

THE DEVELOPMENTAL NATURE OF WHISPER IN CHILDREN

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REC.No.M9010

A DISSERTATION SUBMITTED IN PART FULFILMENT FOR THE DEGREE
OF M.Sc.(SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE,
MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE - 570006.

MAY 1993.

TO MY TEACHERS
WHO HAVE DONE SO MUCH FOR ME
THAT IT WILL BE HARD FOR ME
TO DO AS MUCH AS AND
FOR THOSE WHO WILL FOLLOW.

DECLARATION

This Dissertation entitled THE DEVELOPMENTAL NATURE OF WHISPER IN CHILDREN is the result of my own study, undertaken under the guidance of Dr.G.PURUSHOTHAMA, Professor, Department of Speech Pathology, AIISH, Mysore and has not been submitted earlier at any University for any other Diploma or Degree.

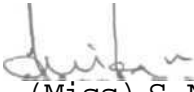
Mysore

1993.

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CERTIFICATE

This is to certify that that Dissertation entitled THE DEVELOPMENTAL MATURE OF WHISPER IN CHILDREN it the bonafide work in partial fulfilment for second year M.sc. (speech and Hearing) of the student with Rag. No.M9010


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CERTIFICATE

This is to certify this Dissertation
entitled THE DEVELOPMENTAL MATURE OF
WHISPER IN CHILDREN has been prepared
under my supervision and guidance.

Mysore
1993



GUIDE

ACKNOWLEDGEMENTS

I am greatly indebted to my guide Dr.G.Purushothama, Prof. in Speech Pathology for patiently correcting my illegible handwriting, his excellent guidance and support shown, starting from the topic selection, till the end or else, I would have been still thinking about a topic.

I thank Dr.Prathibha Karanth, Head of the Department of Speech Pathology for giving me permission to conduct this study.

My sincere thanks to Dr.S.Nikam, Director, All India Institute of Speech and Hearing for permitting me to conduct my dissertation.

There are no words to express thanks to my parents and teachers for being the spirit of my study and for bringing me till this stage. My love, my life prasanna, I cannot thank you enough for everything you have done for me.

I am grateful to Mr.Kalaish, HOD-Clinical Psychology for giving me moral support and making me clear all my ups and down.

I thank all the school teachers for their kind cooperation for providing children for data collection, "Royal English School, 14th Main, Sarawathipuram, Lord's Convent, MIG-13, Gangothri Layout, Mysore; Chinmaya Vidyalaya, Jayalakshmi Puram, Sai Bhabha Higher Primary School, Jayalakshmi Puram, Saint Joseph School, Gangothri School, Manasagangothri.

I cannot forget those tiny tots who served as subjects showing their scientific mind in acquiring new behavior and in the process making me also more scientific minded thanks to them.

Thanks to Mrs.Prema for helping me to plan methodology and Mr.G.V.Ganeshiah for the neat diagram.

My thanks are due to Mr.Venkatesh, C.s., Dr.P.Vidyasagar, Dr,Sundar Raj, Mrs. Basanthi Devi for their everlasting support.

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Thanks to 2 nuts swath and mahesh for providing me a homely

environment along with criticism, suggestions and valuable correction, I can never forget you all 'J', Nirmal, Saru, Patru for you friendly nature in needed time, especially to Patakji, Ravanan, for their advice and valuable criticism respectively.

I am also grateful to the ever obliging Library staff of AIISH for their help.

Last but not least - Thanks AKKA for making my dissertation light, bearing with my illegible handwriting and typed neatly and fast.

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INTRODUCTION

No normal person has failed to develop this faculty and no other species is known to have developed this ability.

– Boone, 1983.

Voice plays an important role in speech communication. The production of voice depends on the synchrony between respiratory, phonatory, articulatory, and resonatory systems.

The larynx is an organ of extraordinary mobility. It may readily alter its positions according to the specific function required to the moment.

During the performance of its primary vital functions* the larynx is strongly elevated for swallowing and to a lesser degree for inspiration. While it is lowered for expiration (Luchsinger, 1965). While it is performing secondary phonic functions the movements of the larynx are much more complicated. In general, one may state that in untrained natural voice, the larynx is elevated for high tones and levered for low tones.

In addition to the natural inclination toward a certain laryngeal position, which include body structure, musculature development and breathing type, training plays greater role. Vocal education may readily alter laryngeal positioning for specific vocal function (Luchasinger, 1965).

Phonation is a function of larynx. Heiraholtz (1963) gave a more accurate explanation, showing that phonation is the product of air released through glottis. It is known that voice is produced by a steady flow of air from the lungs sequented at the laryngeal level into a series of air puffs at a fundamental frequency that generates higher in the cavities of the upper air way.

Phonation without voice is whisper. Panconcellilalz in stated that, "whispering is always an aphonic performance" (cited in Luchsinger, 1965). He introduced en elastic tube through his nose as far as his nasopharynx holding his breath and closing his glottis. He blew a continuous air-stream through the tube by articulating the speech sounds in the usual way, he could hear himself whispering exacting in the same manner as in laryngeal whispering.

He demonstrated that the glottal patterns of the whispered speech contains the speech qualities of intensity duration and sound timbre to a certain degree. But there is no tonal pitch. He asked an Italian to recite the first verses of the area, "Lodona C Mobile" from Verdis Rigoletto by whispering into a microphone. When this whispered recording was played back to listeners who knew no Italian.

They neither comprehended the text nor detected that e "Melody" had been whispered. In contrast Italian speaking listeners recognised the area from the text. Believing that the words had been spoken and not sung.

Voice in for communication, human communication is an exchange of feelings, knowledge, and wants between two or more people (Boone, 1987). The modalities of human communication include our ability to touch, to voice, to gesture, to see, to hear, to listen, to speak, to read and to write. Communication has long been recognised as one of the most fundamental component of human behavior. The ability of human beings to use their vocal apparatus with their organs to express their feelings, to describe an event and to establish communication is unique to them. The onset of the human era is recognized to have started with the acquisition of the ability to communicate using vocal apparatus for social interactions.

The act of speaking is a very specialized way of using the vocal mechanism. The act of singing is even more complicated mechanism. Speaking or singing demands a combination or interaction of the mechanisms of respiration, phonation, resonance and speech articulation (Boone, 198S).

Jacobson (1942) says that, in children all communicative behaviors are developmental in nature. Kalpaa (1971) reported that, children at the age of 3 weeks to 5 months begin to use modification of his crying patterns to communicate different status of maladaptation. A parent soon learns to differentiate between the whispering cry of mild discomfort, and the intense cry of anger exhibited by the child even when put-down. In the later instances, child picked up again, may cease screaming, thus communicating the end of his state of distress.

The crude use of vocalization is not clearly differentiated from physiologically induced crying. It does however, produce the earliest form of communication interaction between mother and child. It is augmented by the emergence of the cooing vocalisation most frequently associated with pleasure state.

During the subsequent state, identified by Kaplan and Kaplan (1971) as occurring around 6 months the purposeful, use of the vocalisation becomes more sophisticated as intonational variation begins to expand in pitch variation and in complexity of pattering babbling also occurs during this stage. It is not used purposefully as a communication controlling behavior although it does seem to be important to subsequent speech development. These are stages called vocal patterning.

It is possible that children exhibit various patterns in their vocalisations during this time. One speech) variations in their phonatory behavior is "whispering". The developmental nature of which is yet to be well recorded.

Whispering is also a vocal behavior like phonation. It was a special role in communication. It is used in situations, unlike the use of voice, to restrict the communication to a single listener or to a small group. Interestingly whisper may also be an indicator of laryngeal pathology.

Whispering is as complex a process, or more, like phonation. Children seem to make use of this as early as in beginning school years. It will be interesting to learn about the developmental nature of this phenomena.

It is felt that it will be a good question to ask as to what is the developmental nature of whisper. Much before that, it will be better to ask about the beginning of the phenomena whisper.

The present study is undertaken to know about the beginning of whispering behavior in children.

It would be ideal to follow children longitudinally from infancy to learn about the beginning of whisper.

However, it is feasible to study the behavior in a cross-sectional way. In the present, it is planned to study the behavior in a relatively formal set-up like kindergarten classroom. For the study, the following hypotheses are proposed.

1. The behavior whisper appears in children as early as at the age of 3 years.
2. Mothers of children younger than 3 years of age, will be aware of their children's whispering behavior, as partners in communication, in communicating with them in specific instance.

REVIEW OF LITERATURE

Speech is civilization itself. The word, even the most contradictory word, preserves contact - it is silence which isolates.

- Thomas Mann.

Wares (1976) attempted to define whisper. He reported that "the glottal chink is narrow but open during whisper, and resistance is approximately 4.0 to 6.0 ems H₂O/L/sec. Respiratory effort is considerably increased and this is reflected by increasing airflow rates and greater interoral pressure. The duration of sound production is also increased during productions of whisper, and this probably accounts for much of the three-fold increase in respiratory volumes used presumably, increased time and effort are necessary to generate airflow turbulence and produce the sounds of whispered speech.

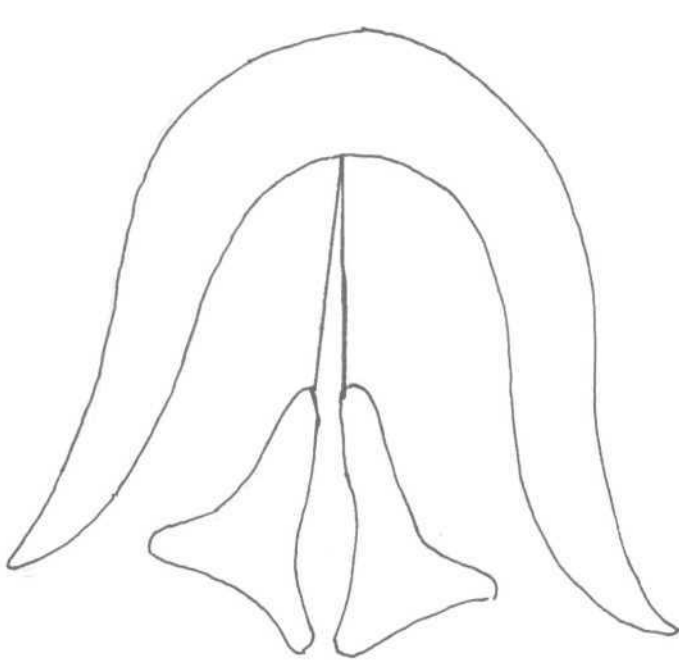
Bracket (1957) defines whisper that "under condition of partial laryngeal valving and with vocal folds stabilized sufficient airflow through the vocal tract en exhalation will produce laryngeal or frications which is commonly labelled whispering.

Zemlin (1988) described the Whispering mechanism. The essential difference between vocalisation and whispering

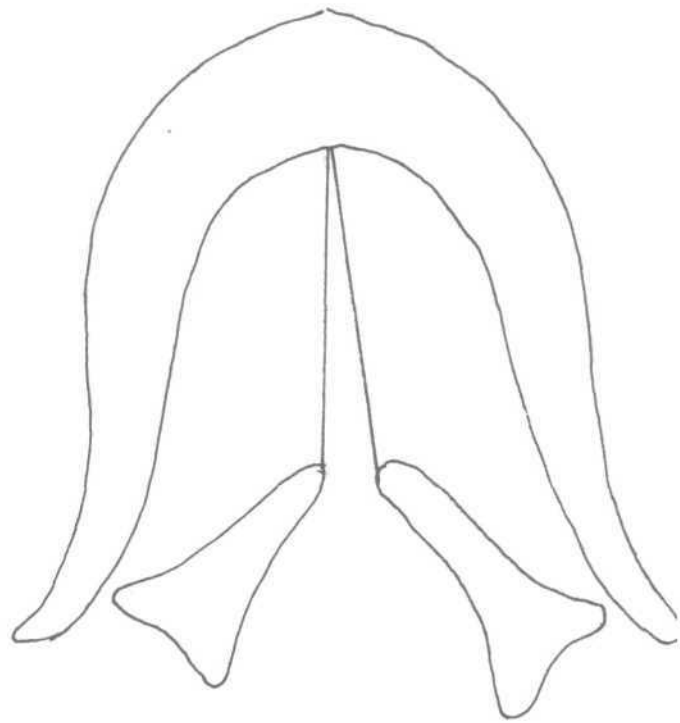
lies in the configuration of the non-vibrating vocal folds during exhalation and the resulting acoustic product. During normal phonation, the arytenoid cartilages are approximated so that their medial surfaces are in direct contact. The vocal cords lie parallel in one another. In whispering, however, the arytenoids are slightly abducted and 'toed on', creating a small triangular chink in the region of the cartilaginous glottis. When the breath stream is released, turbulence occurs in the chink, and frictional sounds are generated. Airflow through the glottis plays a very important role in the production of a whisper, amounting to about $200 \text{ cm}^2/\text{sec}$. for a forced whisper.

Pressman and Kelemen (1955) asserted that in a low-volume whisper the folds assume a position a little more closely approximated than that for quiet respiration. They go on to state that When the vowel /a/ is produced, the margins of the glottis are straight, and that upon producing the /i/, there is a toeing-in movement of the vocal processes of the arytenoids, but without a medial shift of the mass of their bodies. They account for such a glottal configuration by positioning that the arytenoid muscles fail to contract during the production of an /i/ vowel.

Schematic Diagram Of Larynx
During



Phonation



Whisper

When the larynx is viewed by means of high speed photography during the whisper, the vocal folds may be seen to move very slightly in some subjects, and not at all in others. In no case do they vibrate to any great extent or periodically as in conventional phonation. Although, Whispering places few demands on the vocal mechanism, as a form of sound production, it is, at best, second best. Eg. "The intensity of the loud whisper is 20 dB less than the intensity of conversational speech. Whispering is also a very uneconomical way to use the breath supply". Whereas a person can phonate for as long as 30 seconds, during vocalisation the same person can whisper for about 10 seconds before another breath must be taken.

Frictional noises, such as those produced by whispering, are composed largely of aperiodic sounds which at any instant in time have a fairly unpredictable spectrum (energy distribution is nearly random). Whispered speech has no fundamental frequency and no harmonic structure. For this reason, whispered speech cannot easily be inflected. Only the bandwidth of the noise can be altered by slight changes in the vocal tract. These alterations may produce a subjective impression of an increase or decrease in pitch. Modification of the volume velocity of this air-stream through the

glottis will also change the character of the noise that in being generated, but because the glottis offers virtually no resistance to air-flow, only slight modifications in the intensity of whispered speech are possible.

Monoson (1976), a thorough study of the characteristics of whisper strongly support the contention that whisper cannot be regarded as observe to the vocal folds and can thus be used as a substitutive for conventional phonation in those instances where vocal rest is recommended as a therapeutic strategy (cited in Zemlin, 1988).

Helmhoiz (1954) attributed that, the pitch of whispered vowels to the formants, since no fundamental frequency would be present. He also reported that, pitch differences between the vowels are perceived in the absence of vocal fold vibration.

The perception of pitch when acoustic energy corresponding to F_2 and all higher formant, was electronically filtered from the spectrum of the whispered vowels pitch ranking were disrupted and no correspondent judgement was noted.

Judson (1942) noted down the mechanism of whisper. He reported that glottis may be open to such a degree that it presents frictional hinderance to the passage of the air-stream. This produces fractional sounds. Such sounds from the pertly closed pertly opened glottis are utilised ia whispering.

According to Judson within anatomical and physiological limits, the acoustic effects produced by whispering are constant and invariable, there is always the same articulatory mold to the cavities, Whispered speech cannot be inflected kind it* quality cannot be changed, however, it may be produced with variation in emphasis and its rate. Because whispering involve* but a small expenditure of energy, its carrying power ia limited, the range of audibility of whispering ia alight compared with that of phonated speech. Eg. the lewdest (spoken without shouting) voiced, sound can be heard from five to twenty times as far as sounds can be heard when whispered in as laud a meaner as possible.

Whispering is also uneconomical in the use of exhaled air-stream, the relatively large glottis permitted such a waste of air that the efficiency of whispering ia low.

Only a few words may be whispered before another breath must be taken, for these reasons whispering would provide a relatively ineffective basis for speech.

Travis (1957) reports that whispering differs from voiced phonation in the following manner:

1. The glottis shows the shape of an inverted 'y' and the vocal cords are incompletely closed.
2. Vocal cord tension is much lower than in phonation, and the cord margins do not visibly vibrate. As a result, the escaping air is set into non-periodic fractional turbulence so that a noise is produced instead of tones with periodic vibrations.
3. The consumed air volume is greatly increased, whispering is therefore much more strenuous than in speaking in normal voice.
4. In consequence is much lower than it is during phonation.

Hocke (1972) reports that, in whispering, where the vocal cords do not vibrate so as to produce tone of precise pitch, one might expect intonation less speech. Yet in some whispering some intonational contrast are observable.

How they are produced is not understood. The vocal cords can produce certain further effects. In taurraur, the cords are in vibration, but in condition the passing air-stream is set into local turbulence, in on a kind of Whisper, there is the local turbulence without the voicing. In another kind of whisper, the cords are dosed tightly but the arytenoid cartilaginous behind them are moved apart. So that the air can pass through.

The cords are drawn wide apart to a position of full abduction in forceful inspiration. In quiet whispering the folds are slightly separated along the anterior two thirds and a triangular operture remains posteriorly. In a strong whisper the folds are adducted firstly along the anterior $\frac{2}{3}$ and the air is forced through posterior triangle with considerable friction (Boone, 1968).

weitsmen (1976) describes that the processing of whispering adduction of the false vocal folds takes place with a decrease in the size of the laryngeal cavity. This type of laryngeal constriction becomes more exaggerated for strong, so called stage whispering. This particular whispering is considered to contribute towards facilitating the generation of turbulent noise in the larynx cavity, as well as to the prevention of vocal fold vibration by transglottic airflow.

Weitzman, Swashima, Hirose and Ushijima (1976) report that a typical subglottic laryngeal constriction with the glottis open is observed in whispered speech or phonation. Further, they say that, adduction of vocal folds takes place with a decrease in the size of the anterior posterior dimension of the laryngeal cavity.

According to Zemlin (1981) a typical subglottic laryngeal constriction with the glottis open is observed in whispered phonation. Here an adduction of the false vocal folds takes place with the decrease in the size of the laryngeal cavity in anterior and posterior dimensions. The type of laryngeal constriction becomes more exaggerated for the strong so called stage whispering. This particular gesture for whispering is considered to contribute to the prevention of the vocal fold vibration by the transglottal airflow, as well as to facilitate the generation of turbulent noise in the laryngeal cavity. The physiological mechanism behind supraglottic laryngeal constriction is not clear.

The EMG reports say that posterior cricothyroid and lateral cricothyroid muscles are responsible and related to supraglottic laryngeal constriction.

Stathopoulos, Hoit, Hixon, Walson, and Solomon (1991) did a study on respiratory and laryngeal mechanism during Whisper. The study reveals that "Differences in respiratory function between whispering and speaking. The general configuration of the chest wall as the same as that of previous studies (Hixon, 1973,1976; Hodge, Rochet, 1909; Holt, and Hixon, 1937; Holt, 1939, 1990). The configuration characterized by a lower abdominal volume and a higher rib cage volume during utterances production compared to relaxation, muscular pressure required for utterances production were provided by both the rib cage and abdomen, and abdominal muscular pressures predominating (Hixon et al. 1976). the fact that the configuration of the chest wall was similar for whispering and speaking indicates that the muscular mechanism operating were essentially the same. This observation offers sight into the nature of respiratory - laryngeal interaction because it indicates that the general posturing of the chest wall is relatively Independent of the state of the laryngeal airway. However, they have also found that, higher rib cage volume initiations and greater rib cage volume excursion for women and men. This study shows that, higher flows under a low load condition. (Whispering), they did not compensate by using higher lung

volumes and higher tracheal pressures, but generally did converse. This difference in performance probably was related to the acoustic targets for whispering and speaking are different.

According to Boone (1962) whispered speech is a pretty effective form of communication and, children first communicate by using voice by imparting greater audibility but gradually in developmental stages, they try and modify their voice quality. This changing of voice quality has importance for communication.

It is the feeling of this author that whisper calls for an awareness of the act on the part of the speaker (whisperer) more than that while he speaks. One would tend to believe that either a child is subjected to or himself uses whispering would bring him an awareness of the ongoing linguistic activity.

Clark (1977) says that, when adults talk to children, they modify their voice, articulation, syntax, and semantics natures in the speech,

Carnia (1975a) did a study on adult and children conversation. This author reports that, if children are sitting on lap or standing right next to adults will speak

directly into their ears, so it is clear they intended to listen. Author further reports that, all the mothers in her study on occasion whispered to 2 years olds, and a few times whispered to 5 yeara olds, but none whispered to older children. This shows that, children with younger age group, mother try and modify their voice quality (Cited in dark, 1977).

Bajupratap (1991) did study on development of word stress in children 3-4 yeara. He reported that, even at the age of 4 years, children did not obtained 100% score which indicates that the mastery of stress is not completed yet. Females at 4 years of age show 100% responses indicating a mastery of stress at the and of 4 yeara of age, and stress and contraative stress children seems to pass through developmental stage which ia indicated by all the studies and their capacity to produce seems to be established by 6 years of age, word stress may be mastered earlier. Here significantly female children seems to be a head of male children in the acquisition atleast some agegroup.

Is it possible that meta-linguistic activity at a supra-segmental level comes earlier than that of symbolic

levels. Though studies are needed on these lines, one can imagine that on similar lines of observation that children have expressive intonation patterns (a suprasegmental features) much before sounds are articulated clearly segmented features. It can be hypothesized that earlier metalinguistic activity will be about the communication process itself than the segmental features.

Arkebauer (1967) did study regarding air pressure variation during whisper and phonation. He says, whispered speech differ from vocal speech in terms of the air pressure that build up in the vocal tract during the production of stop consonant. In vocal speech the peak intraoral air pressure (P_o) for voiceless stop (k) is greater than it is for their voiced cognates (g).

Hurry (1967) reported that, in whispered speech, oral pressure is essentially the same for both voiced and voiceless stops.

Mocket (1972) reported in his study that, in whispering the vocal cords do not vibrate, so as to produce tone of precise pitch, one might expect intonationless speech, yet in some whispering some intonational contrast are observable. How they produce is not understood.

wanning (1979) reported the absence of F₀ in whispered speech.

Lehiste did a study on the prosodic feature of whispered speech. It is a well known fact that people can be understood without any difficulty when they whisper instead of speaking normally. This fact is not very strange, if the formant frequencies of the vowels and envelopes and spectrum of the fricatives and plosive sounds are considered to be the information carrying elements of speech. It must be doubtful, however, whether full information can be carried by whispered speech in tonal languages like Chinese or many West-African languages, where pitch is used to differentiate the meaning of various lexical items, consisting of otherwise group of identical groups of phones.

Klitch (1982) reported that, whispered speech differs from vocal speech in terms of the air pressure that built up in the vocal tract during the production of stop consonants. In vocal speech the peak intraoral air pressure for voiceless stops is greater than its for the voiced cognates.

He also reports that mean air flow rates in breathy and whispered speech are significantly greater than those found

in normal vocal speech and are more typical of those found during production of voiceless fricatives, consonants. Hence, regarding speech with a breathy quality can be made by comparing the airflow with that of the whisper and breathy speech has a significant difference.

Boone (1971) studied whisper in pathological conditions, whispering generally means that varying degrees of approximation of vocal cords and is not advisable for pathologic condition of vocal cords. Whispering is possible even without a larynx. Laryngectomized patients are able to compress the oral air content in such a way as to produce whispered articulation. This is achieved through movements of the tongue, the cheeks and the floor of the mouth. Before being instructed in the use of the esophageal phonation, these patients try to communicate by this type of "oral whispering" or "pseudo whispering". In this manner of speaking only the unvoiced consonants are articulated correctly that is /P, t, k, f, s/. All other speech sounds are produced by mute articulatory movements that cannot be heard. So that the listener is forced to rely on lip reading (Stem 1979; Bangs, Lierle, Strother, 1946).

Ballenger (1971) cited in his study that, aphonia is nothing but a kind of whisper. In cases of aphonia and dysphonia, whispering is present. In cases of intermittent aphonia is also some whisper is present.

METHODOLOGY

The intention of the study was to observe how early the whispering behavior is seen in children. A longitudinal study of very young children say of age range 12-24 months was not feasible. This study is a cross-sectional study.

Subjects: 350 children of age range 30-54 months from the kindergarten classrooms served as subjects. The sample was an incidental one. The kindergarten schools were chosen from different parts of the city in Mysore. The experimenter took care not to include children with any apparent speech, language and hearing problem or related physical handicaps.

Procedures The experimenter met the children in the school. The interaction was to elicit the response whisper. At a time she met two or three children. After building rapport with children, the experimenter asked them some questions to be answered. Experimenter also asked them if they knew how to tell secrets into others ears. Experimenter asked each child to tell something like what they ate for breakfast, into the other child's ear.

There was no difficulty in eliciting whisper as there was immediate demonstration available from the child to children. Some time it became necessary that the experimenter herself had to demonstrate whispering to tame children. The experimenter noted the response on paper.

Scoring: A child who readily whispered the answer into other's ear was scored one. If the child needed experimenter interaction then the score was half. If there was no response, the score was nil. The experimenter further continued to collect more information on whispering behavior of young children as reported by the mothers.

Subjects and procedure:

Sixtyeight mothers were informants, who were met in their homes, their working places. Some mothers were met at the school premises. The mothers were children ranging in age from 18 to 48 months.

Procedures: Initially mothers were explained about the purpose of the study and then asked some questions and regarding the child's whispering behavior. The mothers were graduates and some of them attended high school. Mothers were asked for the information about the children's use of

whispering and the age they had been using it. The answers were noted down on the paper.

the experimenter continued to collect more information on whispering from the teachers of kindergarten children.

Subjects: Twelve teachers of loiter kindergarten and upper kindergarten were informants. They were from the schools where the children (subjects) were studying.

Procedure: Initially the teachers were explained about the study. They were asked about their observation of whispering behavior among children. They were asked whether children used whisper. If they did how often and what could be the occasions that they whispered. The responses were noted down.

the data for the study mainly consisted of the information in the number of children who could readily whisper and those who did on detailed demonstration and those who could not. It also consisted of the experience of the people who keep the children's company.

-

RESULTS AND DISCUSSIONS

This study was conducted to learn as to how early children start whispering. It was expected that, there were no difference between males and females in this behavior. The responses from children were analysed together. The Information from mothers and teachers on his behavior are presented separately and discussed.

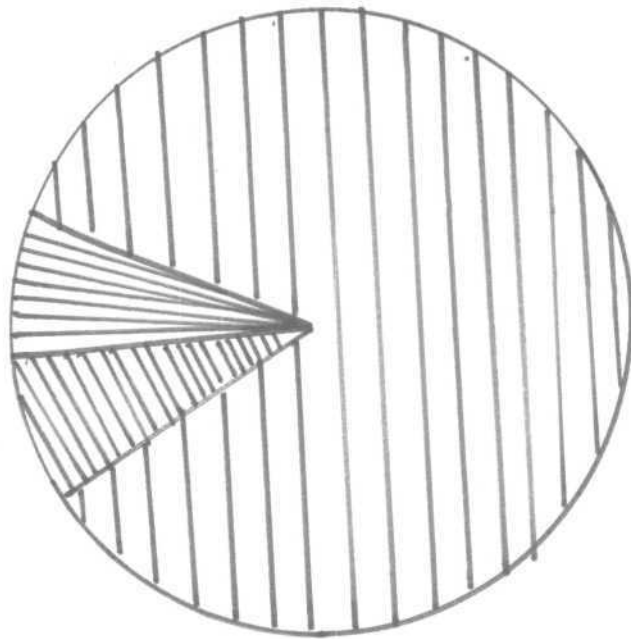
Among 350 children, 315 children (90%) could come out with whispering behavior. Another 17 children (4.9%) needed experimenter intervention to exhibit the behavior whisper. But another 18 children (5. 1%) did not come out with whispering behavior even after experimenter's intervention.

from the findings of the present study, it can be inferred that, most children by the age of 3 years have the ability to whisper functionally. The results are also shown in the following figure.1

The experimenter further continued the study to collect more information about whispering behavior of children.

Sixtyeight mothers of children age 1½ years to 4 years, 34 mothers were interviewed. Half of then reported that

FIG-1-PIE DIAGRAM OF CHILDREN'S RESPONSE



Shown whispering



Shown no whispering even after experimenter's intervention



Shown whispering only after experimenter's intervention

their children started using whispering at the age of 2½ years. However, 16 mothers (24.3%) reported that children started showing whispering behavior at the age of 2 years itself. Another 16 mothers (25%) reported that their children started showing whispering behavior at the age of 3½ years.

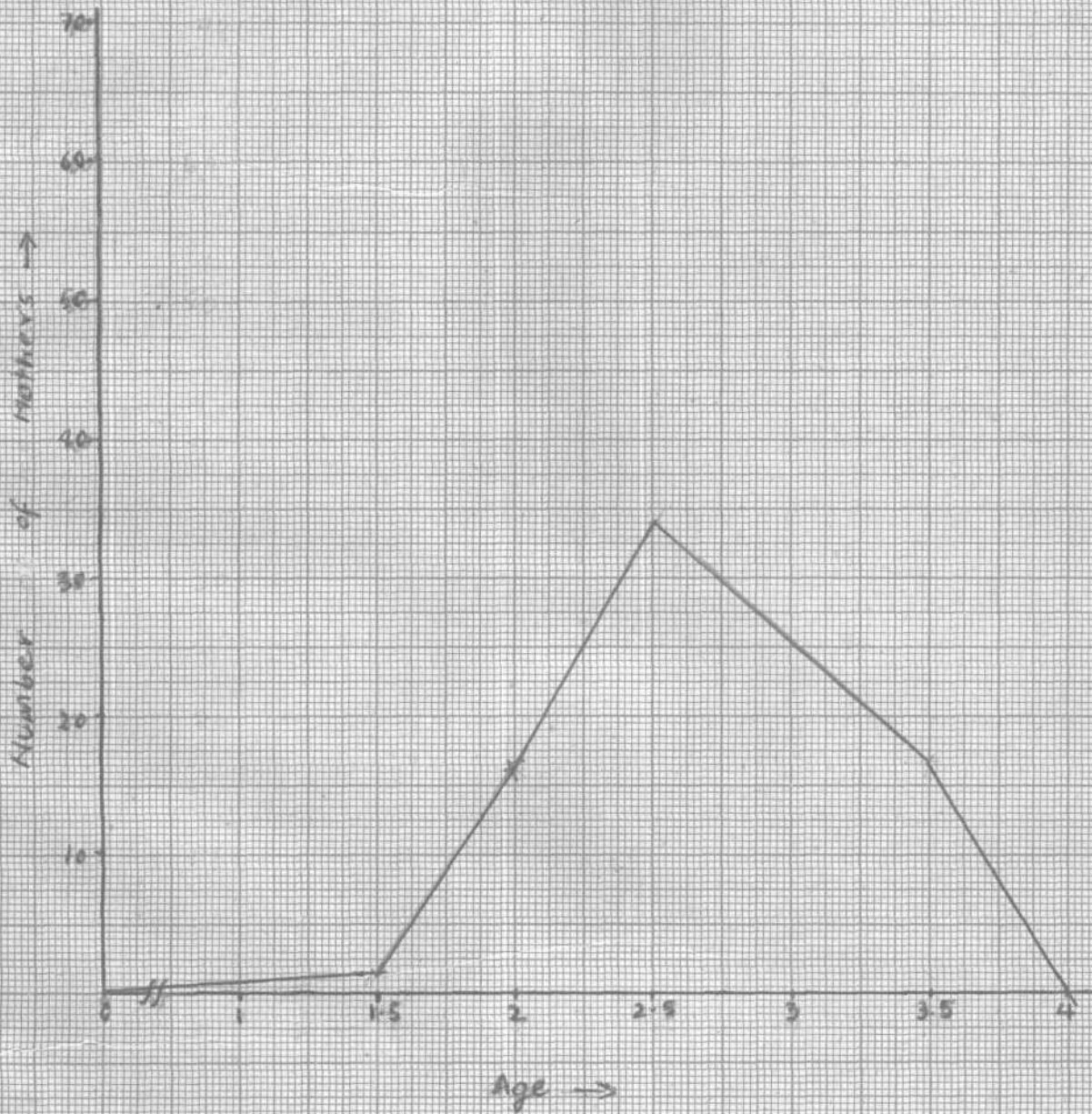
Host of the mothers reported, the age at which children shown whispering behavior about 2½ years. Most children below 3 years of age have shown this behavior (GRAPH). However, two of mothers Informed that their children were able to whisper at the age of 18 months itself.

Teachers of lower and upper kindergarten reported that children in lower kindergarten itself start using the whispering behavior in the classroom. However, they whisper more outside the classrooms than inside, comparatively.

In the light of the findings the hypothesis that "The behavior whisper appears in children as early as at the age of 3 years" can be accepted.

Similarly, the hypothesis that "Mothers of children younger than 3 years of age, will be aware of their children's

Scale
x axis \rightarrow 2 unit = 6 months
y axis \rightarrow 2 unit = 10 mothers.



Graph shows the no of mothers who reported the age at which whisper was seen.

whispering behavior, as partners in communications in communicating with them in specific instances" is also accepted.

From the result of the study it is dear that children master the ability to communicate by whispering by the age of 3 years from the reports available. However, it is possible to say that the behavior makes its appearance as early as 18 months. It is reinforcing to think that this "metalinguistic ability" occurs quite early in communication development. Also semantically it provides children with certain concepts in communication. It is one's clinical experience that the language disabled children do not exhibit this behavior. It would be interesting to see how late this behavior would appear in the language delayed children and what relation it has to the development of other aspects of language. However, much more observation of this behavior is needed to establish the appearance of this behavior chronologically along with other linguistic aspects.

SUMMARY AND CONCLUSION

This study was carried out to know at what age the children start using whispering.

As there are a large number of young children are available in schools it was planned to collect data from Kindergarten schools. 350 normal children of age range from 2.6 month to 4.6 month taken as subjects. Along with this school teachers and mothers also served as informants.

Results show that most of the children could whisper special communication by the age of 3 years.

Mothers reported that, their children started whispering around the age of 2.6 months. This shows children could acquire whispering around this age.

The following hypothesis that proposed were accepted:

- 1. The behavior whisper appears in children as early as at the age of 3 years.**
- 2. Mothers of children younger than 3 years of age will be aware of their children's whispering behavior, as partners in communications, in communicating with them in specific instances.**

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