

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 skills⁴. 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 respond⁵. 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 something⁶ 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 behaviour⁷. The key marker of intentionality is development in joint attention evidenced mainly as eye gaze orientation between the adult and object of interest⁸. 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 age¹¹. 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 knowledge¹². Vygotsky views adults as important source of cognitive development who transmit their culture's tools of intellectual adaptation that children internalize¹².

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 learning¹³. Shifts in eye gaze orientation between referent and partner are a means to demonstrate coordinated joint engagement¹⁴. 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 engagement⁸. 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 partner²⁰. 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 orientation²⁰. One of the functions that these instances of single eye gaze orientation serve is passive joint engagement¹⁴. 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 concern¹⁴. 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 infancy³. "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 grimaces²⁶; ritualized gestures and deictic gestures²⁷. Most commonly studied deictic gestures include reaching, showing, giving, and pointing²⁸. Presymbolic communication behaviors are concrete, oriented towards practical results and focused on actions. Ultimately these behaviors are private, idiosyncratic and distinctive to each infant²⁹. Furthermore, in presymbolic communication behaviors, there exists a direct and often physical relation between the communicator and the message being sent³⁰. 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 another³¹. Use of symbolic gestures [also referred to as representative gestures and conventional gestures], protowords and words³² are categorized as symbolic communication behaviors. At around 12 months, children also start using word approximations or words and representational gestures¹⁹. 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 out³³. 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 procedures³² with more experimental controls was carried out³⁴. 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 out³⁵. 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 once³⁶. Another study suggested that, 8-9 months is the key age in the emergence of joint engagement³⁷.

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 age³³ and gradually not until 15-18 months of age develops to its fullest potential³⁶. However, the key age of emergence of joint engagement is 8-9 months³⁷.

Gestures/Actions with communication partner

Two primary categories of gestures: deictic and representational gestures have been identified²¹. Deictic gestures establish reference by calling attention to or indicating an object or event⁷, 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 gestures³⁹. 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 process³⁹. 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" gestures⁴⁰. 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 object²¹.

In an attempt to study the emergence of deictic and representational gestures, twelve typically developing children were followed from 6 months to 24 months¹⁹. Behaviour regulation, joint attention and social interaction were the three broad functions of communication⁴¹ 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 scale²⁰. 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 data²⁰. 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 register⁴². 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, REELS⁴³ 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 scale⁴⁴.

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
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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 Annotator⁴⁶, 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 tracks 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 function⁴⁷].
- 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

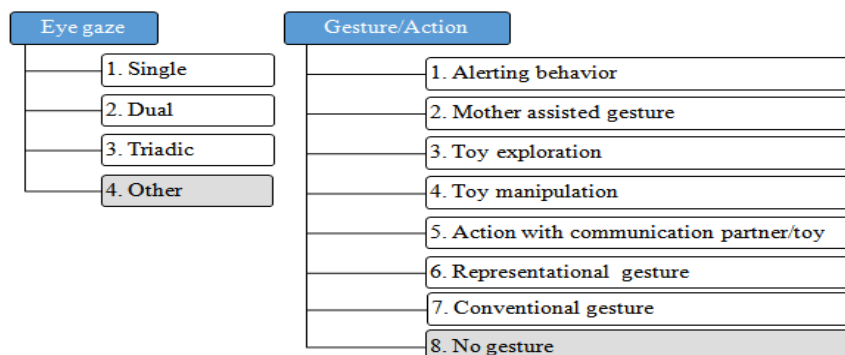
The researcher carried out the annotation of the video samples of the two mother -child dyads after a time gap of 3 months. Overall, 93.01% of intra judge reliability for child's communication was obtained for the annotations done under for eye gaze orientation and gesture/action.

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

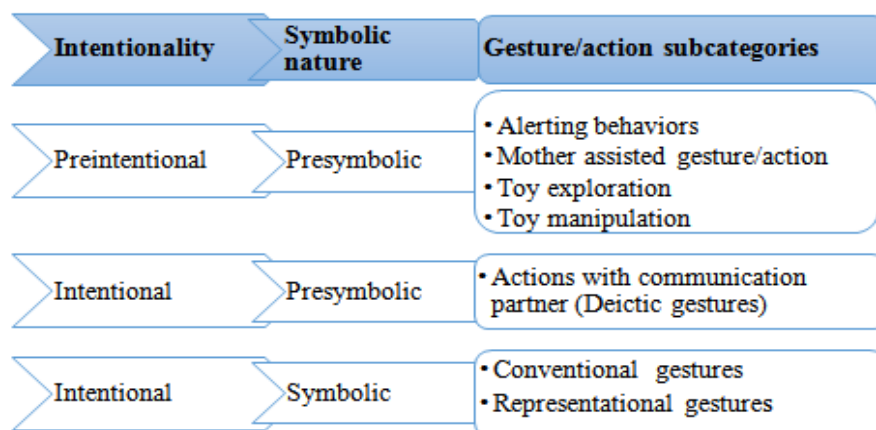
annotations under Gesture/Action formed a complex in most communication turns. In order to breakdown the complex, in each communication turn up to three gestures/actions were annotated. These annotations were further analysed and grouped into subgroups as shown in fig 2. Analyses was carried out with 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 interactions³, 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 examiner²⁰. 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

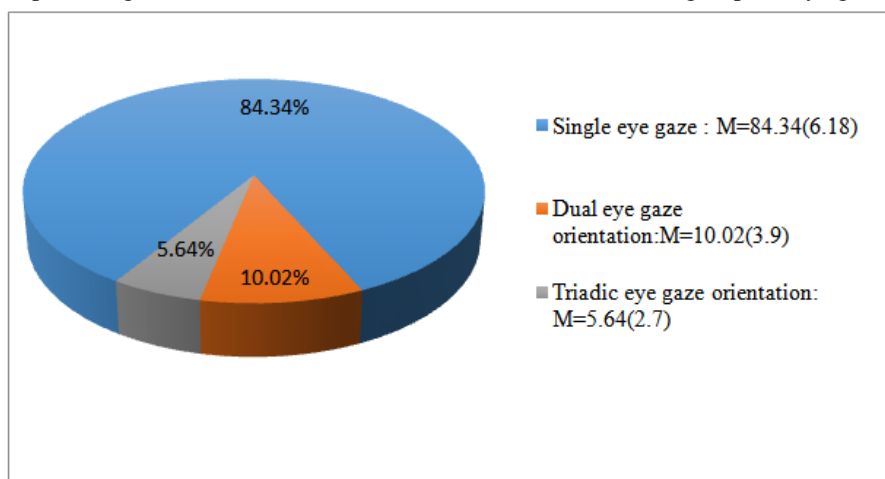
The present research aimed to analyze the communication behaviors of Typically developing (TD) children between 6 to 12 months of age. The objectives of the study were firstly, to explore proportion of use of preintentional communication behaviors indicated by the use of single eye gaze fixation on the 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	Intentional	Toy manipulation	3.13 (2.93)	
			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

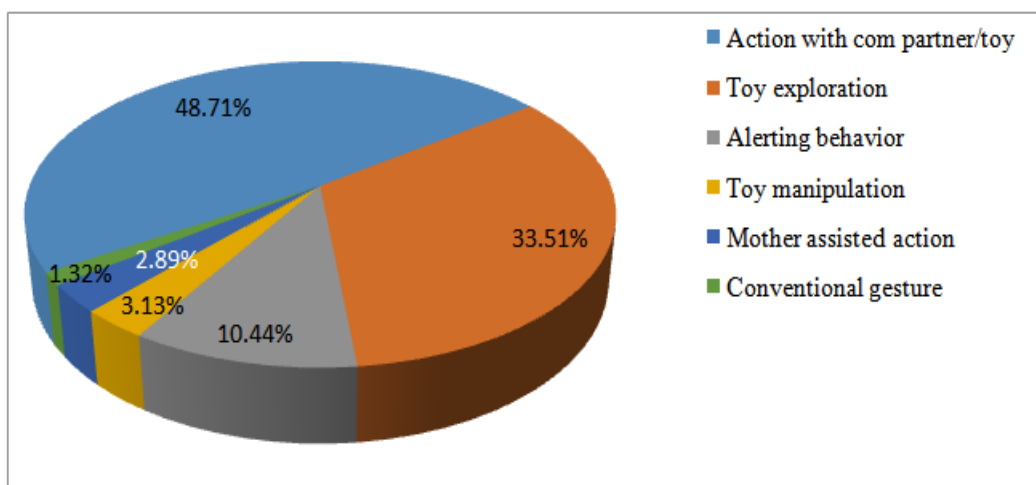


As per table 2 and fig 4, the mean percentage of occurrence of single eye gaze (M=84.34%, SD=6.18) was maximum, followed by dual eye gaze orientation with mean of 10.02% (SD=3.9) and then triadic gaze with

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 orientation²⁰. 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

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 attention¹⁴.

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 reviewed³³. The reason for these contrasts may be attributed to methodological differences. In the study reported³³ 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 months³⁴. 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 quoted³⁴(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 engagement³⁷, 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 examiner²⁰ or child and mother¹⁹ 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 learner³.

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 it⁵. 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 proximal development proposed by Theory of social interaction⁴⁸. 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 caregivers⁴⁹. 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 gestures²¹ 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 styles¹⁹. 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 research¹⁹. 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 appropriately⁵⁰.

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 preintentional communicators through eye gaze modality. Preintentional preysymbolic 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.

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