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## **Unit - 4 □ Assessment and Identification of Needs**

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## **4.1 Introduction**

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Speech is a medium, used to convey message which is in a particular form called language. In other words, language is verbally expressed using speech in humans. Speech and language help in successful communication. Impairment of speech or language cause communication disorders which in turn affect the child's educational, social and personality development.

Speech development starts at an early age and attains adult mastery by the age of 7-9 years. Speech production is an interesting and intricate process. It involves different systems of the human body. These systems are:

1. Respiratory System
2. Phonatory System
3. Articulatory system
4. Resonatory System

The airflow from the respiration process is modified and produced by the other three systems. This is called speech production. As a prerequisite of age appropriate speech development, the intactness of all the above systems is essential. In this chapter we will learn about these systems, their role in speech production, need to assess these systems.

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## 4.2 Objectives

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To learn about :

1. Respiration and phonation, the process, types and the need to assess these processes
2. Articulation & Phonology: speech organs as articulators, speech sounds and their description & classification. Assessment of articulation.
3. Various prosodic aspects of speech & their assessment
4. Normal development of speech in children from birth
5. Speech intelligibility and factors affecting it. Assessment of speech intelligibility.

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## 4.3 Respiration and Phonation

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### 4.3.1 Respiration

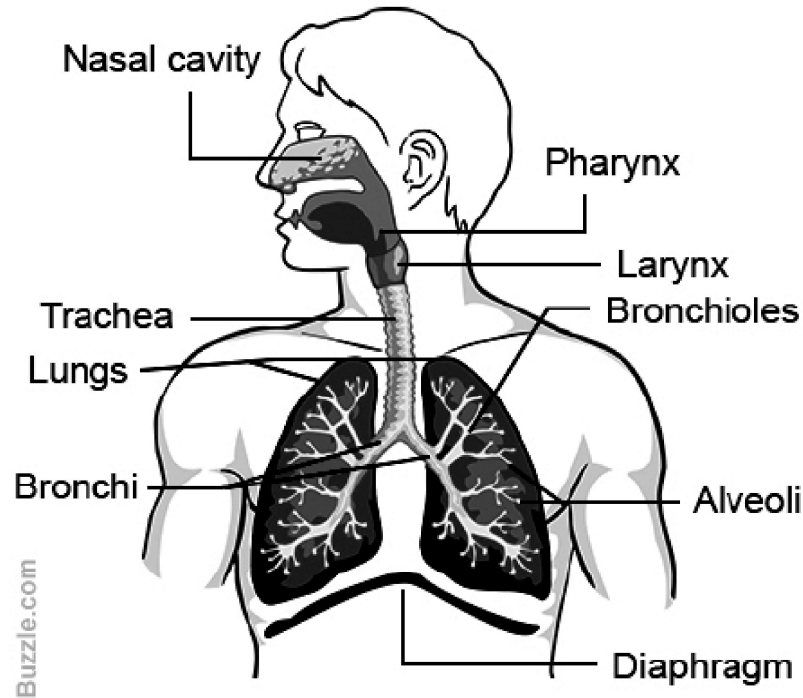
- It is a process which is very essential for human life, it helps in breathing and exchange of air with the environment. Speech production is a secondary function of respiration. Respiration provides the power for the process of speech production. The respiratory process involves the following basic structures/parts:
  - Bronchi
  - Trachea
  - Lungs
  - Pharynx
  - Larynx
  - Oral and nasal cavities

Other structures which provide the structural support are:

- Musculature
- Thorax
- Skeletal framework- spinal column, rib cage and pelvis

- Thorax and abdomen and their muscles
- Muscles of neck, chest and shoulder

### Diagram of Respiratory System



#### 4.3.2 Pre-requisites for Respiration

All the above mentioned structures/parts should be anatomically intact and should be physiologically accurate that is have good function in order to carry out the process of respiration. Respiration involves inspiration/inhalation that is taking air in and expiration/exhalation that is breathing air out. All the structures function with each other to help in inspiration and expiration.

The nerve supply and control of higher centres of human body over the process of respiration should be uninterrupted and appropriate for proper functioning of the respiratory system.

The child should not have diseases of the respiratory system, for example upper respiratory tract infection, asthma or conditions of brain damage (cerebral palsy) which may cause disturbances of the respiratory system.

### 4.3.3 The Process

The general process of respiration is vital for life. It consists of two sub processes namely inhalation/inspiration and exhalation/expiration. The cycle of inhalation followed by exhalation is also called breathing. This is carried out to get fresh air containing oxygen from the environment and removing impure air containing carbon dioxide from the human body. The air is inhaled through the nose/oral cavity, it passes through the pharynx, larynx and then reaches the lungs. It is in the lungs where exchange of oxygen with carbon dioxide takes place. When the lungs have taken in sufficient amount of air from environment, the body prepares for the next cycle of breathing that is exhalation. In exhalation air goes out via the same path. For speech production, the vocal fold vibrate during the exhalation phase. The whole process is controlled by information from the brain conveyed through nerve supply to the respiratory system.

### Speech breathing

For speech production the process of general breathing or respiratory mechanism alters. The inspiration time increases or in other words we take in more air so that we can support our speech production especially if the utterance is long and loud. Moreover, we can time our inspiration and expiration—for example during singing or recitation we can decide on the times we want to breathe in and out. Moreover, the exhalation time is much longer as compared to quiet breathing.

### 4.3.4 Types of Respiration/Breathing

There can be variations in the breathing pattern depending upon the structures involved. However the type of breathing used usually do not affect the speech production process. It can be of following types:

1. **Diaphragmatic or abdominal breathing-** It involves expansion of the abdomen. It is carried out in a relaxed state. It leads to deep breathing and is advisable in many respiratory diseases. Best for prolonged singing.
2. **Thoracic breathing-** It is a more shallow breathing. Usually very less amount of air is taken in the chest and exhaled out.
3. **Clavicular Breathing-** It is the shallowest type of breathing. In this the clavicle moves keeping the lower part inactive. Only upper part of lungs get

involved during the breathing. This type is not suitable for speech production and can lead to a strained voice.

#### **4.3.5 Need for Assessment**

Respiration is one of the vital supporting mechanism/process for speech production. Any disruption in the structures and function of the respiratory system will lead to speech disorders. Thus the physiology of the respiratory system needs to be assessed in case of speech disorders. Parameters such as air pressure, vital capacity, S/Z ratio, phonation duration are assessed on a routine basis. The needs can be as follows:

1. The assessment and measurement of the parameters related to respiratory system, gives us information about the intactness of the system. The obtained values can be compared with age and sex appropriate norms to check for any abnormality.
2. A general need is to establish normative data according to age, sex and other body statistics such as weight etc. Comparison with these values can help us identify disorders.
3. The measured values can act as baseline before the speech therapy sessions and can be measured in between sessions to check progress of therapy.
4. The assessment results help to differentially diagnose between pathologies or conditions e.g problem of respiratory system vs problem of vocal folds (phonatory system)
5. The measured values can give us idea about child's current capacity, this can help us to set speech therapy goals.
6. Assessment of respiratory function help to decide the therapeutic strategies or methods that can be used for remediation for example behavioural, or instrumental.

#### **4.3.6 Phonation**

Phonation occurs when the air flow from lungs causes the vocal folds in the larynx to vibrate. Usually phonation refers to a prolonged or sustained voice production. In order to achieve a sustained voice the air flow from the lungs during exhalation should be carried out in a controlled manner rather slowly and not abruptly.

#### **4.3.7 Process**

The process of phonation involves laryngeal muscles, cartilages of the vocal cord, ligaments and nerve supply. The vocal folds are elastic in nature owing to their anatomical make-up. At rest they act as a valve which stops food particles to enter the larynx and prevent aspiration. However the secondary function of vocal folds is speech production, which occurs when they fall apart and close in a periodic fashion due to the process of exhalation. The pathway above vocal folds lead to vocal tract which has two openings oral cavity and nasal cavity. The air flow coming from the lungs passing through vocal folds can come out through oral or nasal cavity. The cycle of vocal fold vibration, that is periodic opening and closing, causes the air pressure beneath the vocal folds to fall or rise. When the air pressure from lungs builds up beneath closed vocal folds they are forced to open or fall apart. Again when the pressure falls below a certain level they again close or come together. Moreover the various muscles and other structures play together and bring changes in tension, length and mass of vocal folds. This leads to faster or slower vibrations and causes changes in the quality of voice produced. For example when the vocal folds are tensed and become thinner, the voice produced increases in pitch. The vibratory patterns vary among humans and gives identity to human voice along with other features.

#### **4.3.8 Prerequisites**

1. All the anatomical parts involved in phonation should have normal structure and function. In other words any anatomical anomaly will affect phonation.
2. All the structures involved in phonation should have appropriate working.
3. The respiratory system, which provides power for phonation should be working appropriately.
4. The vocal tract, vocal folds, larynx should not be affected due to any disease or disorder. E.g motor disorder like cerebral palsy.
5. An individual should have normal hearing sensitivity to monitor the act of phonation and regulate the air flow.
6. An individual should have normal cognitive functions and motor control so that the whole process can be regulated.
7. The individual should not use any faulty ways to produce voice or should not practice any vocal abuse to have a proper phonation.

#### **4.3.9 Types of Phonation**

The space between the two vocal folds change in distance and shape depending upon the amount of opening and closing of the vocal folds. Depending upon the shape of this space called glottis, there can be following types of phonation:

- No Phonation/Voiceless sound - There is silent passage of airflow, the vocal folds remain far apart allowing air to pass freely. The sounds produced in this condition are called voiceless.
- Voiced Phonation - The vocal folds vibrate regularly, that is with complete closure on each vibration. The sounds produced in this condition are called voiced.
- Other types - the other types of phonation are breathy, falsetto and whisper, which are produced by different positions of vocal folds between no closure and regular closure.

#### **4.3.10 Need for Assessment**

Phonation is the first step in voice/speech production. The presence of normal phonation indicates the initiation of an appropriate speech. Normal phonation is characterised by adequate loudness, age appropriate pitch and soothing quality of voice. Any abnormality of these characteristics will lead to speech disorders especially voice disorders. The detailed assessment of phonatory system is an important part of speech assessment. The parameters assessed are phonation duration, S/Z ratio, objective as well as subjective measurement of pitch, loudness and quality. The needs for assessment are as follows:

1. The assessment of phonation helps to trace the site of dysfunction. For example at the vocal folds, or below at the respiratory level.
2. The assessment results can be used by the medical specialist for medical diagnosis, to check treatment progress. For example assessment before and after some laryngeal surgery or voice rest.
3. The assessment results also help to check efficacy of certain devices used, for example devices used to remove hypernasality.
4. The results of assessment help to set the goals of speech therapy, help in deciding about the therapeutic procedures to be administered.



5. The assessment results act as a baseline measurement for speech therapy and help to monitor progress.
6. The results of assessment can be used to counsel the parents/child about the voice/phonation problem which helps them to get motivated for treatment.
7. Assessment can be carried out to establish normative data in a given population. This data can be used for comparison in case of dysfunctions.

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## **4.4 Basics of Articulation and Phonology**

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### **4.4.1 Introduction**

#### **ARTICULATION**

It is the process where the air stream coming from the lungs through vocal folds is modified by the movements of speech organs in the vocal tract. These speech organs are the lips, the tongue, jaw, soft palate. The speech organs involved in articulation can be classified as active articulators and passive articulators. For producing a speech sound two articulators need to come in contact and modify the air stream. The point of contact is called the place of articulation and the way in which the contact is formed and released is called manner of articulation. The result of the air flow modification is production of speech sounds, or combination of speech sounds, which are recognised by the brain. Again these sounds can be classified as vowels, semivowels, diphthongs & consonants. Any errors in production of the speech sounds causes articulation disorder.

#### **PHONOLOGY**

It is the study of speech sounds, how they are organised, used and combined to form language. In other words it is the study of sound system of a language. It includes all the sounds and their features. It also includes the rules which decide how these sounds interact with each other. For example the production of sound /l/ in the words /lal/ and /Balti/ differ from each other. A typically developing child's language is characterised by phonological processes. These are naturally occurring language patterns seen in a child's language. For e.g final consonant deletion /jo/ for /jol/. However they disappear at a certain age. When this does not disappear at that particular age, it causes phonological disorder.

#### 4.4.2 Active and Passive Articulators

##### Active Articulators

These are the speech organs which actively move and make contact with other articulator in order to produce a speech sound. The kind of speech sound produced depends on the articulators, the place and manner of articulation. The active articulators are as follows:

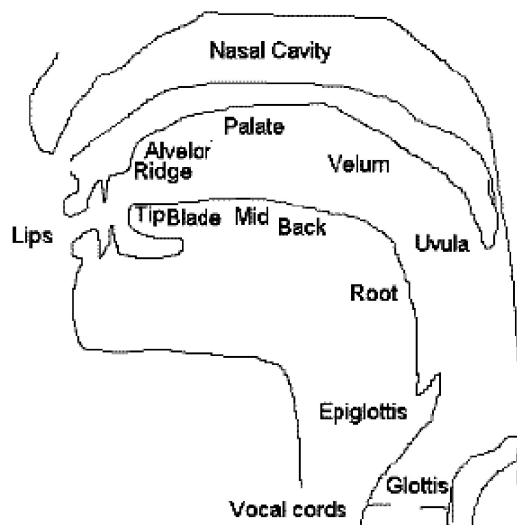
- **Lips-** the visible part of mouth. Owing to its muscular make up, it's very flexible and can take a variety of shapes like rounding, retracting, and opening. The lips usually make contact with each other and other structures to produce consonants. For example /b/ is produced when both lips come in contact. And vowels and semivowels are produced with changed shapes. For example lip retracting for /i/.
- **Tongue-** another muscular structure, one end is fixed and the other end moves freely. It can move side to side, move up, touch the part behind upper teeth, lower its body, raise its body. In the production of vowels the tongue's position is altered, resulting in air flow modification. In case of consonants, tongue may make contact with another articulator. For example for the sound /t/, it touches the alveolar ridge or palate.
- **Lower Jaw -** it's a highly movable structures and houses the lower teeth also. The movement of jaw is very crucial for speech sound production, it can lower and raise itself to varying extents which helps in production of different vowels and consonants. Moreover the lower teeth provides as an articulator for some consonants as /f/, /v/.
- **Soft Palate-** it's the muscular portion of palate after the hard palate. It end in the uvula, which acts as a gate between oral and nasal cavities. So when the soft palate and uvula rise and close the nasal path, the air flow has to pass through the oral cavity and the sounds are oral. When the palate moves down and allows air to pass through the nasal cavity, nasal speech sounds are produced. For example /m/, /n/.

##### Passive Articulators

- **Teeth -** divided into lower and upper teeth. Important for biting, grinding and chewing of foods. It act as a passive articulator for many speech sounds. It does not moves on its own, but an active articulator e.g tongue or lips, makes contact with it to produce a speech sound. For example /t/ in the Bengali

words /tala/ or /tal/ is produced by the contact of tongue and upper teeth. These sounds are called dental or labiodental.

- **Alveolar Ridge-** it is the part just behind the teeth. Usually the ridge behind the upper teeth is of importance for speech productions. The active articulator tongue make contact with this portion to produce sounds like /t/ in the word /tata/,/r/ etc. These sounds are called alveolar sounds
- **Hard Palate-** Just after the alveolar ridge,the rigid and immovable part called har palate starts and continues upto the end of buccal cavity. This portion separates the nasal and oral cavity as it lies between both. It helps to direct the air flow towards the exit of oral cavity. It acts as a passive articulator for many speech sounds.Speech sounds produced with the help of hard palate are called palatal sounds. For example /r/,/l/



**Diagram of Articulators**

#### **4.4.3 Classification of vowels and consonants**

All the speech sounds produced can be divided broadly into vowels and consonants. Some other descriptions include semivowels and diphthongs. All the speech sounds can be classified into some groups depending on the way they are produced. The classification of speech sounds is very important in every language, as it helps to understand the production of each sound. Moreover it also helps to analyse and remediate speech errors.

## **Vowels**

These sounds are produced when the air flow from the vocal folds can pass freely through the oral cavity. In other words the articulators do not make any constriction or contact with each other to block the air flow. However the active articulators change their shape and position to alter the air flow and result in different vowel production.

### **Classification of Vowels**

#### ***Based on lip shape***

- Rounded and Protruded - when both the lips take a rounded or protruded shape, the vowels produced are called rounded. For example /o/, /u/.
- Unrounded - when the lips do not assume any rounded shape, can stretch or retract, then unrounded sounds are produced. For example /a/, /i/

#### ***Based on Tongue Position***

- Front - these vowels are produced when tongue tip moves up or down. For example vowel /i/
- Central - these vowels are produced when tongue's middle part moves up or down. For example vowel /a/
- Back - the back of the tongue rises or lowers compared to the resting position of the tongue. For example /o/, /u/.
- High - tongue moves and stays at higher place than the resting position.
- Mid - the height of the tongue remains unchanged

#### ***Based on duration***

- Long vowel- longer duration taken to produce a vowel
- Short Vowel- short duration is taken to produce a vowel.

### **Classification of Consonants**

Consonants are produced by movement of active articulators and in some cases complete or partial contact with the passive articulators. The airflow is altered and modified during production of consonants.

Consonants can be classified based on the following aspects:

- Place of articulation
- Manner of articulation
- Voicing or no voicing

**PLACE OF ARTICULATION-** This category describes the articulators whether active or passive involved in the production of a particular speech sound. It indicates the point at which the air flow is completely or partially obstructed. The consonants can be classified as follows:

<b>Type of the Sounds</b>	<b>Description</b>	<b>Example in English</b>
Bilabial	Produced by contact of both lips	/b/,/p/
Labiodental	Produced by contact of lower lip and upper teeth	/f/,/v/
Dental	Produced when tongue tip touches upper teeth	/th/,/dh/
Alveolar	Produced when tongue tip touches alveolar ridge (gums behind upper teeth)	/t/,/d/
Palatal	Produced when tongue touches the hard palate	/ch/,/j/
Velar	Produced when back of the tongue touches the soft palate	/k/
Retroflex	Produced when tongue tip twists and make rapid repeated movements and touches the hard palate	/r/
Glottal	Produced when there is simultaneous vibrations of vocal folds and release of puff of air	/h/

**MANNER OF ARTICULATION-** this category describes consonants based on the way they are produced. The air flow from the vocal folds can pass through a narrow passage between articulators or can be stopped abruptly by an articulator. The stoppage of air flow can be followed by release of air puff or no such release. The sounds can be described as follows:

<b>Type of Sound</b>	<b>Description</b>	<b>Example in English</b>
Plosives or Stops	Produced when air flow is completely and abruptly withdrawn causing sudden release of air	/p/,/t/
Fricatives	Produced when the air flow passes through a narrow constriction causing a friction noise	/s/
Affricates	Produced when air flow is stopped abruptly and then released to cause a frictional noise	/ch/
Nasals	Produced when the air passes through the nasal cavity instead of oral cavity	/m/,/n/
Aspirate	Produced when a greater amount of air is obstructed and suddenly released	/ph/,/kh/
Laterals	Produced when the air flow is blocked in the centre of oral cavity and released through the sides	/l/

**Voiced Vs Voiceless-**Voiced consonants are produced when vocal folds vibrate and release air stream in to the vocal tract. Voiceless sounds are produced when there

is no vocal fold vibration but the air from the lungs directly reaches the oral cavity. The sounds can be categorised as follows:

<b>Type of Sounds</b>	<b>Voiced</b>	<b>Voiceless</b>
Bilabial	b	P
Alveolar	d	T
Velar	g	K
Labiodental	v	F
Fricative	Sh	s

All the speech sounds can be described by their place of articulation, manner of articulation and voicing characteristics. For example the sound /b/ is a bilabial, plosive and voiced sound.

#### **4.4.4 Assessment of Articulation**

Abnormality in any of the articulators lead to errors of speech production. These errors are characterised by phonetic/phonemic errors or articulation errors. The error in production of speech sounds can be specific for example in a particular position of word, or it can be in general erroneously produced all the time. Articulation errors can be caused by abnormality in the structure of articulators or functions of articulators. These abnormalities are present as a associated condition of many disorders like motor speech disorders (cerebral palsy), mental retardation, hearing impairment, structural abnormality (tongue-tie, cleft lip-palate).

#### **Need for Assessment**

The assessment of articulation is a part of routine speech assessment. It helps us to understand the underlying cause of disorder, helps to assess the awareness of individual and family thus their counselling about the disorder, to decide the treatment plan like medical vs therapeutical, indicates use of formal tests, helps to form a baseline for therapy, assess the progress of therapy, decide on time of discharge from therapy, and to decide on follow up design.

#### **Assessment Procedure**

Brief Case History- The complaint, its onset and nature is recorded in details. The informant can be parents, caregivers and the child himself. A note is taken about

the associated disorders. Brief history about the treatment availed till date is taken for example surgery,therapy etc.

**Assessment of Articulators-** the articulators are assessed for their appearance and functions. These can be observed directly if the child is cooperative or can be assessed with the information provided by the parents. The following parameters are assessed:

<b>Articulators</b>	<b>APPEARANCE</b>	<b>FUNCTION</b>
lips	Normal/abnormal	Movements like rounding, retraction and protrusion present/absent/restricted
Tongue	Normal/Abnormal	Movements like side to side, pullingup, rolling up
Hard Palate	Normal/Abnormal	NA
Soft Palate & Uvula	Normal/Abnormal	Movement during vocalisation
Teeth	Normal/Abnormal	Chewing
Jaw/Mandible	Normal/Abnormal	Opening & closing of lower jaw.

The primary functions of the articulators are also assessed. These are blowing, swallowing, sucking and chewing. A note is taken about drooling (if present).

**Error Analysis-**The speech sounds produced which are incorrectly are recoded,the frequency with which they are misarticulated is noted. The position at which they are misarticulated is noted for example final position of a word. The error patterns in word and sentence level is recorded. The consistency of the errors is assessed.

**Speech Intelligibility-** The overall speech intelligibility is rated on a scale of 0 to 6, where 0 denotes normal speech and 6 denotes very poor speech intelligibility.

**Diadochokinetic Rate -** the production of syllables /pa/ /ta/ and /ka/ in one second is recorded. This gives information about rate and range of movement of articulators (lips,tongue,mandible & soft palate)

**Stimulability -** The stimulability of the child is assessed under two conditions with reinforcement and without reinforcement. The stimulus can be auditory, visual, audio-visual, graphic and motokinesthetic.



**Formal Tests** - Some formal tests can be used to specify the speech sounds erroneously produced, their position in the word level, consistency of their production and the pattern of the error like substitution by another sound, deletion or omission of the sound etc. Example of such tests are Bangla Articulation Test and Picture Articulation Test.

In **Bangla Articulation Test** all the vowels and consonants are listed with words comprising these sounds at three positions initial, medial and final. The response is elicited mostly by using pictures or models for young children. For older children the written words can be used directly. For children who cannot read, the tester may produce the words and ask the child to repeat. In the last case factors related to tester like testers speech production skills, knowledge of the language and personal bias should be realised. Also the child's hearing status should be considered while performing the test using auditory stimulus. The child is usually given few trials and then the final response is recorded. The response can be either correct or incorrect. Further the incorrect response can be categorically recorded into four responses, substitution(s), omission (o), distortion (d) and addition (a). The error can be present in all the three positions or any one or two positions. A sample of the format used is as follows:

Sl.No.	Phonemes	Position	Item	Correct	S	O	D	A
1	/a/(the first Bengali vowel)	Initial	onsho					
2		Medial	bol					
3	/aa/	Initial	Aam					
4		Medial	Mach					
5		Final	pa					

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#### **4.5 Suprasegmental Aspects of Speech and its Assessment**

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The speech sounds (segmental features- vowels & consonants) are connected to form phonemes and words. The words are connected to form sentences. The speech of human is characterised by lot of meaning conveyed by words and the way they

are produced in a particular context or environment. The way speech is produced conveys the emotional status of the speaker, his/her intent and also the process of communication is smoothly carried out. Words or segmental part of speech alone cannot convey the full message on its own. Suprasegmental aspects also called prosody of speech give colour and flair to segmental features and make speech production interesting. If suprasegmental features are removed human speech will become robot like. The same sentence can convey varied meanings or intentions with varying use of any of the suprasegmental features. The prerequisite for appropriate suprasegmental features is presence or acquisition of appropriate segmental features,adequate hearing and adequate psychological development. Suprasegmental features also get affected when rate and strength of movement of articulators is affected.

#### **4.5.1 The various suprasegmental features of language are mainly as follows:**

- Stress
- Intonation
- Rhythm

#### **Let us learn briefly about each.**

**Stress** - It is that feature which is used to indicate or convey importance of a particular word or phrase in a sentence. It can be used on the whole word or on a part of the word. The part of speech which is stressed is produced with greater energy. Stress patterns also differ based on words/no of syllables. In single syllable words, the primary stress is usually on the whole word. In bisyllabic and multisyllabic words the stress can be on a single or multiple syllables.

For example let us take a sentence THIS IS MY RED BAG. We can convey different information by changing the stress from one word to the other,like

**THIS** is my red bag indicates the ownership of the bag among many similar bags.

This is **MY** red bag indicates the ownership of the bag to a particular person

**Intonation**- It is conveyed by variation in pitch pattern of voice production within a phrase or sentence. The pitch can be rising or falling or in any other manner to convey varying meanings. Intonation mark sentence ending. It also convey feelings

like anger, or sarcasm. The use of intonation differentiate a sentence as a statement or a question.

For example, "This is your red bag" with not much pitch variation is a statement. And the same sentence becomes a question when the sentence ends with a rising pitch, 'This is your red bag?'

**Rhythm-** This is the timing pattern between the successive units of speech. There is a periodicity or timing pattern while the speaker takes breath in between utterances. In one breath he may utter 2-3 or more words depending on the context. In music, this is usually repetitive, same timing is maintained in a full song, but for speech, the rhythm depends on the speaker, content and context. Another aspect called tempo can be understood here, it is the speed or rate at which a speaker speaks. It is dependent on the speaker.

**Juncture-** It is the pause pattern used between words and leading to association of a particular syllable to a particular word. Moreover the placement of phrases at phrase juncture, the length of pauses is also very crucial. For example "peace talks" vs "pea stalks"

#### **4.5.2 Assessment of Suprasegmental Feature**

The assessment of suprasegmental features is carried out as a part of routine speech assessment. The child or speaker under assessment needs to have a developed connected speech. The assessment lead to the understanding of deficits in expression of these features. Thus this helps to plan and carry out speech therapy program.

#### **Perceptual Analysis**

There is a lack of standardised tests. Mostly perceptual analysis is carried out to assess each feature. The analysis can be carried out by recording speech samples from the child while reading, talking or storytelling. The analysis can be carried out even during conversation with the child as a part of assessment. Some tests described in the literature describe the use of experienced listeners, for the perceptual analysis. The listeners should have adequate knowledge about the language, context and should be aware of the normal patterns of suprasegmental features. However the perceptual analysis can be carried out by the clinician alone. During reading activities, the features can be highlighted to help the child to produce them correctly. For example stressed words can be underlined. Moreover use of rating scales to rate overall speech intelligibility also gives us information about suprasegmental features. Use of

correct prosodic features is very important to obtain good speech intelligibility. Children using the suprasegmental features correctly are more intelligible.

### **Instrumental Assessment**

Instrumental evaluation always gives direct and objective results. Many parameters of speech can be measured using **spectrographic analysis**. This gives information about durational aspects of speech, pitch variations, intensity, stress, intonation, rate of speech, and voice quality. The prosodic control can be objectively assessed section by section and analysed to get information on fundamental frequency, its parameters and intensity contours. The assessment can be carried out by downloading certain software in an advanced computer fitted with a high fidelity microphone. Examples Praat, Audacity etc. These analyses can also be carried out in standalone systems like Visi-Speech. The assessment of fundamental frequency between two utterances can be done easily to differentiate between question and statement. Similarly the peak fundamental frequency values and intensity values can be compared between stressed and unstressed words.

However accuracy of instrumental measurements can be affected in case of impaired speech. For example presence of hypernasality may reduce the acoustic contrast between utterances, reducing the obtained values. Moreover there can be instrumental errors or lack of tester's knowledge which can affect the results.

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## **4.6 Milestones of Speech Development in Typically Developing Children**

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Development of speech sounds follows a particular pattern in typically developing children. All the speech sounds including vowels, consonants, semivowels, diphthongs and blends develop at different ages depending upon mastery of central control on motor speech organs, muscles and proficiency of articulatory movements. As a result speech sounds which can be produced with ease develop first followed by more intricate sounds.

The speech development can be illustrated from birth as follows:

### **Birth to 3 months**

The infant mainly has crying and comfort sounds at this stage. These sounds have rudimentary vowel like utterances, which cannot be specified.

### **3 to 6 Months**

The child starts cooing, gurgling and babbling. Speech sounds like /p/, /b/ and /m/ become prominent along with vowels like /o/, /u/, /i/ and /a/ in their speech production.

### **6 to 12 months**

Continue to use the above developed consonants and vowels with more efficiency.

### **1 Year to 2 years**

Few more consonants get added n, t, d in the child's speech production. At this stage the child starts to take a step towards developing production of more complex speech sounds. In this time the child experiences certain phonological processes, which might sound faulty to an adult but are very normal patterns found in the speech development of a typically developing child. The phonological processes are:

**Voicing-** This is where sounds made with no voice are replaced with voiced sounds (e.g. "car" becomes 'gar', "tea" becomes 'dea')

**Stopping-** This is where sounds made with a long airflow are replaced by sounds made with a stopped airflow (e.g. "sea" becomes 'tea', "shoe" becomes 'to')

**Final consonant deletion-** The ends of words are often missed out (e.g. "tap" = 'ta')

**Velar Fronting-** This is where sounds made with the tongue hitting the back of the mouth (e.g. /k/ and /g/) are replaced with sounds made at the front of the mouth (e.g. /t/ and /d/) so "car" becomes 'tar', "key" becomes 'tea'

**Palatal Fronting-** This is where the tongue is moved forward in the mouth so the 'sh' sound becomes a /s/ sound

**Weak Syllable Deletion-** This is where non-stressed syllables are deleted from words (e.g. "elephant" becomes 'ephant')

**Assimilation-** The pronunciation of the whole word is influenced by the presence of a particular sound in the word (e.g. "dog" become 'gog')

**Consonant Cluster Reduction-** This is where clusters of consonants in words are reduced by one or more consonants (e.g. 'brick' becomes 'bick', "clown" becomes 'cown')

**De-affrication** - This is where the affricate sounds 'sh', 'ch' and 'j' are replaced with fricative sounds ('sh', /s/, /z/) or the /t/ or /d/ sound.

**Gliding** - This is where the /l/ and the /r/ sounds are replaced with the /w/ or the 'y' sound.

The voiceless 'th' sound (as in '**th**ank you') is replaced with a /f/ sound

The voiced 'th' sound (as in '**with**') is replaced with a /v/ sound

## **2-4 years**

More speech sounds get included in the production list like /k/,/g/,/f/,/s/. The child also keeps repeating the phonological processes. The child's speech is still not very intelligible to unfamiliar person.

## **4-6 Years**

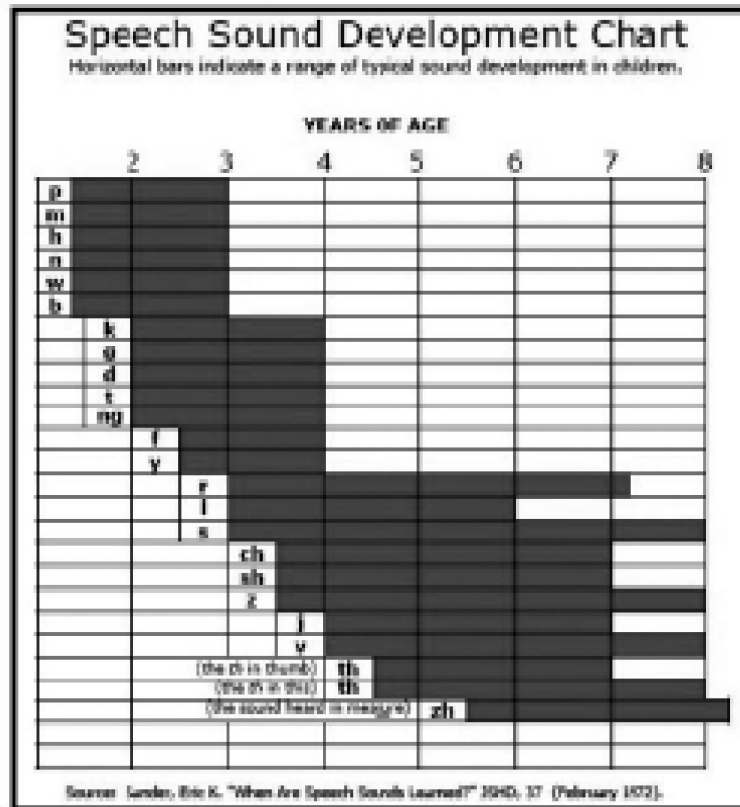
More difficult speech sounds start emerging like , /y/, /h/, 'sh', 'ch', 'j', /z/, /l/, /v/. The child still uses the phonological processes and continues to make the normally occurring errors.By 6 years the child's speech becomes very distinct with few errors like in sounds /r/,and /th/. Even unfamiliar individuals start comprehending the child's speech.

## **6-8 years**

By 8 years the child is able to say almost all speech sounds with much clarity. The normal phonological patterns start to disappear and completely disappear by 8years.

### **4.6.1 Chart of normal speech sound development sequence.**

The horizontal bars represent age.The speech sounds are mastered by the age where the bar terminates. For example the sounds k,g,d,t are mastered by 4 years of age.




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## 4.7 Speech Intelligibility

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### 4.7.1 Concept

To carry out effective and smooth verbal communication, it is mandatory to understand what is being said. That is the speaker should have clear and intelligible speech. Speech intelligibility is a measure of how well a particular speaker's speech is comprehensible. The speaker should be understood by familiar as well as unfamiliar listeners. Age appropriate voice, articulation, normal fluency of speech, normal language development and good quality of speech production sum up to give rise to good speech intelligibility. Usually a child's speech starts to become intelligible even to unfamiliar listener by and after 4 years of age.

#### *Intelligibility to familiar listeners*

By 18 months = 25% intelligible

By 24 months = 50-75% intelligible

By 36 months = 75-100% intelligible

Lynch, Brookshire & Fox (1980)

***Intelligibility to unfamiliar listeners***

Dr Peter Flipsen Jr , (2006)

By age 1 = 25% intelligible

By age 2 = 50% intelligible

By age 3 = 75% intelligible

By age 4 = 100% intelligible

**4.7.2 Factors affecting speech intelligibility**

In order to speak clearly the speaker should have the following characteristics:

1. ***Voice:*** The individual should have age and sex appropriate voice quality. The organs of the respiratory system, vocal tract should be structurally and functionally adequate to result in an acceptable voice quality. The child should not have any structural abnormality, motor speech disorder, intellectual deficiency and hearing impairment in order to be able to produce good quality of voice. The children have similar voice quality until puberty, after which male and female adolescents have different voice quality. The voice should be adequate in loudness, appropriate in pitch and should have a pleasing quality(not harsh, hoarse or nasal)
2. ***Articulation*** - All the articulators should have normal structural make up. The active articulators should have appropriate rate and range of movements. The child should not have any motor speech disorder, hearing impairment, structural anomaly (cleft lip/palate) and intellectual deficiency in order to have clear articulation.
3. ***Fluency*** - The rate at which the speech is produced should be age appropriate. It should be free from any non-fluencies like repetitions, blocks or hesitations. However up to an age of 4 years, the child might display a normal non-fluency pattern which should not be confused with fluency disorder.
4. ***Suprasegmental features-*** The use of stress, intonation, rhythm and pause should be timely and appropriate. A child having speech without these features



will sound robotic, and not pleasing to the ears, and will lead to disinterest, lack of motivation of the listener.

5. **Knowledge of language-** The child should have normal language development sequence. It is not only important the way speech is produced, but what content it has.

#### **4.7.3 Assessment of Speech Intelligibility**

Assessment of speech intelligibility is a part of routine speech assessment. It provides information about the child's current speech intelligibility which can be used to counsel parents, decide treatment strategies and also curriculum for education. The measurement acts as a baseline before treatment/therapy and also helps to monitor progress of therapy.

##### **Perceptual Procedures**

Most of the clinicians use perceptual measures for assessing intelligibility. Rating scales are widely used in all set-ups. A speech sample, either live or recorded is presented to a listener or group of listeners for judging the intelligibility on a scale. For example a scale of 0 to 6 is used, where 0 denotes most intelligible and 6 denotes poor intelligibility. Unfamiliar listeners are best as the listener bias can be removed.

However there can be some limitations of the perceptual measurements. The points on rating scales may not be clearly demarcated. The rating might slightly differ from one judge to another.

##### **Other Procedures:**

##### **Write down Methods**

The listener/judge can write down the child's utterances as understood. Thereafter the number of words correctly produced can be calculated. The intelligibility can be calculated in percentage by using the simple calculation:

Speech Intelligibility (%) = No of words correctly produced/Total no of utterances

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## **4.8 Let's sum up**

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Respiration provides the power for the process of speech production. The structures involved in respiration and their respective functions should be intact for adequate speech production. There is a need for assessment of

respiratory process as a part of routine speech evaluation. Phonation is the next step after respiration. It involves the vocal folds and vocal tract. The phonatory system is also evaluated as a part of routine speech assessment procedure. The assessment results are used for management of various speech disorders.

There active and passive articulators which act in coordination to result in smooth speech production. All the speech sounds are classified based on manner, place and voicing characteristics. Articulation assessment provides important information for speech sound correction.

The emotions/feelings of a speaker are conveyed with the help of suprasegmental features used in speech production. Intonation, stress and rhythm are the basic prosodic features. These features can be assessed perceptually as well as instrumentally.

The development of speech sounds in a child follows a particular sequence. Any disruption leads to delayed speech or speech errors. It typically starts at birth and continues till 8 years of age.

Speech intelligibility is obtained by the presence of many contributing factors. It is very important for effective communication. Assessment of speech intelligibility is a part of routine speech assessment. Mostly perceptual measure are employed to assess speech intelligibility.

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## **4.9 Check Your Progress**

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1. What are the various systems of human body which are involved in the act of speech production?
2. What is speech breathing?
3. Why do we need to assess the respiratory system?
4. What are the sounds which are produced with the help of alveolar ridge and tongue?
5. What are the speech sounds you can expect to hear in the speech of a 4 year old child?
6. Frame a sentence in your language, change the intonation patterns and say the sentence.

7. At what age you can expect to hear intelligible speech from a familiar child and an unfamiliar child?

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#### **4.10 Reference**

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