrence of combination of different PCBs or symbolic communication behaviors with single, dual and triadic orientation.

In the adapted CCS, occurrence of combination of more than one PCB (deictic gestures, conventional gestures and vocalizations) with single orientation, dual orientation and triadic orientation (scores 4, 8, 10 respectively) and occurrence of one or more PCBs with one or more symbolic communication behaviors (symbolic gestures, proto-words and words) (score 11) and occurrence of multi symbolic communication behaviors (score 13) represent behavior complexes.Table 4, 5, 6 describes the types of PCBs combined by child K and child S and their frequency of occurrence in single, dual and triadic orientation patterns respectively.

4.3.1 Types and frequency of occurrence of combination of different PCBs with the single orientation

Table 4: Components of behavioral complexes with single orientation and frequency of occurrence in child k and child S.

Combination	Child K	Freq	Child S	Freq
D+D	a) Drop toy and reach for the toy	1	a) Pick toy and give to it to the mother,	1
	b) Release toy and reach for toy	1		
	c) Pick toy and reach for the toy	1	b) Drop toy in one hand and pick another toy	1
	d) Take toy and show toy manipulation	1		
	e) Take toy and resist mother's hand over hand for toy manipulation	1		
	f) Pick toy and drop toy	1		

D+V	g) h)	Pick toy and vocalize Reach toy and vocalize	1 1	c) Take toy and vocalize	1
D+D+V	i)	Pick toy, release toy and vocalize	1		

Child K displayed Single object/event/person orientation with more than 1PCB (Score 4) in 9 instances. Two types of combinations were observed, combination of two deictic gestures (D+D) in 6 occasions; combination of a single or multiple deictic gestures with vocalization (D+V or D+D+V) in 3instances. On the contrary, child S displayed Single object/event/person orientation with more than 1PCB (Score 4) in 3 instances. Combination of two deictic gestures (D+D) in 2 occasions and combination of a single deictic gestures with vocalization (D+V) in a single instance.Combination of two deictic gestures with vocalization (D+D+V) was displayed exclusively by child K. Child K displayed seven deictic gestures in three different combinations and these gestures were drop, reach, release, pick, take, show, resist mother's action. On the contrary child S displayed four deictic gestures pick, drop, give toy and take toy in two different combinations. Child K and child S used three deictic gestures in common which were drop, pick, and take toy.

4.3.2 Types and frequency of occurrence of combination of different PCBs with the dual orientation

Table 5: Components of behavioral complexes with dual orientation and frequency of occurrence in child k and child S.

Combination	**Child K**	**Freq**	**Child S**	**Freq**
D+D	a) Pick toy + Show toy manipulation b) Whole hand point on toy's mouth + Point to own mouth c) Take toy+ Drop toy on mother's lap d) Show toy manipulation + Drop toy e) Reach toy+ Pick toy from ground	3 1 1 1 1	a) Pick toy + give toy b) Give toy + take toy c) Pick + Show d) Take toy + Show toy manipulation e) Take toy + push away toy f) Pick + Give	3 1 1 1 1 1
D+D+D	f) Drop toy + Pick toy + Resist mother's offer of toy	1	g) Show toy + Pick toy + Reach toy	1
D+C	g) Rocking with joy+ Index finger pointing	2	h) Show toy manipulation + Sway head on drum beat	1
D+V	h) Show toy manipulation + Vocalization i) Index finger pointing contact + Vocalization j) Resist hand over hand for sitting + Vocalization	2 1 1	i) Show toy manipulation + Vocalization j) Reach toy + Vocalization k) Point with stick + Vocalization l) Show + Vocalize	1 1 1 1
D+D+V	k) Reach toy + Take toy + Vocalization l) Release toy to mother + Take toy + Vocalization m) Head point + Vocalization + Index finger pointing	1 1 1	-	

Child K displayed dual orientation with more than 1PCB (Score 8) in 17 instances. Three types of combinations were observed, combination of two or more deictic gestures (D+D, D+D+D) in 8 occasions; combination of a deictic gesture with a conventional gesture in 2 instances; combination of single or multiple deictic gestures with vocalization (D+V or D+D+V) in 7 instances. Combination of two deictic gestures with vocalization (D+D+V) was displayed exclusively by child K. On the contrary, child S displayed dual orientation with more

than 1PCB (Score 8) in 14 instances. Combination of two or more deictic gestures (D+D, D+D+D) in 9occasions; combination of deictic gesture with conventional gestures in 1 instance and combination of a single deictic gesture with vocalization (D+V) in 4 instances. Child K displayed eight deictic gestures in five different combinations and these gestures were drop, reach, release, pick, point, take, show, resist mother's action and a conventional gesture of rocking with joy. On the contrary Child S displayed seven deictic gestures, pick, give, show, reach, push, point and take toy and a conventional gesture of swaying head to the drum beat in four different combinations. Child K and child S used five deictic gestures in common which were pick, point, show, reach, and take.

4.3.3 Types and frequency of occurrence of combination of different PCBs with triadic orientation

Table 6: Components of behavioral complexes with triadic orientation and frequency of occurrence in child k and child S.

Combination	**Child K**	**Freq**	**Child S**	**Freq**
D+D	a) Pick toy + show toy manipulation	1	a) Take toy + give toy	1
D+C	-		b) Give toy + swing with song	1
D+V	b) Show toy manipulation + Vocalization c) Pick toy+ vocalization d) Take toy+ vocalization	1 1 1	c) Point to toy + Vocalization	1
D+D+V	-		d) Push away toy + reach toy + 3vocalization e) Pick toy + give toy + vocalization	1 1
D+C+V	Pick toy+Hands extended with toy for help + vocalization	1	-	
D+D+D+C	-		f) Give toy + Clap + pick toy + kick toy	1

Child K displayed triadic orientation with more than 1PCB (Score 10) in 5 instances. Three types of combinations were observed in child K, combination of two deictic gestures (D+D) in 1occasion; combination of a single deictic gestures with vocalization (D+V) in 3 instances; combination of a deictic gesture, a conventional gesture and vocalization in 1 instance which was a unique complex displayed by only child K. On the contrary, child S displayed dual orientation with more than 1PCB (Score 10) in 6 instances. Combination of two deictic gestures (D+D) in 1occasion; combination of a deictic gesture and a conventional gesture in 1 instance; combination of a single or multiple deictic gestures with vocalization (D+V; D+D+V) in 3 instances. Child S displayed a unique combination of three deictic gestures with a conventional gesture (D+D+D+C) in one instance.Combination of deictic gesture with a conventional gesture and vocalization (D+C+V) was displayed exclusively by child K and combination of two deictic gestures with vocalization (D+D+V) and three deictic gestures with a conventional gesture (D+D+D+C) was the unique combination displayed only by child S. Child K displayed three deictic gestures in three different combinations and these gestures were pick, take, show and a conventional gesture of extending hand with toy for help. On the contrary Child S displayed seven deictic gestures pick, push, point, reach give, take toy and kick toy and two conventional gesture of swaying head to the song and clapping. Child K and child S used two deictic gestures in common which were pick and take toy.

4.3.4 Types and frequency of occurrence of combination of different PCBs and symbolic communication behaviors

Table 7: Components of behavioral complexes with PCBs and symbolic communication behaviors and frequency of occurrence in child k and child S.

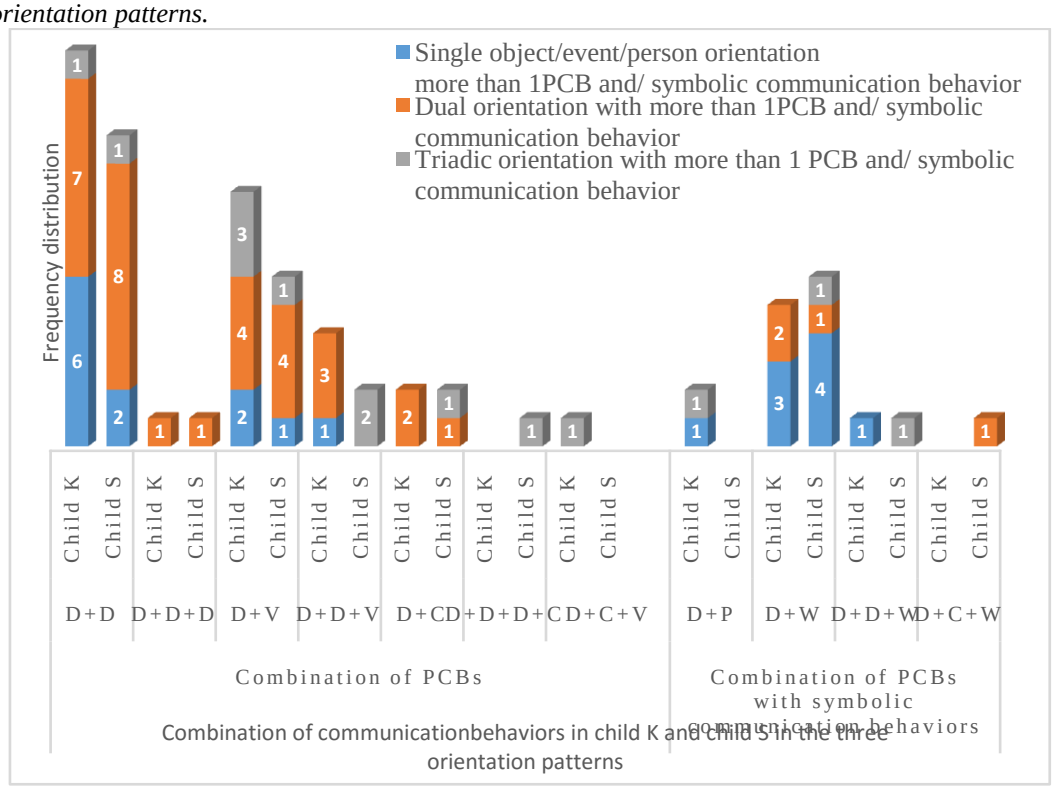
Combination	**Child K**	**Freq**	**Child S**	**Freq**
D+W	a) Point (dual orientation) + a:ku <put> b) Point (Single	1 1	a) Show toy (single orientation) + mella<softly>	1 1

	orientation) + a:nu<elephant> c) Point (Single orientation) + KaNNu<eye> d) Show toy (dual orientation) + koDu<give> e) Give toy (single orientation) + a:na <elephant>	1 1 1	b) show toy manipulation (single orientation) + attempt to make less sound and says mella<softly> c) Point (single orientation) + alli<there> d) Point (single orientation) + KoDu<give> e) Pull toy (triadic orientation) + ida<this> f) beya<don't want>+Kick toy (dual orientation)	 1 1 1 1 1
D+D+W	f) Pick + Throw (Single orientation) + a:na<elephant>	1	g) Pick toy + show toy (triadic orientation) + blu<blue colour>	1
D+P	g) Reach for toy (Triadic orientation) + aumaum<eating> h) Point (Single orientation) + bau<dog bark>	1 1	-	
D+C+W	-		h) Push toy + head shake (dual orientation) + beya<don't want>	1

Child K displayed combination of single or more than one PCB (deictic gestures-D, conventional gestures- C, vocalization-V) with symbolic communication (words- W, proto words- P) (Score 11) in 8 instances. Three types of combinations were observed, combination of one or more deictic gestures with word (D+W; D+D+W) in 6 occasion; combination of deictic gesture with proto word (D+P) in 2 instances. Child S displayed combination of single or more than one PCB (deictic gestures-D, conventional gestures- C, vocalization-V) with symbolic communication (words- W, proto words- P) (Score 11) in 8 instances. Combination of one or more deictic gestures with word (D+W; D+D+W) in 7 occasions; combination of deictic gesture with a conventional gesture and word (D+C+W) in 1 instance. Combination of deictic gesture with protoword (D+P) was displayed exclusively by child K and combination of deictic gestures, conventional gesture and a word was the unique combination displayed only by child S. On further analysis, Child K displayed different 6 deictic gestures in the complexes (Point, show, give, pick, throw, reach), two proto words ('aumaum' <eating>, 'bau' <dog bark>) 4 different words ('a:ku'<put>, 'a:nu' <elephant>, 'koDu' <give>, 'kaNNu' <eye>). Child S displayed 5 deictic gestures (show, point, pick, pull, push), a conventional gesture (head shake) and 5 words ('mella' <softly>, 'alli'<there>, 'koDu' <give>, 'beya' <don't want>, 'ida' <this>).

According to the Local homology model, between 18-20 months there is a growth in vocabulary size and its resultant word combinations, growth in multiword utterances and this growth correlates with the multi-scheme gestural combinations (Thal& Tobias, 1994 [22]). However, in the present study, even though the children were of 18 moths age (Child K 18 months 5 days, Child S 17 months 20 days) both children did not show multiword utterances at all, multi-gestural combination were demonstrated in abundance as depicted in the table 4,5,6,and 7. The possible reasons for this discrepancy may be that, the studies considered to support the model considered children between 18 and20 months of age, but the present study has considered children at 18 months of age. So, before children begin to demonstrate multiword utterances and multi-scheme gestures which are symbolic in nature, there might be a transition stage where the children try to combine the PCBs and then combine PCBs with symbolic communication behaviors. This stage of transition may occur at around 18 months and may not last for a longer period.

4.3.5 *Types and frequency of occurrence of combination of PCBs /symbolic communication behaviors with the three orientation patterns.*



*D- Deictic gesture, V-Vocalization, C- conventional gesture, P-Proto-word, W-word

Figure 3: Types and frequency of occurrence of combination of PCBs /symbolic communication behaviors with the three orientation patterns.

In adapted CCS it is not required to classify the PCBs that occur on score 11, combination with symbolic communication behaviors under the three orientation. However, in the present study these combinations were analyzed and represented under the respective orientation. Figure 3 represents the summary of combinations of PCBs and symbolic communication behaviors and their frequency of occurrence as displayed by child K and child S in single, dual and triadic orientation. In other words, it summarizes the tables 4, 5 6 and 7. From the figure 3 it can be noted thatin single, dual and triadic orientation patterns the two children displayed seven different combinations PCBs which included combination of 1) two deictic gestures (D+D) 2) three deictic gestures (D+D+D) 3) a deictic gesture and vocalization (D+V) 4) two deictic gestures and vocalization (D+D+V) 5) a deictic gesture and a conventional gesture (D+C), 6) three deictic gestures and a conventional gesture (D+D+D+C) 7) a deictic gestures a conventional gesture and vocalization. The two children displayed four combinations of PCBs with symbolic communication behaviors which were 1) a deictic gesture and a protoword (D+P), 2) a deictic gesture and a word (D+W), 3) two deictic gestures and a word (D+D+W) and 4) a deictic gesture a conventional gesture and a word (D+C+W).

Both children displayed greater combinations of PCBs than PCBs with symbolic communication behaviors. With respect to the three orientation patterns in combinations of PCBs, most combinations occurred with dual orientation (5 combinations) followed by equal number of combinations (three combinations each) in single and triadic orientation in child K. In contrast, most combinations occurred with triadic orientation (5 combinations) followed by dual orientation (three combinations) and finally single orientation (two combinations) in child S. Thus, considering the different combinations of PCBs and frequency of occurrence in dual and triadic orientation put together in both children, both children are mostly intentional communicators. However, it cannot be ignored that both children continue to use behavior complexes with single orientation which are considered as pre-intentional communication, to satisfy some of their communication requirements,though the type and frequency of occurrences are lower.

On analyses of the combinations of PCBs and symbolic communication behaviors, it is obvious that in all the combinations, the presence of deictic gestures is common in both children. Further analyses of the deictic gestures revealed thatapart from the deictic gestures listed in the CCS, additional deictic gestures were observed in the children such as shirking the hand away from mother's grasp to resist her action, picking toy from floor, taking toy from mother, and release of grasp of the mother on the toy, showing the toy etc. In other words, it would be difficult to limit the deictic gestures as a set of predefined behaviours. Although few deictic gestures

can be identified easily, in practice however, with careful observation many behaviours/actions of children which serve a communication function may be treated as a deictic gesture. These could occur spontaneously in interaction with communication partner. In other words, deictic gesture types could be an open set. When interaction samples are annotated, it is essential for the investigators to observe, discern and note the actions that occur as a part of child's use of the object and whether it serves any communication purpose/function.

IV. CONCLUSION

With the aim of analyzing the pre-symbolic and symbolic communication behaviors of two typically developing children with mean age of 1.6 years in unscripted free-play interaction context with their respective mothers the communication complexity scale (Brady et al., 2012 [1]; Christensen in 2014 [38]) was adapted.One of the salient adaptations is demarcation of deictic gestures as presymbolic communication forms and symbolic gestures as symbolic forms of communication; and Redefining score 11 as Combination of Presymbolic and symbolic behaviors, 12 as Single symbolic behaviors and introduction of score 13 to represent Multi symbolic behaviors. On application of CCS on the samples of mother-child interaction obtained from Child K and S, it was observed that the frequency of occurrence of behaviours in both children on CCS were strikingly similar. The highest frequency for both children in PIPS behaviors was on score 3 and 4. Highest frequency on IPS behaviors was on 7 and 8 and for IS behaviors, it was on 11. Among PIPS, IPS and IS both children scored highest frequency on IPS. Thus the present study demonstrates successful adaptation of CCS for typically developing children who are predominant users of intentional communication and in the context of free-play mother child interaction. In addition, the similarity in the communication profile of the two children depicted on adapted CCS is attributed to the similarity in the developmental domains of the children, similarity in the socio-demographic backgrounds of the mothers and language environment of the children.

As part of the second objective, the performance of both children were further analyzed to find the types of presymbolic and symbolic communication behaviors that occurred as a single entity along with the three orientation patterns namely single, dual and triadic orientation. Both children displayed a greater variety of communication behaviors and with greater frequency of occurrence with dual and triadic orientation put together than in single orientation, thus the children were predominant users of intentional communication. In addition, though the frequency of occurrence of pre-symbolic and symbolic communication behaviors matched for both children, the types varied significantly.

Third objective of the study was to analyze of the patterns of combination of pre-symbolic and symbolic communication behaviors with single, dyadic and triadic orientation. With respect to the three orientation patterns in combinations of PCBs, most combinations occurred with dual orientation (5 combinations) followed by equal number of combinations (three combinations each) in single and triadic orientation in child K. In contrast, most combinations occurred with triadic orientation (5 combinations) followed by dual orientation (three combinations) and finally single orientation (two combinations) in child S. Thus, considering the different combinations of PCBs and frequency of occurrence in dual and triadic orientation put together in both children, both children are mostly intentional communicators.

Thus both children demonstrated varied strength in their communication behaviors. While the child K displayed strength in terms of greater frequency of usage in pre-symbolic and symbolic forms both in isolation and combination, Child S displayed strength in displaying more number of combination patterns of communication behaviors and also more types of communication behaviors which were combined to form a single complex.

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REFERENCES

[1] Brady, N. C., Fleming, K., Thiemann-bourque, K., Olswang, L., Dowden, P., Saunders, M. D., & Marquis, J. (2012). Development of the Communication Complexity Scale, *American Journal of Speech-Language Pathology, 21*, 16–28.

[2] Oller, D. K. (2000). *The Emergence of the Speech Capacity*. Mahwah, NJ: Lawrence ErlbaumAssociates.

[3] Bates, E., Benigni, L., Bretherton, I., Camaioni, L.,&Volterra,V. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press.

[4] Bates, E., Camaioni, L. &Volterra, V. (1975). *The acquisition of performatives prior to speech*. Merrill-Palmer Quarterly, 21, 205–226.

[5] Bruner J. 1975. The ontogenesis of speech acts. *Journal of Child Language,2*, 1–19

[6] Masur, E. F. (1983). Gestural development, dual-directional signaling, and the transition to *words. Journal of Psycho- linguistic Research, 12*, 93–109.

[7] Acredolo, L., & Goodwyn, S. (1988). Symbolic gesturing in normal infants. *Child Development, 59*, 450–466.
[8] Iverson, J., Caprici, O., & Caselli, M. (1994). From communication to language in two modalities. *Cognitive Development, 9*,23–43.
[9] Nelson KE. (1974). Concept, word, and sentence: interrelations in acquisition and development. *Psychological Review, 8*, 267–285.
[10] Bloom L. 1973. *One Word at a Time*. The Haugue: Mouton.
[11] Wetherby, A., Cain, D. H., Yonclas, D. G., & Walker, V. G. (1988). Analysis of intentional communication of normal children from the prelinguistic to the multiword stage. *Journal of Speech and Hearing Research, 31*, 240–252.
[12] Carpenter, M., Nagell, K., &Tomasello, M. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, Serial, 255, 63(4).*
[13] Zinober, B., &Martlew, M. (1985). Developmental changes in four types of gesture in relation to acts and vocalizations from ten to twenty-one months. *British Journal of Developmental Psychology, 3,* 293–306.
[14] Crais, E., Douglas, D. D., &Campbel, C. C. (2004). The Intersection of the Development of Gestures and Intentionality. *Journal of Speech, Language, and Hearing Research, 47,* 678–694.
[15] Bigelow, A. E. (2003). The development of joint attention in blind infants. *Development and Psychopathology, 15(2),* 259-275.
[16] Mundy, P., &Jarrold, W. (2010). Infant joint attention, neural networks and social cognition. Neural networks: *Journal of the International Neural Network Society, 23(8-9*),985.
[17] Reinbartsen, D. B. (2000). Preverbal communicative competence: An essential step in the lives of infants with severe physical impairment. *Infants & Young Children, 13(1),* 49-59.
[18] Mundy, P., Willoughby, J. (1998). *Nonverbal communication, affect, and social emotional development*. In A.M. Wetherby, S.F. Warren & J. Reichle (Eds.), Transitions in prelinguistic communication: Preintentional to intentional and presymbolic to symbolic (Baltimore: Paul H. Brookes, 1990) 111-133.
[19] Beuker, K. T., Rommelse, N. N. J., Donders, R., &Buitelaar, J. K. (2013). Development of early communication skills in the first two years of life. *Infant Behavior and Development, 36*, 71-83
[20] Mundy, P., & Newell, L. (2007). Attention, joint attention, and social cognition. *Current Directions in Psychological Science, 16(5),* 269–274.
[21] Mundy, P., Sigman, M., &Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders, 20(1)*,115–28.
[22] Thal, D., & Tobias, S. (1994). Relationships between Language and Gesture in Normally Developing and Late Talking Toddlers. *Journal of Speech and Hearing Research, 37*, 157-170
[23] Bates, E., Bretherton, I., Shore, C., &McNew, S. (1983). *Names, gestures and objects: Symbolization in infancy and aphasia*. In K. Nelson (Ed.), Children's language,.(Hillsdale, NJ: Erlbaum, 1993) 4, 59-123
[24] Brownell, C. (1988). Combinatorial skills: Converging developments over the second year. *Child Development, 59*,675-685.
[25] Fenson, L., & Ramsay, D. (1981). Effects of modeling action sequences on the play of twelve-, fifteen-, and nineteen-month-old context in early lexical development. *Journal of Child Language, 8*, 565-582.
[26] McCune-Nicollch, L. (1981). Toward symbolic functioning: Struc- ture of early pretend games and potential parallels with language. *Child Development, 52*, 785-797.
[27] McCune-Nicollch, L., &Bruskin, C. (1982). *Combinatorial competency in play and language*. In D. Pepler& K. Rubin (Eds.), The play of children, Current theory and research(New York: Karger, 1982) 30-45
[28] Shore, C. (1986). Combinatorial play: Conceptual development and early multiword speech. *Developmental Psychology, 22*,184-190.
[29] Fenson, L., Dale, P., Reznick, S., Thal, D., Bates, E., Hartung, J., et al. (1993). *The MacArthur Communicative Development Inventories: User's guide and technical manual*. San Diego, CA: Singular.
[30] Wetherby A., &Prizant, B. (1993). *Communication and Symbolic Behavior Scales*. Chicago: Riverside.
[31] Swapna, N., Jayaram, G., Prema, K. S., &Geetha, Y. G. (2010). *Checklists for preschool children with communication disorders (0-6years).* All India Institute of Speech and Hearing: Mysore
[32] Rowland, C. (1990, 1996, 2004*). Communication Matrix*. Unpublished manuscript. Portland, OR: Oregon Health & Science University
[33] Rowland, C. & Fried-Oken, M. (2010) Communication Matrix: A clinical and research assessment tool targeting children with severe communication disorders. *Journal of Pediatric Rehabilitation Medicine, 3,* 319-329.
[34] Petrovich-Bartell, N., Cowan, N., & Morse, P. (1982). Mothers' perceptions of infant distress vocalizations. *Journal of Speech and Hearing Research, 25*, 371-376.

[35] Mundy, P., Delgado, C., Block, J., Venezia, M., Hogan, A. & Seibert, H. (2003*). A manual for the abridged Early Social Communication Scales (ESCS).* Coral Gables, FL: University of Miami, Department of Psychology.
[36] Mullen, E. (1995). *Mullen Scales of Early Learning*: AGS Edition. Circle Pines, MN: AGS.
[37] Zimmerman, I., Steiner, V., & Evatt Pond, R. (2003). *Preschool Language Scale*, (Fourth Edition. San Antonio, TX: The Psychological Corporation, 2003).
[38] Christensen, K. A. (2014). *Assessing Intentional Communication in Typically Developing Infants Using the Communication Complexity Scale*. (Unpublished master's thesis). University of Washington, Washington.
[39] Brady, N. C., Thiemann-Bourque, K., Fleming, K., & Matthews, K. (2013). Predicting language outcomes for children learning augmentative and alternative communication: child and environmental factors. *Journal of Speech, Language, and Hearing Research, 56(5),* 1595–612. http://doi.org/10.1044/1092-4388(2013/12-0102)
[40] Vandereet, J., Maes, B., Lembrechts, D., & Zink, I. (2010). Eliciting proto-imperatives and proto-declaratives in children with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities, 23,*154–166.
[41] Werner, H., & Kaplan, B. (1963). *Symbol formation*. (New York: Wiley, 1963))
[42] Bzoch, K., & League, R., (1971). *The receptive expressive emergent language scale*. Austin, Tx: Pro-Ed.
[43] Sloetjes, H., &Wittenburg, P. (2008). *Annotation by category-ELAN and ISO DCR*. In Proceedings of the 6thInternattional Conference on Language Resources and Evaluation (LREC 2008).
[44] Venkatesan S. (2004). *Toy kit for kids with developmental disabilities: User manual*. Mysore: All India Institute of Speech and Hearing.
[45] Goldin-Meadow, S., Goodrich, W., Sauer, E., & Iverson, J. (2007). Young children use their hands to tell their mothers what to say. *Developmental Science, 10(6),* 778–85. http://doi.org/10.1111/j.1467-7687.2007.00636.x

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Communication Repertoire of Typically Developing Children between 6-12 Months in Free Play Mother-Child Dyadic Interaction

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ABSTRACT: Background: Communication is a complex process and reflects developments in cognition, motor, socio-emotional and language domains. Children between 6-12 months age fall in a unique stage of development where they are acquiring verbal mode of communication but still can effectively communicate with nonverbal modes such as eye gaze orientation and gestures.
Methods: Nine mother-child dyads were videorecorded in free play mother-child interaction. The videos were analyzed to study the distribution of single, dual and triadic eye gazes orientation in the interaction. The gestural repertoire of the children was also studied as seven subcategories and their mean percentage of occurrence. Results: children used single eye gaze orientation the most (M=84.34%), followed by dual (M=10.02%) and then triadic eye gaze orientation (M=5.64%). In gesture/action category children used action with communication partner (deictic gestures) to the maximum extent (M=48.71%) followed by toy exploration (M=33.51%), alerting behavior (M=10.44%), toy manipulation (M=3.13%), mother assisted action (M=2.89%) and conventional gestures (M=1.32%). The children did not demonstrate use of any representational gesture.
Discussion: Thus children of 6-12 months age considered in the study were predominantly preintentional communicators as demonstrated by highest percentage of occurrence of single eye gaze orientation. Also the children displayed highest mean percentage of occurrence of preintentional presymbolic gesture/action (49.97%) followed by intentional presymbolic gestures (48.17%) and lastly intentional symbolic gestures (1.32%). Thus children of 6-12 months age considered in the study were also mostly presymbolic communicators.

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I. INTRODUCTION

Communication behaviors in children between 6-12 months age is not only an expression of needs and sharing of information but also is a reflection of constant complexly integrated developments in cognition, motor, socio-emotional and language domains. Children between 6-12 months age not only progress through graded stages of sensorimotor development in the cognitive domain[1,2] as described by Piaget in his cognitive theory,[3] but also acquire postural stability by beginning to sit, crawl, walk with assistance and display acquisition of fine motor skills[4]. Children mature in the socio-emotional domain by being connected to the environment and attaining self-regulation by being able to decide on which sensory stimuli to attend and how to respond[5]. It is difficult to compartmentalize behaviors children exhibit into those resultant of development in any one domain, as there are interactions in the development in all these domains and development in one will influence development in the other.

The present study explores the communication repertoire of typically developing children between 6-12 months in mother-child free play interaction context under eye gaze orientation and use of gesture/action.

Theoretical basis for development of intentionality

Based on whether the child has an understanding of how objects and persons can be means to obtain something[6] or not, the communication behaviors of 6-12 month old children can be dichotomized into goal-oriented/ intentional and preintentional communication behaviors. By definition, intentional communication is a specific signal that child deliberately uses to affect another's behaviour[7]. The key marker of intentionality is development in joint attention evidenced mainly as eye gaze orientation between the adult and object of interest[8]. Joint attention has been viewed as central to children's later skills of social cognition which is defined as the child's understanding of one's own sensory-motor intentionality (or his ability to control his behaviors to achieve a result) and the intentionality of others[8,9,10] which is referred to as theory of mind, an understanding of

thoughts and beliefs of others that emerges at around 4-5 years of age[11]. So, the development of intent to communicate stems from social interaction. One of the key theories that stress the fundamental role of social interaction in the development of cognition is Vygotsky's theory. In contrast to Piaget's cognitive theory that argues that the cognitive development originates from independent explorations in which children build knowledge of their own. Vygotsky's theory proposes that cognitive development stems from social interactions from guided learning within the zone of proximal development as children and their partners co-construct knowledge[12]. Vygotsky views adults as important source of cognitive development who transmit their culture's tools of intellectual adaptation that children internalize[12].

The term joint attention has often been used to characterize the whole complex of social skills and interactions, and joint attention has been hypothesized to underlie the earliest forms of human cultural learning[13]. Shifts in eye gaze orientation between referent and partner are a means to demonstrate coordinated joint engagement[14]. This pattern of eye gaze shift between the referent and partner is termed the dual eye gaze orientation. Later on children begin to use triadic gaze [14,15] which is defined as three-point gaze shift to connect an adult with an object or event of interest. Thus, visual attention is the most directly observable measure of joint engagement[8]. The development of coordinated joint attention is a hallmark of shift from preintentional to intentional communication[9,16,17]. The process of transformation from preintentional to more intentional communication behaviors occurs at around 9-12 months of age [8,18,19].

Research has demonstrated that children initially learn to direct their crying and gestures toward their communication partner[20]. The instances where child focuses the visual attention towards an object of interest or activity or towards mother are referred to as single eye gaze orientation[20]. One of the functions that these instances of single eye gaze orientation serve is passive joint engagement[14]. Mothers play a major role of being supporters of passive joint engagement; in effect free their infants of the need, to shift attention back and forth between the mother and the object of mutual concern[14]. However, instances of passive joint engagement are difficult to be differentiated from those in which children direct their gaze only to the mother or object of interest.

In addition to visual attention, gestures are one of the early indicators of intentionality. By definition, gestures are actions produced with the intent to communicate and are typically expressed using fingers, hands, and arms, but can also include facial features (e.g., lip smacking for "eating") and body motions (e.g., bouncing for "horsie")[15].

Thus the major overt behaviors that can be considered as mark of intentional communication in young children, who are not yet communicating verbally are; the ability of the infant to alternate eye gaze orientation between object and the communication partner, emergence of deictic gestures and use of word-like sounds [22,23,24,25]. However, the present study aims to explore only eye gaze orientation and use of gestures.

Theoretical basis for development of presymbolic behaviors

Based on whether the behaviors are representing an object or event directly or representing a referent by means of another symbol, the communication behaviors can be presymbolic or symbolic. The term Presymbolic communication originated from the Piaget's term "symbolic representation", used in the stages of cognitive development in infancy[3]. "Symbolic" representation implies the portrayal of an absent object and/or make-believe representation; the child substitutes objects or events (signifiers) for other objects or events (the signified)[3]. Symbolic representation in infancy is preceded by the sensori-motor actions. These sensori-motor actions are called the presymbolic actions (Pre- before in time or order; Symbolic- Serving as a symbol; Symbol- A thing that represents or stands for something else). A major portion of the Presymbolic actions serve as the presymbolic communication behaviours. Examples of presymbolic communication behaviours exhibited by infants and toddlers include vocal behaviors such as cooing, fussing; generalized body movements such as stiffening of body, facial grimaces[26]; ritualized gestures and deictic gestures[27]. Most commonly studied deictic gestures include reaching, showing, giving, and pointing[28]. Presymbolic communication behaviors are concrete, oriented towards practical results and focused on actions. Ultimately these behaviors are private, idiosyncratic and distinctive to each infant[29]. Furthermore, in presymbolic communication behaviors, there exists a direct and often physical relation between the communicator and the message being sent[30]. Symbolic behaviors on the other hand are characterized by the "symbolic function" which is defined as the ability to call forth purposefully one entity to stand for/represent another [31]. Use of symbolic gestures [also referred to as representative gestures and conventional gestures], protowords and words [32] are categorized as symbolic communication behaviors. At around 12 months, children also start using word approximations or words and representational gestures[19]. These have been regarded as symbolic communication behaviors.

Eye gaze orientation

Following the direction of adult gaze requires the infants to look at the adult and then recognize the direction of gaze of the adult and look at the object of interest that is in that direction. So, gaze following is a subset of dual eye gaze orientation. To study infants' ability to follow the gaze of other persons, a cross sectional study with 24 infants in the age range of 2-14 months was carried out[33]. 30% of 2-4-month-olds, 39% of 5-7-month-olds, 67% of 8-10-month-olds, and 100% of 11-14-month-olds followed the adult's line of regard on at least one of two trials. Furthermore, 80% of "negative trials" involved no response: when infants responded, they usually did not turn in the wrong direction. These results suggest that even infants as young as 2-4 months of age can follow others' direction of gaze. The drawback of the study was in the interpretation of gaze following; there was no distinction between the infants following the adult's gaze with intention and by chance. A more systematic study of infant gaze following using the same procedures[32] with more experimental controls was carried out[34]. Results revealed that, it was not until around 10 months of age that infants reliably followed the direction of adult gaze. Thus, age of emergence of gaze following, a subset of dual eye gaze orientation is not clear. However, it can be inferred that dual eye gaze orientation emerges well before 12 months of age, indicating that the intentional communication demonstrated by eye gaze orientation emerges before the child celebrates its first birthday.

In an attempt to understand development of joint-engagement skills, a study was carried out [35]. 28 infants were followed longitudinally at 3-month intervals between the ages of 6 and 18 months. The frequency of occurrence of joint engagement, the percentage of time spent in joint engagement, and the mean duration of joint-engagement episodes all increased with age. Thus, only about a third of 6- and 9-month-olds were observed at least once in coordinated joint engagement with their mother, 68% of 12-month olds, 89% of 15-month-olds, and all the 18-month-olds engaged in joint engagement at least once[36]. Another study suggested that, 8-9 months is the key age in the emergence of joint engagement [37].

In summary, it can be said that, the emergence of intentional communication indicated by dual and triadic gaze and gaze following behaviors emerges as early as 2-4 months of age[33] and gradually not until 15-18 months of age develops to its fullest potential[36] . However, the key age of emergence of joint engagement is 8-9 months[37].

Gestures/Actions with communication partner

Two primary categories of gestures: deictic and representational gestures have been identified [21]. Deictic gestures establish reference by calling attention to or indicating an object or event[7], thus can be interpreted by their context. This quality of deictic gestures makes it to be used with a wide spectrum of objects and/or events (e.g., reaching for a cup, pointing to a dog running)[21]. Research has indicated that earliest deictic gestures emerge between 7 and 9 months of age [8,19]. Several researchers have reported that, deictic gestures often first appear as open-handed reaching, reaching to be picked up, ritualized gestures to indicate refusal (e.g., pushing away), or consistent attention-getting body movements such as repeated leg and arm flailing[18,19,38]. Deictic gestures are often divided into contact and distal gestures[39]. Distal gestures are said to be typically later appearing (10–12 months). It was suggested that, the transition from contact to distal gestures may be related to the symbol acquisition process[39]. The second major type of gestures, representational gestures, both establishes reference and indicates a particular semantic content. Representational gestures can be object-related gestures that signify some feature of the referent (e.g., cupped hand to mouth to represent "drinking," "sniffing" a flower), referred to by some as "symbolic" gestures [40]. They can also be culturally defined conventional gestures that are used socially (e.g., waving "bye," finger to lips for "quiet") and represent some action or concept rather than a specific object[21].

In an attempt to study the emergence of deictic and representational gestures, twelve typically developing children were followed from 6 months to 24 months [19]. Behaviour regulation, joint attention and social interaction were the three broad functions of communication [41] under which the emergence of gestures were reported. Twenty gestures under behaviour regulation, seventeen gestures under social interaction and ten gestures under joint attention were reported. Among these, few were combination of a gesture and vocalization/word/word approximation and few were words or only looking. Thus, a portrait of hierarchical emergence of gestures, vocalization for communicative purposes and use of words or word approximations and their combination in children was provided by the authors. One of the attempts to describe communication behaviours of children who communicated with mainly presymbolic means resulted in the development of communication complexity scale[20]. In communication complexity scale (CCS), the authors not only provided opportunity to document as subtle an action as alerting behaviour to but also more complex expressions in phrases covering a wide spectrum of communication level from preintentional to intentional non symbolic to intentional symbolic communication.

Thus, between 6-12 months age of typically developing children deictic gestures emerge and stabilizes and representational gestures begin to emerge. Children in this age range exhibit a wide range of gestures and form an interesting population to study gesture use.

Need for the study

The present study explores the proportion of preintentional and intentional communication behaviours under eye gaze orientation and proportion of preintentional presymbolic, intentional presymbolic and intentional symbolic communication behaviours under gesture/action category in typically developing 6-12 year old children.

Previous research on dual and triadic gaze orientation have mostly used structured tasks involving scripted interactions[33, 34]. As these results cannot be directly generalized to free play interaction tasks, the present study plans to consider use of single eye gaze orientation and its proportion of use in relation to dual and triadic eye gaze orientation in the context of free play mother-child interaction.

Research on study of gestures in children has considered parent interview or gestures in scripted interaction contexts as their source of data[20]. However, there are relatively fewer studies which have explored occurrence of gestures in free play interactions. There are even fewer studies that have studied the types of gestures and their frequency in the context of free play interactions. The present study planned to fill the gap in the literature and to study the proportion of different types of gestures that can be classified under preintentional presymbolic, intentional presymbolic and intentional symbolic gesture/actions. This information may be useful in determining the typical trend of interaction.

The results of the study will throw light on the distribution of different subgroups of gestures/action that can occur in mother child free play interaction and also the proportion of occurrence of single, dual and triadic eye gaze orientation.

II. METHODS

Aims and Objectives of the study: The present research aimed to study the communication behaviors of 6 to 12 months old typically developing (TD) children. The objectives of the study were to analyze a) Eye gaze orientation and b) Gesture/Action

Participants: Nine mother-child dyads with typically developing children [Female- 6; Males-3] within the age of 6 to 12 months [Mean age- 8.87 months; SD- 1.9] were considered through Purposive sampling. All mother-child dyads were Asians and residents of Mysore and Bangalore districts of Karnataka, India. The native language of all dyads was Kannada. All children were screened for risks for communication disorders during pre natal, natal and post natal period using High risk register [42]. Children with no complaints of hearing or visual impairments; and no reports of systemic diseases requiring frequent medical attention were considered for the study. It was ensured that children were healthy without any kind of upper respiratory tract infection or fever during data collection. Children in an alert state and cooperative for interaction were considered. To determine the receptive and expressive language age of the children, REELS[43] was administered [Mean RLA -8.3 month; SD- 2; Mean ELA -8.3 month; SD- 2]

All mothers were between 20 to 35 years. The Mothers had formal education for minimum 7 years. All mothers had normal speech, language and physical abilities and were healthy as reported. Seven out of nine mothers were homemakers and two were working. All nine dyads were from middle socio-economic status as determined by using Socio-economic status scale[44].

Ethical procedures: The ethical guidelines for bio-behavioural research involving human subjects prescribed by All India Institute of Speech and Hearing was followed. The study was proposed before AIISH Ethics Committee (AEC), and an approval was sought. Accordingly, a written informed consent was obtained from all the participants before data collection.

Procedure Each mother-child dyad was initially interviewed; the language age of the child was determined by administering REELS (Bzoch & Legue, 1971) followed by determining the Socio-economic status. The mothers were described about the aims and objectives of the study and a written informed consent was obtained. Preparation of the site for data collection involved removing the unwanted toys and dangerous objects from child's reach and fixing the tripod stand, camera and matting the floor. The mother was given the toy kit and was instructed to use one toy at a time for interaction with the child. The mother-child interaction was video recorded using a single video camera to obtain a sample of 1 hour duration. The video recording was done in 3 sittings within a gap of 1 to 3 days in between the two sittings.

Materials. The "Toy kit for infants with developmental disabilities"[45] was used. The toys were classified into three groups based on the characteristics, accordingly toys resembling living creatures or miniature objects were considered in the first category, toys that could be mechanically manipulated were considered in the second category and toys that produce sound or light on manipulation were considered in the third category. Table 3 provides the list of toys that was used in the study under three different categories.

Table 1 Toys used in the study

Toys resembling living creatures/miniature objects	**Toys that could be mechanically manipulated**	**Toys that produce noise/light on manipulation**

A.	Doll, Mickey mouse	D.	Stack of rings	G.	Rattles, Office bell
B.	Hand puppet	E.	Blocks, Connector set	H.	Drum, Xylophone
C.	Push along Car/train	F.	Soft, colored Ball	I.	Torch

Task. Semi-structured free play interaction was employed for the study. Mothers were instructed to interact with the child as naturally as possible. As each child's preference for toys was different, the time spent with each toy was not fixed. The procedure was made flexible to give complete opportunity for the mother-child dyad to use any toy from the available kit for any duration of time. To ensure that the toys selected were uniform across the dyads the categorization of toys was made. Each dyad had to play with three toys each from each group of toys as given in table 3.

Setup. The video recording of the communication interaction between the mother-child dyad was in a silent room with minimal auditory and visual distractions and optimal lighting and ventilation. The seating of the participants was on the matted floor. The child was made to sit facing the camera. The mother sat either across from the child or on one of the child's sides, so the dyad was clearly in view of the camera lens. A single camera placed right in front of them at a distance of minimum 1 to 2 meters on the tripod stand was used to record the video samples. If the child was in the sitting position, it was ascertained that the dyads' face and upper body profile was covered in the video. If the child was in supine/prone position, the child's complete body and the mother's upper body profile was covered in the video (Fig 1).

Instrumentation. A digital video camera, Sony DCR-SR88 with 60X optical zoom and its accessories was used. An Asus Pro P53E laptop with basic accessories was used to transfer, store, segment, code and annotate the data. In addition, a Creative headset HS-150 with on-the-ear, supra-aural closed headset, behind-the-neck design was used. Corel VideoStudio pro X4 was used for editing the video samples and EUDICO Linguistic Annotator [46], ELAN version 4.7.3 was used for data segmentation, coding and annotation.

Recording. The interaction between the mother and child dyad was video recorded by the researcher in the natural context without participating in the activities directly. Each mother-child interaction was video recorded for a total duration of 1 hour. After the completion of the video recording the dyads were given a small token of appreciation for participating in the study.

Data analyses

Editing. Each mother-child dyad was captured in free-play interaction context facilitated by the use of a set of fifteen toys listed in table for 60 minute duration. However, to maintain uniformity in the interaction across the dyads, interaction with only three toys from each category of toy set was considered. With each toy an interaction lasting for 60 to 70 second was considered. Thus, a meaningful interaction sample of 60-70 second from each of the nine toys, made a total duration of 540 to 630 second (9-10.5 min) per dyad. The process was carried out in three levels.

Level 1: The interaction samples which had clear visibility of the child's and mother's upper body profile were separated from those which did not and the latter was eliminated in each mother-child dyad's video. The interaction samples done in 2-3 sittings were combined into a single video file.

Level 2: The interaction chains were aligned in a uniform order on three separate tracks in Corel video studio X4 Pro software. Mother-child interactions elicited through use of toys resembling living creatures/miniature objects (toys ABC) were arranged in the first, interaction with toys which could be

mechanically manipulated (toys DEF) were aligned in the second and interaction with toys that produced noise/light on manipulation (toys GHI) were aligned in the third track. Table 1 details the toys and the codes used for the toys. Finally, these three tacks were combined into a single track retaining the same sequence. Thus the single track contained the videos of mother-child interaction in a standard order across the dyads.

Level 3: The process of selection of the 60-70s meaningful interaction was carried out using the following criteria.

1) An interaction with a specific toy with maximum number of communication acts of the child was present when compared to other interaction chains with the same toy. [A communication act is defined as a vocalization or gesture that is mostly directed toward the communication partner and which serves a communicative function[47]].
2) Only one interaction chain per toy ranging in duration of 60 to 70 seconds was considered for analyses. This resulted in the sample of 540 to 630 second (9-10.5 min) duration for each dyad.
3) In case if the meaningful interaction chain did not last for 60s then two interaction chains were combined together to form a minimum of 60 second duration video sample.
4) If two interaction chains had the same number of communication acts, the interaction chain with maximum variety of the communication behaviors was considered.
5) The interactions were chosen in such a way that it contained a clear beginning and ending of the communication act.

Segmentation.

Each dyad's edited meaningful sample of 9-10.5 min duration was considered for further analyses. The communication interaction between the mother-child dyads were segmented into mother's communication turns and child's communication turns on two tiers of the annotation software (ELAN). The basic assumption behind the segmentation was that, the communication process occurs alternatively turn by turn between the communication partners. The turns had clear beginnings from either of the dyad member; however there were overlaps between the child's and mother's communication behaviours on the time domain after the turn began. For the present study only annotations on the child's communication turns tier was considered.

Annotation.

The child's communication behaviors were annotated under two major groups 1) Eye gaze orientation and 2) Gesture/action.

- Eye gaze orientation (E) was annotated as the communication partner or object on which the eye gaze of the child was fixed or the child's eye gaze shifted between any two points E.g., If the child's eye gaze alternated between a toy and the communication partner, annotation was "Toy-mother".
- Gestures/actions with communication partner (G) were annotated as a short keyword or a phrase. This code was annotated as "0" if there was no gesture in the given segment. In any given communication turn, up to a maximum number of three gestures/actions were annotated. E.g, G- mouth toy in mother's hand- reach toy.

Inter judge reliability

Two qualified SLPs were considered for evaluating interjudge reliability for the annotated samples. These SLPs were trained with samples which were not included in the study for a minimum of 3 hours to ensure that the annotations and codes used for analyses were well understood. Randomly two mother child dyads considered in the study were picked and the trained SLPs were made to agree or disagree with the annotations on the two domains in child's communication turns. Mean percentage agreement was calculated considering the percentage agreement with the researcher and SLP1 and researcher and SLP2. Overall, 89.12% mean percentage of agreement was found for annotations of child's communication turns done under the two categories. The disagreements were later discussed and annotations were modified on the consensual judgment.

Intrajudge reliability

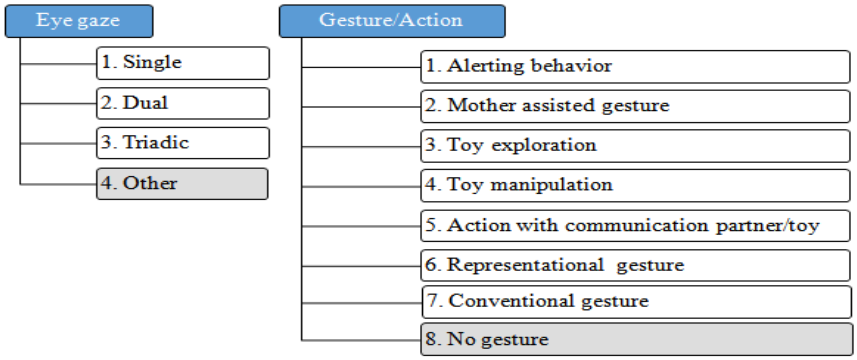
The researcher carried out the annotation of the video samples of the two mother -child dyads after a time gap of 3 months. Overall, 93.01% of intra judge reliability for child's communication was obtained for the annotations done under for eye gaze orientation and gesture/action.

Data tabulation

The total number of communication turns segmented and analysed for the nine children were 781. The annotations done under the two categories, eye gaze orientation and gesture/action were separated. The

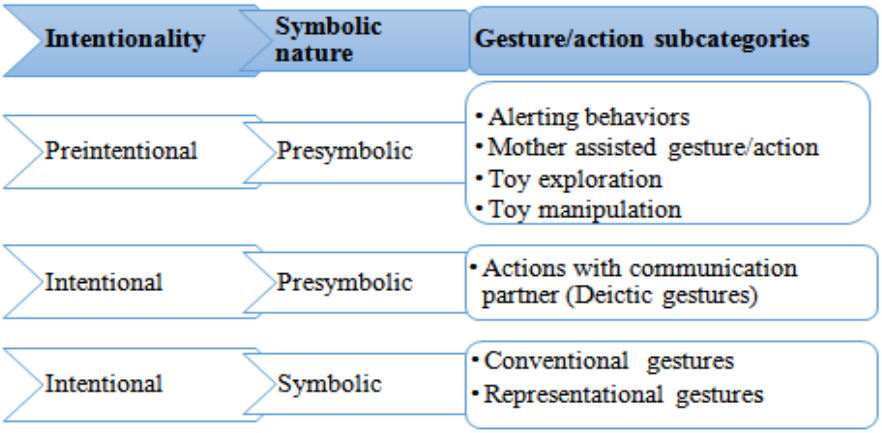
annotations under Gesture/Action formed a complex in most communication turns. In order to breakdown the complex, in each communication turn up to three gestures/actions were annotated. These annotations were further analysed and grouped into subgroups as shown in fig 2. Analyses was carried out with all the subgroups, except for others subgroup of the eye gaze orientation code, No gesture (annotated as '0') in the gesture/action code.

Fig 2 Grouping of the Annotations for the two codes



Gesture/action

Fig 3 Schematic representation of gesture/action subcategories classified based on intentionality and symbolic nature



Gesture/action with communication partner was divided in to seven subgroups as shown in the fig.3. The subgroups were hierarchically divided based on whether the behaviors were preintentional or intentional and on the symbolic nature of the gesture/action. Intentionality in a gesture or action was determined by the very act of performing any gesture by the child. Deictic gestures, representational gestures and conventional gestures were considered as intentional forms of communication. Symbolic nature of gestures/actions were determined as per the definition "Symbolic" representation implies the portrayal of an absent object and/or make-believe representation; the child substitutes objects or events (signifiers) for other objects or events (the signified)[3]. Alerting behavior, Mother assisted action, Toy exploration, Toy manipulations were subgroups of gesture/action category that were considered as preintentional presymbolic gestures.

Unlike previous studies that have not considered mother assisted gesture/action, toy exploration and toy manipulation as communicative when demonstrated in the scripted interactions[3], the present study considers these as communicative. There are two reasons, firstly the present study used free-play mother-child interaction and not scripted interaction between the child and examiner[20]. The reason why scripted interactions or structured interactions do not consider mother assisted gesture/action as communicative because, these are considered "Prompted communication acts" since these lack the quality of being initiated by the child. Toy exploration and toy manipulation are not considered communicative because, these behaviors are usually not active interaction and lack initiation of the interaction from the child's part. However, the present study considers even passive participation of child in the interaction as communicative so these are annotated and scored. The objective of the present study was to explore the proportion of preintentional presymbolic, intentional presymbolic and

intentional symbolic gestures to get a clear picture of the communication repertoire of the children between 6-12 months age.

III. RESULTS

The present research aimed to analyze the communication behaviors of Typically developing (TD) children between 6 to 12 months of age. The objectives of the study were firstly, to explore proportion of use of preintentional communication behaviors indicated by the use of single eye gaze fixation on the communication partner or the object of interest to proportion of use of Intentional communication marked by the use of dual and triadic gaze under eye gaze orientation. Second objective of the study was to explore the proportion of use of preintentional presymbolic gesture/action indicated by use of alerting behaviors, mother assisted actions, toy exploration and toy manipulation to the proportion of use of intentional presymbolic communication behaviors indicated by use of gesture/actions with communication partner (deictic gestures) to proportion of use of intentional symbolic gesture/action indicated by the use of conventional and representational gestures.

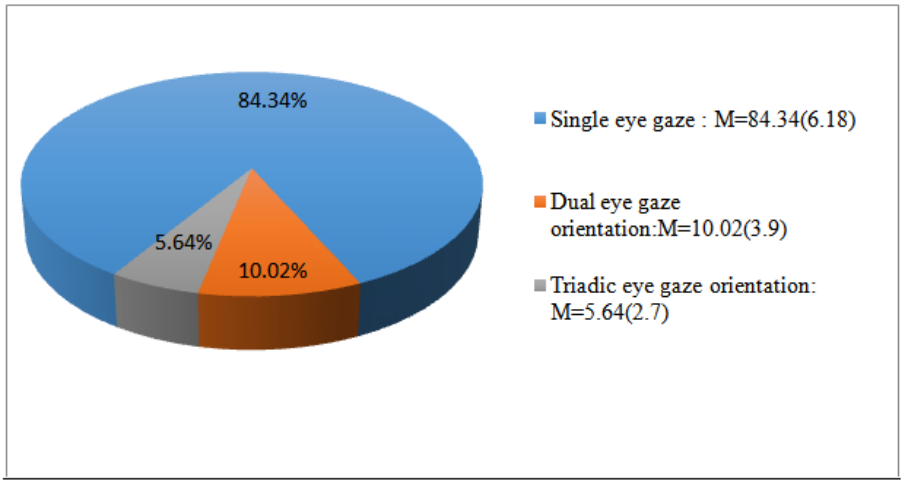
The total number of communication turns analyzed was 781. The number of annotations for eye gaze orientation patterns (Ne) considered were 754 and for gesture/action with communication partner (Ng) were 1,208. The number of occurrence of three subgroups of eye gaze orientation and seven subgroups of Gesture/action were calculated and converted into percentage. Table 2 depicts the mean percentage of occurrence and standard deviation of subgroups of eye gaze orientation and gestures/actions with communication partner demonstrated by the children considered in the study.

Table 2 Mean, SD of 6-12 year old TD children across communication behaviors

Communication behaviours of typically developing children between 6-12 months (Ne- 754; Ng-1208)				
	Communication behaviours based on symbolic nature	Communication behaviors based on intentionality	Subgroups of communication behaviors	Mean Percentage (%), SD
Eye gaze orientation	NA	Preintentional	Single	84.34 (6.18)
		Intentional	Dual	10.02 (3.90)
			Triadic	5.64 (2.70)
Gesture/Action	Presymbolic	Preintentional	Alerting behavior	10.44 (5.90)
			Mother assisted action	2.89 (2.34)
			Toy exploration	33.51 (8.49)
	Presymbolic		Toy manipulation	3.13 (2.93)
		Intentional	Action with com partner/toy (deictic gestures)	48.71 (5.87)
	Symbolic	Intentional	Conventional gesture	1.32(0.99)
			Representational gesture	0.00

Eye gaze orientation:

Fig 4 Mean percentage and Standard deviation of occurrence of three subgroups of eye gaze orientation

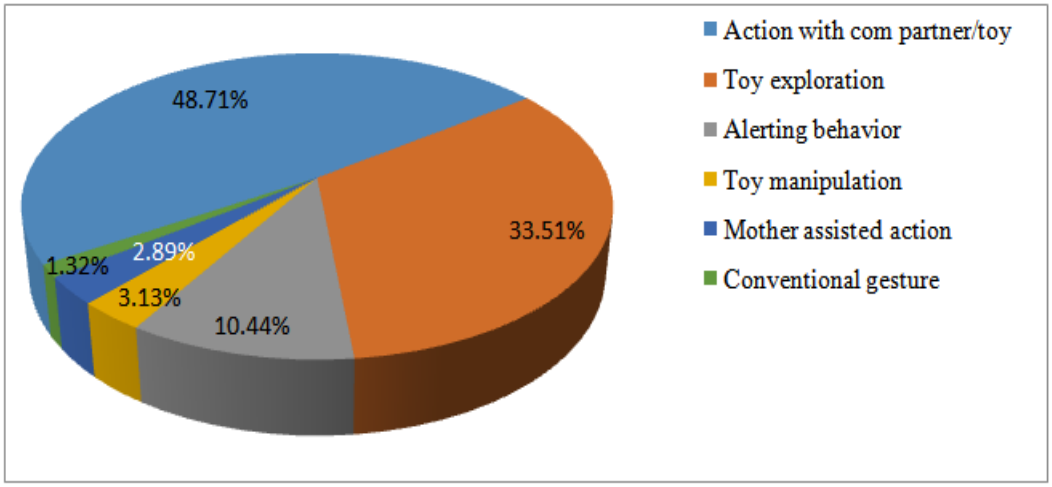


As per table 2 and fig 4, the mean percentage of occurrence of single eye gaze (M=84.34%, SD=6.18) was maximum, followed by dual eye gaze orientation with mean of 10.02% (SD=3.9) and then triadic gaze with

mean of 5.64% (SD=2.7). Fig 4 depicts the mean percentage of occurrence of three subgroups of eye gaze orientation. From fig 4, it can be inferred that preintentional communication behavior reflected by use of single eye gaze orientation occurred to the maximum extent in relation to intentional communication behaviors marked by the use of dual and triadic gaze together (10.02%+5.64%=15.66%).

Gesture/Action

Fig 5 Mean percentage of occurrence of six subgroups of gesture/action



The graphical representation in fig 5 depicts that, the mean percentage of occurrence of Action with communication partner/toy (deictic gestures) was 48.71% (SD=5.87), followed by occurrence of toy exploration for 33.51% (SD=8.49), followed by occurrence of alerting behavior for 10.44% (SD=5.9). Mean percentage of occurrence of Toy manipulation was 3.13% (SD=2.93), Mother assisted actions was 2.89% (SD= 2.34) and Conventional gesture was 1.32% (SD=0.99). No children in the group exhibited any representational gesture.

From table 2, it can be noted that, the distribution of preintentional presymbolic gesture/actions demonstrated by the children by the use of alerting (M=10.44%), mother assisted gesture/actions (M=2.89%), toy exploration (M=33.51%) and toy manipulation (M=3.13%) together summed upto 49.97%. The proportion of use of intentional presymbolic gesture/actions as demonstrated by the use of gesture/action with communication partner (deictic gestures) accounted for 48.71%. The proportion of use of intentional symbolic gesture/action demonstrated by the use of conventional gestures occurred to the least extent with the mean percentage of occurrence of 1.32%. So, the children of 6-12 months age considered in the present study displayed preintentional presymbolic gesture/actions to the maximum extent followed by intentional preymbolic gesture/action and exhibited use of intentional symbolic gesture/actions to the least extent.

Preintentional presymbolic gesture/action

Toy exploration (M=33.51%): The table below provides the list of behaviours that were considered as toy exploration behaviours. The list indicates that by carrying out toy exploration, the children mostly derived tactile, kinesthetic, visual, auditory stimulation from the toys.

Table 3 List of toy exploration behaviours and total number of occurrence

Toy exploration behaviors	No. of Occurrence
Mouths toy	153
Pick toy from floor	76
Turn toy up and down	72
Drops toy	47
Remove toy from mouth	24
Touch toy	12
Shake toy	11
Spreads toys on floor	9
Total	**404**

Alerting behaviours (M=10.44%): Indicates that the children displayed visible or audible change that appears to be in response to specific stimulus but without the orientation[20]. The table below provides the list of alerting behaviours exhibited by the children and the total number of occurrence of each alerting behaviour.

Table 4 List of alerting behaviours and total number of occurrence

Alerting behavior	No. of occurrence
Flap hands and legs to indicate displeasure/excitement	31
Change position of discomfort	28
Cessation of activity	18
Search for sound source/ person	17
Turn towards mother	17
Turn away from mother	15
Total	**126**

Toy manipulation and Mother assisted actions: The mean percentage of occurrence of toy manipulation (M=3.13%) and mother assisted actions (M=2.89%) were the least among the other subcategories of preintentional presymbolic gesture/action.

Intentional presymbolic gesture/action

Actions with communication partner (Deictic gesture) (M=48.71%): It comprised of the most popularly studied deictic gestures such as showing, pointing, reaching. In addition, release of toy to mother's grasp, throwing toy, pushing toy away, moving towards mother, pushing away mother were also annotated and considered. As depicted in the table 5, the gestural repertoire of children consisted of twenty different deictic gestures, eleven (55%) were used by more than five children and nine (45%) were used by lesser than five children. The total number of occurrence of deictic gestures displayed more than five children was 526 (90.22%) and that by lesser than five children was 57(9.78%).

Table 5 List of alerting behaviours and total number of occurrence

Deictic gestures displayed by more than five children	No. of Occurrence	Deictic gestures displayed by lesser than five children	No. of Occurrence
Reach for toy/mother	205	Bang on toy/ toy on floor	15
Take toy/pull toy from mother's hand	120	Cover face with hand	7
Resist/protest mother's action	55	Push away toy/mother	7
Release toy to mother's grasp	40	kick toy	6
Hold mother/toy	28	Point to mother/toy(index finger)	6
Move towards mother/toy	21	Extend arms to be picked up	5
Show toy manipulation/show toy	17	Hit mother/toy	4
Give toy/offer toy	15	Pat toy/mother	4
Throw away toy	11	Place toy elsewhere	3
Climb/sleep on mother	7	**TOTAL**	**57**
Move away from mother/toy	7		
TOTAL	**526**		

Intentional symbolic gesture/action

Conventional gestures: Mean percentage of occurrence of conventional gestures was 1.32%. In the gesture mode, this subgroup is the only one which comprise of intentional and symbolic communication behaviours.

Table 6 List of conventional gestures and total number of occurrence

Conventional gestures	No. of occurrence
Give it to me hand gesture	3
Blow raspberries	2
Dances to the music	2
Kiss mother/toy	2
Touching heads	2
Call someone at a distance by hand	1
Handshake (offer hand)	1
Head shake	1
Hi-five with mother	1
Hug mother/toy	1

TOTAL	**16**

Representational gestures: There was no display of representational gestures by any child considered in the study.

IV. DISCUSSION

Eye gaze orientation:

Single eye gaze orientation (M= 84.34%) was predominantly used in free play mother-child interaction task in the present study. From this observation, it can be inferred that, the visual attention of the child is mostly focused on the communication partner or the toy that is used for eliciting interaction. Since single eye gaze orientation on the toy of interest is not differentiable from the passive joint engagement, it can also be interpreted as that, a subset of the single eye gaze orientation which had the child fix gaze on the toy of interest could be considered as the child being engaged in passive joint attention[14].

Dual eye gaze orientation occurred for a mean percentage of 10.02%. Most studies reported in the review have demonstrated higher percentage of occurrence of dual orientation than that reported in the present study. Eye gaze following, a subset of dual eye gaze orientation was reported to be 66.5% and 100% in 8-10 month old and 11-15 month old children in one of the studies reviewed[33]. The reason for these contrasts may be attributed to methodological differences. In the study reported[33] examiners were the interaction partners, the task was a structured approach in which the examiner established eye contact and turned to fixate gaze on a signal light placed at 90° right and 90° left of the examiner, there were no toys used in the interaction to elicit gaze following. On the other hand, the present study used mother as communication partner, free play interaction as the task and used toys for interaction with the child; and annotated eye gaze orientation between the mother and object of interest in the child's communication turns for dual eye gaze orientation. Another study reported that, infants reliably followed the direction of adult gaze at around 10 months[34]. The present study is in line with these results considering that the children between 6-12 months age considered in the present study embeds the age range of children considered in the study quoted [34](the present study four out of nine children were between the ages 10-12 months).

The occurrence of dual (M=10.02%) and triadic gaze (M= 5.64%) in the present study though not as higher in proportion as single eye gaze orientation indicates two interesting points. First, it strengthens the research that reports 8-10 months as the key age of emergence of joint engagement [37], as the present study have considered children between 6-12 months age. Secondly, it can be inferred that infants may be involved in passive joint engagement that is indicated by child's eye gaze fixation to the target toy reflected as a subset of single eye gaze orientation in the context of free play mother child interaction. Thus children between 6-12 months age exhibit predominantly pre intentional communication through single eye gaze orientation and though in smaller proportion intentional communication as well through dual and triadic gaze. These findings may be considered to be in support of the previous research [9, 16, 17], that 6-12 month is an age group of transition from pre intentional to intentional communication.

Preintentional presymbolic gesture/action:

Alerting behaviors, Mother assisted actions, toy exploration and toy manipulation are the subgroups considered under preintentional presymbolic gesture/action. It is interesting to note that, the mean percentage of occurrence of these four groups together was 49.97%, which is almost half the gesture/action repertoire of the children between 6-12 months age considered in the study, because studies reported in the literature have used scripted or structured interaction between child and examiner [20] or child and mother[19] do not consider these four subgroups of gesture/action as communication behaviors. In addition, studies that consider these as communicative in parental reports do not present the percentage of occurrence of these out of the overall communication repertoire of the child. (E.g., studies that have used communication and symbolic behaviors checklist)

Toy exploration: Children in the present study have demonstrated toy exploration for a mean percentage of occurrence of 33.51%, highest among preintentional presymbolic gesture/action. Toy exploration is suggestive of active involvement of the children to assimilate and accommodate the use of toys as described by Piaget in the sensorimotor stage of cognitive theory. The demonstration of toy exploration for 33.51% of the gesture/action repertoire supports the cognitive theory that proposes to view the child as an active learner[3].

Alerting behaviours: Occurrence of this subgroup as third highest subgroup of gesture/action category for 10.44% mean percentage indicates that children in 6-12 months age spend considerable amount of time in getting alerted by some particular stimuli that surround them. This subgroup was considered because, these are the most primitive type of responses to the wealth of stimuli that is presented during the interaction context in multiple sensory modalities including auditory, visual and tactile modes. Children between 6-12 months would have some experience with the stimuli that surround them owing to the exposure in the first six months.

However, even between 6-12 months of age they still respond to the stimulus more as a reflex displaying behaviours such as Flapping hands and legs to indicate emotions, changing position, cessation of activity, searching for source of sound or person, turning towards mother or away from mother. The socio-emotional development dictates the child's choice to attend to stimuli and respond to it[5]. Occurrence of alerting behavior in the present study for a mean percentage of 10.44% may be indicative that mother-child interaction facilitates socio-emotional development in children.

Toy manipulation: Mean percentage of occurrence of toy manipulation was 3.13%. Toy manipulation comprised of behaviours that involved children skilfully using or playing with the toy. It included acts such as, building blocks to form tower, stacking rings, throwing ball in the direction of the caregiver or catching ball, beating drum or xylophone. Each toy included in the study required mastery over specific set of motor and cognitive skills. Considering that these behaviours occurred only for 3.13% and in comparison to toy exploration which occurred for 33.51% is considerably lesser, it can be inferred that children between 6-12 months are still mastering their prerequisite motor and cognitive skills through toy exploration and slowly progressing to more skilful display of cognitive and motor developments through toy manipulation.

Mothers constantly provided linguistic input during the display of toy exploration and toy manipulation subgroups as well as other subgroups of gestural mode of communication. So, these instances can be considered as opportunities for learning to manipulate and explore toys through mediation of skills through language input, which is the central line of social interaction theory proposed by Vygotsky.

Mother assisted actions: Mean percentage of occurrence of mother assisted gesture/action was 2.89%. Presence of this subgroup for considerably low mean percentage indicates that children between 6-12 months of age prefer to perform gesture/actions on their own and there is little scope for mothers to physically teach children to perform gesture/action. Presence of mother assisted actions provides evidence for zone of promixal development proposed by Theory of social interaction[48]. However, in contrast since the percentage of occurrence of toy exploration and toy manipulation outnumbers the percentage of occurrence of mother assisted actions; it strengthens the Piaget's cognitive theory which considers child as an active learner.

Intentional presymbolic gesture/action

Actions with communication partner (Deictic gesture): Mean percentage of occurrence of actions with communication partner (Deictic gesture) was 48.17%, the highest occurring subgroup in gesture/action category. In comparison with other subgroups in gesture mode, Action with communication partner (Deictic gesture) is unique because it is the only subgroup comprising of intentional communication behaviors which are still presymbolic. The occurrence of action with communication partner to the maximum extent in the study implies that children between 6-12 months of age are mostly clear with their intentions to communicate and mostly choose presymbolic gestural mode for communicating.

It is interesting to note that almost half (55%) the variety of deictic gestures with communication partner, displayed by more than five children has maximum percentage of occurrence (90.22%) and 45% is displayed by lesser than five children and has lesser number of occurrence (9.78%). From this observation it can be inferred that children use diverse deictic gestures for communication, some are preferred by more children than others.

On closer observation of the deictic gestures, out of twenty, 15 (75%) deictic gestures are contact gestures [take toy/pull toy from mother's hand, resist mother's action displayed by holding onto the toy tighter or taking off hand/toy from mother's grasp, release toy to mother's grasp, hold mother/toy, show toy manipulation/show toy, give toy/offer toy, climb/sleep on mother, bang on toy/toy on floor, cover face with hand, push away toy/mother, kick toy, hit mother/toy, pat toy/ mother, place toy elsewhere] and five variety (25%) are distal gestures [reach for toy/mother, move towards mother/toy, move away from mother/toy, point to mother/toy, extend arms to be picked up]. When the number of occurrences is considered, the contact gestures have been displayed for 339 times (58.15%), in contrast the distal gestures are displayed for 244 times (41.85%). From these observations it can be inferred that contact gestures have greater variety of expressions, than distal gestures and have greater number of occurrences, 95 (16.3%) than distal gestures. It can also be inferred that 25% of the variety of distal gestures accounting for 41.85% of occurrence, indicates that children between 6-12 months age considered in the study are in the process of transitioning to the symbolic acquisition, considering that occurrence of distal gestures are indicative of transition to symbolic acquisition (McLean, McLean, Brady, and Etter, 1991). This point is also supported by the presence of conventional gestures in the gestural repertoire of the children considered in the present study.

Intentional symbolic gesture/action

Conventional gestures: Considering that the mean percentage of occurrence is only 1.32%, it can be inferred that children between 6-12 months are yet in the process of mastering intentional symbolic

communication. It is interesting to note that this is the only subgroup in the gestural mode which is both intentional and symbolic in nature and is displayed to the least extent by 6-12 month children. It implies that this age group has a lot of scope to develop. On further analyses, it can be noticed that, none of the conventional gestures were displayed for more than three times not only indicating that the number of occurrence was relatively sparse but also indirectly indicating that none of the conventional gestures were used by more than three children out of nine children.

When compared to deictic gestures, representational gestures are more dependent on modeling by caregivers[49]. Their use therefore may be more reflective of parents' cultural beliefs and practices than are deictic gestures. Thus, representational gesture use appears to be affected by social context, the amount of direct parental input, and family beliefs. Considering the definition of conventional gestures[21] as those used socially (e.g., waving "bye," finger to lips for "quiet") and represent some action or concept rather than a specific object, the argument by holds good for conventional gestures as well. Thus it can be implied that group of mothers considered in the present study did not use gestures themselves with the children to provide models for the children to follow.

Representational gestures: There was no display of representational gestures. Children's representational gestures emerge within familiar games and routines and later becomes less context bound [21,40]. Studies have reported that the emergence of representational gestures is at around 12 months of age[23, 40]. However, in the present study children between 6-12 months of age did not demonstrate use of any representational gestures. One possible reason for this could be that representational gestures may not be a part of some parent interaction styles [19]. Considering that the present study involved mother-child interaction, mostly with the use of toys, the context could have limited the use of representational gestures. A better opportunity to observe the use of representational gestures could have been to observe the parent describe and demonstrate social games that they play with their child and "social" gestures they and their child use as suggested by the previous research[19]. Asking families about their individual practices and creatively considering all types of social interactions can help professionals evaluate both the child's opportunities and use of gestures. In this way, ethnic, linguistic, and cultural background of the family can be considered cautiously and assessment process can be tailored appropriately[50].

V. CONCLUSION

The present study aimed to explore the percentage of occurrence of single, dual and triadic eye gaze orientation under eye gaze orientation category and distribution of number of occurrence of seven hierarchical gesture action category based on intentionality and symbolic nature of the gesture/action displayed by 6-12 month old typically developing children in mother-child free play dyadic interaction context. Predominant usage of single eye gaze orientation was demonstrated by the children followed by dual and triadic gaze, implying that children of this age range are mostly peintenional communicators through eye gaze modality. Preintentional preysmbolic gesture/action was displayed to the maximum extent followed by intentional presymbolic gestures and then the intentional symbolic gestures. This trend of greater usage of preintentional presymbolic and intentional presymbolic gesture/action indicates that children in the age range are mostly presymbolic communicators in gestural modality. Though the occurrence of intentional symbolic gestures was sparse, presence of these indicates that the children are transitioning from the presymbolic to symbolic mode of communication.

The study reported gesture/action under seven subcategories including alerting behaviors, mother assisted gesture/action, toy exploration, toy manipulation, deictic gestures, conventional gestures and representational gestures. It is interesting to note that 49.97% of occurrence of gesture/action comprised of first four subcategories of gesture/action which is least researched. In, addition it also implies that these subcategories form a solid portion of communication repertoire of children's gesture/action mode. It is also fascinating to note that symbolic gestures displayed by use of conventional gestures (1.32%) formed a part of gestural repertoire implying that children between 6-12 months age display a wide spectrum of gestures.

REFERENCES

[1]. Ginsberg HP, Opper S. Piaget's Theory of Intellectual Development. 1988, 3rd ed. Englewood Cliffs, NJ: Prentice-Hall.
[2]. Labinowicz E. The Piaget primer: Teaching, learning, teaching. 1980, Menlo Park, CA: Addison-Wesley.
[3]. Piaget J. The Construction of Reality in the Child. 1954, New York: Basic Books.
[4]. World Health Organization Multicentre Growth Reference Study Group. World Health Organization motor development study: Windows of achievement for six gross motor development milestones. Acta Paediatrica Supplement.2006;450,86–95.
[5]. National Research Council & Institute of Medicine. From neurons to neighborhoods: The science of early childhood development. 2000, Washington, DC: National Academy Press.

[6]. Granlund M, Olsson C. Efficacy of communication intervention for presymbolic communicators. Augmentative and Alternative Communication.1999;15,25-37.
[7]. Bates E. Language and context: The acquisition of pragmatics. 1976, New York: Academic Press.
[8]. Carpenter M, Nagell K, Tomasello M. Joint social and communicative of age 9 to 15 months. Monographs Of The Society For Research In Child Development.1998;63(4),179. https://doi.org/10.2307/1166214.
[9]. Mundy P, Newell L. Attention, joint attention, and social cognition. Current Directions in Psychological Science.2007;16(5), 269–274.
[10]. Tomasello M. Joint attention and cultural learning, In M. Tomasello (Ed.), The cultural origins of human cognition (pp. 56 – 93). 1999,Cambridge, MA: Harvard University Press.
[11]. Baren-Cohen S, Ring H. A model of the mind reading system: Neuropsychological and neurobiological perspectives in P. Mitchell and C. Lewis (Eds). Origins of an understanding of mind, Hillsdale, 1994, NJ: Erlbaum.
[12]. McLeod, S. A. (2014). Lev Vygotsky. Available in www.simplypsychology.org/vygotsky.html, retrieved on 10.06.2018
[13]. Tomasello M. Joint attention as social learning. In C Moore & P Dunham (Eds.), Joint attention: Its origins and role in development. 1995, Hillsdale, N.J.: Erlbaum.
[14]. Bakeman R, Adamson L. Coordinating attention to people and objects in mother-infant and peer-infant interactions. Child Development.1984; 55, 1278-1289.
[15]. Trevarthen C. Communication and cooperation in early infancy: A description of primary intersubjectivity. In M. Bullowa (Ed.), Before speech: The beginnings of interpersonal communication. 1979, Cambridge: Cambridge University Press.
[16]. Beuker KT, Rommelse NNJ, Donders R, Buitelaar J K. Development of early communication skills in the first two years of life. Infant Behavior and Development.2013;36, 71-83.
[17]. Mundy P, Sigman M, Kasari C. A longitudinal study of joint attention and language development in autistic children. Journal of Autism and Developmental Disorders.1990;20(1), 115–28
[18]. Carpenter RL, Mastergeorge AM, Coggins TE. The acquisition of communicative intentions in infants eight to fifteen months of age. Language and Speech.1983;26, 101–116.
[19]. Crais E, Douglas D, Campbell C. The intersection of the development of gestures and intentionality. Journal of Speech, Language, and Hearing Research.2004;47, 678–694.
[20]. Brady NC, Fleming K, Thiemann-Bourque K, Olswang L, Dowden P, Saunders M D, Marquis J. Development of the Communication Complexity Scale. American Journal of Speech–Language Pathology. 2012;21, 16–28.
[21]. Iverson J,Thal D. Communicative transitions: There's more to the hand than meets the eye. In A. Wetherby, S.Warren, & J. Reichle (Eds.), Transitions in prelinguistic communica- tion (pp. 59–86). 1998, Baltimore: Brookes.
[22]. Bates E, Camaion, L, Volterra V. The acquisition of performatives prior to speech. Merrill-Palmer Quarterly.1975; 21, 205-224.
[23]. Bates E, Benigni L, Bretherton I, Camaioni L, Volterra V. The Emergence of Symbols: Cognition and Communication in Infancy. 1979, Academic Press: New York.
[24]. Bruner J. The ontogenesis of speech acts. Journal of Child Language.1975;2: 1–19.
[25]. Masur EF. Gestural development, dual-directional signaling, and the transition to words. Journal of Psycholinguistic Research.1983;12(2): 93–109.
[26]. Rowland C, Fried-Oken M. Communication Matrix: A clinical and research assessment tool targeting children with severe communication disorders. Journal of Pediatric Rehabilitation Medicine. 2010;3,319-329 . doi:10.3233/PRM- 2010-0144
[27]. Tomasello M. Constructing a language: A usage-based theory of language acquisition. 2003, Cambridge, MA: Harvard University Press.
[28]. Masur EF. Mothers' responses to infants' object-related gestures: Influences on lexical development. Journal of Child Language.1982;9, 23–30.
[29]. Flavel J H. Cognitive development (2nd ed). 1985,New Jersey: Prentice Hall
[30]. Crimmins DB, Gothelf CR, Rowland C, Stillman RD, Linam A, Williams C. Communication. In Kathleen Mary Huebner, Jeanne Glidden Prickett, Therese Rafalowski Welch, & Elga Joffee. Hand in hand: Essentials of communication and orientation and mobility for your students who are deaf-blind. Voume I 1995 (pp. 159- 182). New York: AFB press.
[31]. Goodwyn S, Acredolo L. Symbolic gesture versus word: Is there a modality advantage for the onset of symbol use? Child Development.1993; 64, 688–701.

[32]. Camaioni L, Aureli T, Bellagamba F, Fogel A. A longitudinal examination of the transition to symbolic communication in the second year of life. Infant and Child Development.2003;12(1), 1–26. https://doi.org/10.1002/icd.
[33]. Scaife M, Bruner JS. The capacity for joint visual attention in the infant. Nature. 1975;253(24), 265-266.
[34]. Corkum V, Moore C. Development of joint visual attention in infants. In C. Moore & P. Dunham (Eds.), Joint attention: Its origins and role in development. 1995, Hillsdale, NJ: Erlbaum
[35]. Bakeman R, Adamson LB. Coordinating attention to people and objects in mother-infant and peer- infant interaction. Child Development. 1984;55, 1278-1289.
[36]. Adamson LB, Bakeman R. Affect and attention: Infants observed with mothers and peers. Child Development. 1985;56, 582-593.
[37]. Saxon T, Frick J, Colombo J. A longitudinal study of maternal interactional styles and infant visual attention. Merrill-Palmer Quarterly.1997;43, 48–66.
[38]. Thal D, Tobias S. Communicative gestures in children with delayed onset of oral expressive vocabulary. Journal of Speech & Hearing Research. 1992;35, 1281–1289.
[39]. McLean J, McLean L, Brady N, Etter R. Communication profiles of two types of gesture using nonverbal persons with severe to profound mental retardation. Journal of Speech and Hearing Research. 1991;34, 294–308.
[40]. Acredolo LP, Goodwyn SW. Symbolic gesturing in normal infants. Child Development. 1988;59,450-466.
[41]. Bruner J. The social context of language acquisition. Language and Communication. 1981;1, 155–178.
[42]. Yathiraj A, Sameer P, Jayaram M. Infant hearing screening. A comparison of different techniques. Journal of Indian Speech and Hearing Association. 2002;16, 1-14
[43]. Bzoch K, League R. The receptive expressive emergent language scale. 1971, Austin, Tx: Pro-Ed.
[44]. Venkatesan S. Socio-economic status scale. Revised version of NIMH Socio Economic Status Scale-1993. 2011, Mysore: AIISH.
[45]. Venkatesan S. Toy kit for kids with developmental disabilities: User manual. 2004, Mysore: AIISH
[46]. Sloetjes H, Wittenburg P. Annotation by category-ELAN and ISO DCR. In Proceedings of the 6th Internattional Conference on Language Resources and Evaluation (LREC 2008).
[47]. Wetherby AM, Prizant BM. Communication and symbolic behavior scales manual: Normed edition. 1993,Chicago: Riverside.
[48]. Vygotsky LS. Mind in society: The development of higher psychological processes. 1978,Cambridge, MA: Harvard University Press.
[49]. Zinober B, Martlew M. Developmental changes in four types of gesture in relation to acts and vocal-izations from 10 to 21 months. Br J Dev Psychol. 1985;3:293–306
[50]. Barrera I, Corso RM. Cultural Competency as Skilled Dialogue. Topics in Early Childhood Special Education. 2002;22(2):103-113. DOI: 10.1177/02711214020220020501

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