DHLS 2 - Introduction to Speech & Language Pathology

Unit 1: Communication, Language and Speech

Objectives

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After going through this unit you will be able to:

- Define speech, language, and communication
- Explain the various components of speech
- Explain the various components of language
- Describe the characteristics of normal speech, language and communication
- Describe the voicing, place, and manner of speech sounds
- Describe the developmental stages of speech, language and communication
- Describe factors affecting them and causes of speech and language disorders.

1.1 Introduction to communication, language and speech

You know that communication is essential for our day-to-day activities. Have you heard a baby crying? This is his/her first communication with the world.

- Try saying your name. Observe the movement of tongue, lips and teeth. This is communication through **speech**.
- What do the traffic police do when he wants to stop you? He uses **gestures.** Isn't it? This is also a means of communication.
- Do you remember how you filled in the application form for this programme?

Yes, through **writing.** This is another mode of communication.

Now you understood that we could express our ideas and thoughts not only through speech but also by various other modes. What are these other modes? Yes, gestures, writing etc. **This is language**.

In this unit we shall understand what speech, language, and communication are and what are the parameters of language and speech.

1.2 Definitions of speech, language, communication, and prosody

1.2.1 Speech: Speech is the verbal mode of communication. It includes two main components. First is the **articulation ability** which includes structure and function of larynx and vocal tract. Secondly, it comprises of the sounds of the language used. Thus, all humans share same articulatory mechanism, but different language groups make use of different sounds.

1.2.2 Language: Language is arbitrary system of symbols used for communication. It involves **Phonology** (use of sounds and speech patterns in language), **Morphology** (study of the forms and formation of words in a language), **Syntax** (how words are formed into complete sentences), **Semantics** (study of meaning of the words used) and **pragmatics** (use of language appropriate to the situations). Language is normal when these skills are acquired appropriate to the age and gender and follows the rules of the specific social group and culture.

1.2.3 Communication: Communication refers to the transformation of information from one individual to another and can occur by means of various processes and methods and depending on the channel used and the style of communication. Speech and language are the tools that humans commonly use to communicate. It is often categorized as

receptive language and expressive language. Receptive language is the understanding of words and sounds. Expressive language is the use of speech (sounds and words) and gestures to communicate. Communication can be interpersonal (between individual) or intrapersonal (within individual e.g., thinking, reasoning etc). Communication is normal when it is appropriate to the age, gender, culture and language context.

For example, when you are speaking, you are providing information. The listener is getting the information. So, in communication how many persons are necessary? Yes, two or more persons. One who provides information and others who receive information; a speaker, and a listener(s). Without two persons communication is not possible. Figure two shows the essentials of communication.

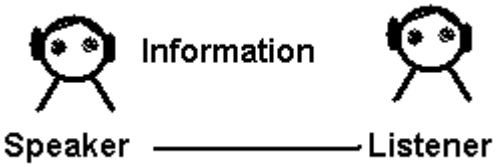


Figure 1: Essentials of communication

When you are reading this material, you are understanding the written information. Isn't it? This is gaining knowledge through language, in the form of reading. You may also use writing to communicate with other person(s). While speaking and listening (understanding) are primary means of communication, reading and writing form the secondary means of communication. To communicate you may also use some signs. For example, you may shake hands to greet a person or wave your hands to bid goodbye.

Communication can be enhanced by codification of symbols. This may vary in complexity. Look at the following symbols. What do you understand by them?

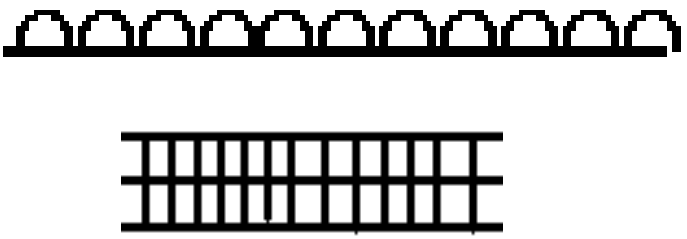


Figure 2: Symbolic representation of language concept

Yes, good. The first one is a road hump and the second is railway gate. These are simple symbols. An example for a complex symbol is $A^2 + b^2 + 2ab = (a + b)^2$.

Now let us understand what language is? Language is a mode of communication. What are the modes? Yes, Speech, writing, and gesture. Therefore, **language is a means, vocal or other, of expressing or communicating thought or feeling.** Figure 3 shows the various forms of language.

Figure 3: Forms of language

Speech is the **verbal mode of communication**. Do you know what the basis of speech is? It is air. The respiratory air passes through the larynx or voice box. We have two vocal folds in the larynx, which vibrate to produce sound. What do you have in the mouth? Yes, you have lips, tongue, teeth and roof of the mouth. These are called articulators. Now try saying /ka/. What is happening to your tongue? It is rising. Isn't it? The movement of articulators modifies the air. So what is speech? Yes, **Speech is the sound produced by vocal folds and modified by the articulators using the expiratory air. Speech is communication through conventional vocal, verbal or oral symbols.**

Now let us understand what prosody is. Try saying 'my name is X' in the same pitch. Is this the way you speak always? No. You vary the pitch. Sometimes you emphasize a word. These are called prosody. **Prosody** includes intonation, stress and rhythm. It is superimposed on speech. **Therefore prosody is a suprasegmental feature.**

Now we have learnt what are speech, language, communication, and prosody. We shall learn the interrelation between speech, language, and hearing.

1.3 Interrelation between speech, language and hearing

We already know what speech and language are. Have you ever observed a child with hearing loss? Have you heard this child speak? Why this child does not speak like any other normal children? It is because the child learns to speak by listening to other's speech in the community. Hence, hearing is very important for one to learn to speak. If the child cannot hear, he will not learn to speak. It has to be taught to

him. The simplest way to understand this is to try hearing sound that has a frequency of 25,000 Hz. You cannot hear because your ears are not meant for hearing sounds with very high frequency. You almost feel that you are deaf. Similarly, hear someone speak in language other than that you know. You will hear it but will not understand. Why is it so? It is because you have learnt to speak in a language by hearing to it. As you have not heard this language, you cannot understand it and speak it. So, you have understood that hearing is very important in order to learn to speak.

Let us now understand how speech and language are related. You are aware that speech is the verbal mode of communication. Let us presume that you want to speak "**The book is on the table"**. For this you should know what book and table are. If you do not know the object book or table you will not have word for that. Hence, without the concept there is no name. Therefore, speech and language are interrelated. There can be language without speech, but there cannot be speech without language.

1.4 Prerequisites of communication

You are aware that communication takes place between two individuals. One of them is the speaker and the other is the listener (receiver). To communicate, a speaker, a listener, and the channel is very important. What does the speaker do? The speaker first decides to say something (intention) to another human being (or to a machine). This event takes place in the higher centers of the mind/brain.

The desired thought passes through the language centers of the brain where it is given expression in words which are assembled together in the proper order and given final phonetic, intonational, and durational form **(language)**.

The language-production centers of the brain are involved in speech motor programming which execute over time by conveying/firing sequences to the lower neural centers and this in turn impart motion to all of the muscles responsible for speech production: the diaphragm, larynx, tongue, jaw, lips, and so on. Much, if not all, of this activity is subconscious, and involves constant corrective feedback.

As a result of the muscle movements, a stream of air emerges from the lungs, passes through the vocal cords where a phonation type (e.g. normal voicing, whispering, aspiration, creaky voice, or no shaping whatsoever) is developed. It receives its final shape in the vocal tract before emerging from the mouth and the nose and through the tissues of the face. The vibrations caused by the vocal apparatus of the speaker radiate through the air as a sound wave. The sound wave may be converted to analog or digital form for storage or transmission, and in the form of electric waves may be transported thousands of miles to its destination, where the information in the electric waves is converted back to the form of sound.

The sound wave, which may have passed through electronic coding and decoding, eventually strikes the eardrums of another human being, where it is first converted to waves on the surface of the tympanic membrane, next to mechanical motion via the ossicles (3 small bones) of the middle ear, then to fluid pressure waves in the medium bathing

the basilar membrane of the inner ear, and finally to firings in the 30,000 neural fibers which combine to form the auditory nerve (hearing).

The lower centers of the brainstem, the thalamus, the auditory cortex, and the language centers of the brain all cooperate in the recognition of the phonemes which convey meaning, the intonational and durational contours which provide additional information, and the vocal quality which allows the listener to recognize who is speaking. It also helps to gain insight into the speaker's health, emotional state, and intention in speaking (auditory and language processing).

The higher centers of the brain, both conscious and subconscious, bring to this incoming auditory and language data all the experience of the listener in the form of previous memories and understanding of the current context, allowing the listener to "decode" in his or her mind a more or less faithful "replica" of the thought which was originally formulated in the speaker's consciousness and to update the listener's description of the current state of the world (understanding). The listener may in turn become the speaker, and vice versa.

In simple words, the concepts are generated (encoded) in the speaker's brain which sends neural commands to the muscles of speech. By moving various muscles the speaker speaks. This is transferred as acoustic waveform and reaches the listener's ears. The middle part of the ear converts this acoustic energy into mechanical energy. The inner ear parts convert the mechanical energy into electrical impulses.

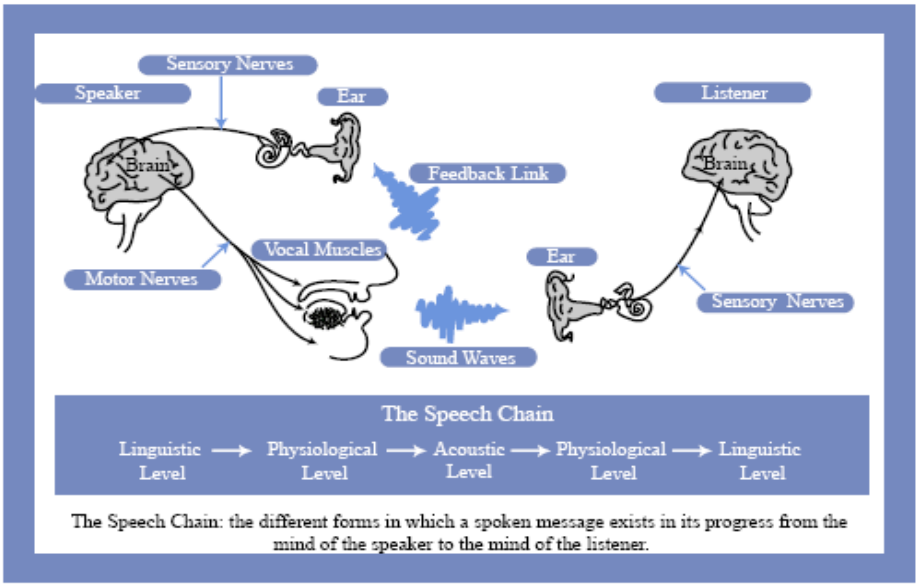


Figure 4: The speech chain

Source: https://aanugraha.files.wordpress.com/2008/02/speechchain.png?w=700

These impulses are carried to the brain of the listener which decodes the concept. This process, of transfer of the concept from the speaker's brain to that of the listener, is called the **speech chain**. Figure 4 illustrates the speech chain.

For all of these to happen, the speaker should have normal nervous system, respiratory, laryngeal, resonatory and articulatory systems. The listener should have a normal hearing. If the nervous system of the speaker is damaged, he will not be able to transform the intent to language. Similarly, if the respiratory system is not functioning, muscles will not be able to generate expiratory air necessary for speech. If the vocal folds are paralyzed, the speech will be whisper and if the articulators are not there (paralyzed or cleft), the air stream will not be appropriately converted to speech sounds.

1.5 Functions of communication

The major function of communication is transmission and exchange of information. The ultimate purpose of communication is gaining knowledge and understanding. It facilitates creation, preservation, advancement, and utilization of all knowledge. Some of the important functions of communication include; interaction with individuals (eg., greet), to regulate or control others (persuade, convince, correct, criticize, threaten or demand), convey information, artistic and imaginative purposes, seek information and to satisfy one's needs.

1.6 Types of language: Non-verbal (signs, symbols, gesture) and verbal (speech)

Language can be verbal or non-verbal. Verbal language includes speech and whistle language. Non-verbal language includes sign language, symbols, gestures, and written language. Table 1: Distinctions between speech, language, and communication

Particulars	Communication	Language	Speech
Definition	Transfer of information	Verbal, gesture or written	Verbal language
Speech mechanism	Not necessarily involved	Not necessarily involved	Involved
	Need not be normal	Need not be normal for gesture or written language	Should be normal
Other senses	Sometimes involved	Sense of hearing, vision involved	Hands and eye not involved
User	Human beings Animals, machines	Human beings Animals also	Human beings

For example, an object can be represented schematically by using picture, map, or graph or a word can be used. The distinctions between speech, language, and communication are depicted in the table above.

1.7 Parameters of language

1.7.1 Phonology

Let us understand the components of language. The speech sounds are called **Phonemes**. By combining a set of phonemes you can make a word. For example, in the word 'Speech', the phonemes are /s/, /p/, /i/, and /c/. If you order the phonemes as /c/, /s/, /i/, and /p/, it is not meaningful. This set of phonemes does not make a word. The study of phonemes is termed **Phonology**.

1.7.2 Semantics

When you read or hear the word '**bus**', you remember a vehicle. So, you have associated the word bus with a vehicle. How did you do this? The relationship between the word and the meaning is arbitrary. Let us assume that your classmates are creating a new language. Represent each object with a word of your own. For example, assume that the following are the words/symbols you have created.

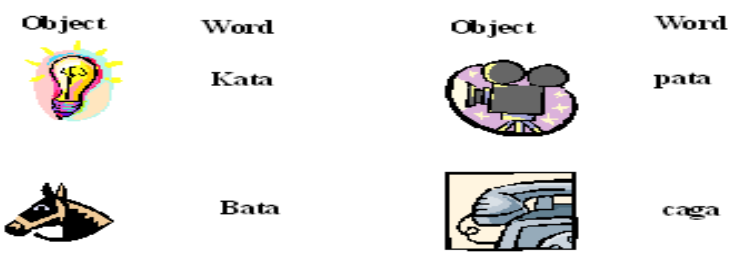


Figure 5: objects and words

Now you have associated these objects with words. This is arbitrary. Keep practicing it. After some time when someone says kata you will associate it with bulb. Therefore, one learns the meaning of words through exposure to language.

Language can be verbal or nonverbal. We have learnt that gesture and writing are nonverbal modes of language. Now let us arbitrarily assign some gestures to alphabets of a language. Assume that the following gestures represent alphabets.

Figure 6: Arbitrary representation of symbols to alphabets

Now if you see  , what do you read it as? Ace?, very good. The study of relationship between word and meaning is called **Semantics.**

1.7.3 Syntax

In conversational speech we usually have a sentence. The words in a sentence are interrelated. For example, if you combine words like ‘sun go moon window’ each word has meaning. But they are not interrelated. Therefore, together they do not give any meaning. On the other hand if you combine words like ‘I am studying Diploma’ is it meaningful? Yes, Why? It is because the words in this sentence are interrelated. The word ‘I’ is associated with the word ‘study’, the word ‘study’ is associated with the word ‘diploma’ and ‘ing’ in the word studying indicates present tense. Hence, a sentence is a combination of words to give meaning. The study of relationship between words is **Syntax.**

1.7.4 Pragmatics

Have you heard a child speaking? Sometimes he imitates adults isn't it? Let us read a joke.

" Swamy, Ramu's father, was working in an office. His boss had a big nose. All workers used to call him joker. Swamy also made fun of his boss. He used to refer to his boss as ***capsicum*** at home. Once, Swamy invited his boss home. He told Ramu not to speak of the nose of his boss, as Ramu was very mischievous. Swamy's boss came home. Ramu was standing behind the door. Slowly he came towards Swamy's boss. Swamy said 'Ramu, come and say hello to uncle'. Ramu said 'Papa, is this the person whom you call ***capsicum***? I will see his big nose and go'. Swamy's boss turned red".

What did you understand out of this? The child, Ramu, does not know that he should not speak like this. Isn't it?

Let us read another incidence.

"Ramu's house was nice. His mother Sheela kept the house very neat and tidy. Once Ramu broke a glass plate. Sheela said 'Ramu! That is bad. Why did you break the plate'? Some days later Sheela's friend Vijaya came home. Sheela gave her breakfast. Unfortunately the plate fell down and broke. Immediately Ramu said 'Aunty! That is bad. Why did you break the plate'? Sheela was embarrassed.

Again Ramu does not know that speaking with children and adults are different. Assume that you are speaking the same matter with a child, your friend and an authority. Do you speak in the same way? For example, if you want to call them for lunch, how will you speak?

To child: Papu, come for lunch.

To Friend: Come yar. We shall have lunch.

To authority: Will you please come for lunch?

Thus, socially you have different ways of speaking. Study of these socially appropriate ways is **Pragmatics.**

Thus the components of language are phonology, semantics, syntax, and pragmatics and the secondary languages are reading and writing.

1.8 Parameters of Speech

1.8.1 Voice

Remember we learnt that the respiratory air passes through the vocal folds in the larynx. Vocal folds vibrate or close and open alternately and at a fast rate. What happens when it closes? The respiratory air is stopped. What happens when it opens? The respiratory air passes through the vocal folds. Respiratory air is a stream of air. This is modified into puffs of air when vocal folds vibrate. This is called voice.

Figure 7: Illustration of stream and puffs of air

We shall look into some examples to understand this concept. Assume you are standing in a queue in a cinema theater. The entrance is small and it allows only one person at a time. When you are in the queue it is

continuous. This is similar to the stream of air. At the entrance only one person enters the theater at a time. This is similar to puffs of air. See figure 7 for a better understanding of this concept. **So voice is the sound produced by the air modified by the vibration of vocal folds.**

Now let us understand the components of voice. Have you heard a child, a man and a woman speaking? What is the difference in their voice? Did you perceive a shrill voice in child's speech? This is a high-pitched voice. Pitch depends on the number of vocal fold vibrations.

Figure 8: Illustration of pitch

Remember, earlier we learnt that vocal fold vibrations produce voice? If vibrations are more, we perceive it as high pitch and low pitch if the vibrations are less. In children the vibrations are about 300-400 times per second. This is perceived as high pitch. In men the vocal folds vibrate 80-180 times per second. This is perceived as low pitch. In women, the vocal folds vibrate at a rate of 180 to 280 times per second. This pitch is higher than that in men, but lower than children's. So pitch depends on age and gender. Pitch is highest in children and lowest in men. See figure 8 for an illustration. Try saying aaaaaa like a man,

woman, and child. Now you understood that **pitch is a component of voice**.

Imagine speaking to your friend next to you. Also, imagine speaking to your friend who is far away. Is your voice the same? What is the difference? Good. You are speaking louder to a friend who is far away. Remember earlier we talked about respiratory air? You require more air for loud voice and less air for a soft voice. So, **loudness is a component of voice.** Figure 9 shows an illustration of loudness. Try saying 'hey' in a soft voice and in a loud voice. Do you feel the difference?

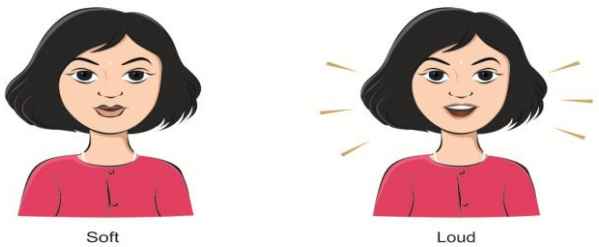


Figure 9: Illustration of loudness

What happens to your voice when you have a cold or bad throat? Yes, the quality of voice changes. Sometimes you may have no voice at all. It may have a breathy quality. Sometimes your voice may sound nasal. The other qualities are harsh, metallic, hoarse etc. So, **quality is also a parameter of voice**. Figure 10 illustrates normal and hoarse voices. Try saying aaaaaa in normal, nasal, and hoarse voices.

Clear Rough/hoarse Very rough/hoarse

Figure 10: Illustration of normal and hoarse voice.

Now you have learnt that **pitch, loudness, and quality** are parameters of voice.

1.8.5 Articulation

Say [ta:ta]. Observe the movements of tongue. These movements are called articulation. Tongue, teeth, lips and roof of the mouth are articulators. **Articulation is the movement of articulators to produce speech sounds.** You can move the articulators in various places. Say [pa] carefully and observe the movement in saying the sound /p/. You are moving the lips together to close the mouth. Aren't you? This is called a **bilabial** place of articulation. Now say [ta] and carefully observe the placement of tongue. Where did you place the tongue? Yes, behind the teeth. This is the **dental** place of articulation. Now say [ka]. Where is the tongue moving? It is at the back of the mouth. This is a **velar** place of articulation. So there are **different places of articulation**.

There are some differences in the production of speech sounds. Try saying /a/ and /p/. Do you observe any difference? In saying /a/, the

tongue is moving but it is not completely blocking the mouth. In /p/ the lips are completely closed. These differences are referred to as **manners of articulation**. Sound /a/ is a vowel and /p/ is a stop consonant. So there are different manners of articulation. We shall take the example of a hosepipe. Imagine you are watering plants. Water flowing through the pipe without any obstruction is equivalent to a vowel. Hold your finger to water a plant at a distance. There is a small opening in the pipe. Water is jetting out of this opening with a high pressure. This is equal to a fricative /s/. Now close the pipe completely with your finger. After some time remove the finger. What do you observe? A gush of water falls out. This is equivalent to stop consonant.

Now keep your fingers on your throat. Say "aaaaa". Do you feel the vibrations of the vocal folds? Yes? This is called voicing. /a/ is a **voiced** sound. Now say sssss continuously. Do you still feel the vibrations? No? This is an **unvoiced** sound. So you have voiced and unvoiced sounds in speech.

1.8.6 Fluency

Have you listened to anyone stuttering? S/he repeats, hesitates and breaks in between. Do you call it fluent? No? why? because the speech is not **continuous**. Make a sentence. For example, ***I am reading this material***. Normally the sentence can be said in 2-5 seconds. Now say one word in one minute. You will take 5 minutes to complete the sentence. Does your friend understand it? Why doesn't he understand? Because **the rate of speech** is very slow. One should have appropriate rate of speech for others to understand. The normal rate of speech is 80-180 words per minute. Have you ever stopped speaking because you

don't recall words? Or have you seen someone speaking with pressure on his or her articulators? You don't call it as fluent speech. Do you? Why? because it was **effortful**. So **fluency is the continuous, effortless speech at a fast rate**. Therefore, the parameters of fluency are **continuity, rate, rhythm and effort**.

1.8.7 Prosody

Listen to yourself when you speak. Your speech has a singsong pattern. This is intonation. **Intonation is the variation of pitch while saying a sentence.** Imagine that you want your friend to pick a red book and not a green book. How do you instruct your friend? ***Pick the RED book***. You emphasize the word RED. This is **stress.** Have you heard music? Can you tap or dance for music. Observe the time between taps. It is regular. This is rhythm. **Rhythm is a repeated movement in time.** The other examples of rhythm are day and night or a clock etc. But the movements in speech are not as regular as in music. However, speech also has a rhythm. Speak two sentences. For example: ***I am reading this material. It is interesting. Do you stop in between sentences***? Why do you stop? Yes. Because you want to inform the listener, that the sentence is completed. Speak the following sentence: ***The first prize goes to Ramu***. Do you stop between **to** and **Ramu**? Yes? Why? Because you want to inform the listener that something important is coming up. Speak a very long sentence. For example: ***Dr. Santosh, scientist of India, went to China to attend a meeting on atomic energy on 6.6.2006 and came back to India on 10.6.2006.*** Do you stop between? Yes? This is because you don't have sufficient air to speak a long sentence. And you want to take a breath. These stops are called

pauses. So **prosody consists of intonation, stress, rhythm and pause.** These are super-imposed on words and are also called **supra-segmental features**.

1.9 Normal speech and Language

What is normal speech? Normal speech is that which is normal in voice in terms of pitch, loudness and quality, normal articulation of speech sounds, fluency and prosody. Sometimes people in certain cultures use a characteristic voice. Also, different languages use different speech sounds. Voice changes according to age and gender. Therefore, **normal speech can be defined as a speech which is appropriate to age, gender, culture, and language**.

1.10 Acquisition/ development of language and speech

Have you wondered how speech, language and communication emerge in a child's development? There are several explanations and theories about the development of communication, language and speech. Mainly there are theories on language acquisition, which include biological maturation theory which says about growth and neural maturation, linguistic rule induction that deals with linguistic structure, behaviorism (learning), cognitivism and social interactionism. Some theories supports nature and some support nurture hypothesis in language acquisition. The nature hypothesis states that language is innate while the nurture hypothesis states that language is a learnt behavior. In this chapter, we shall explore different aspects of normal development of communication, language and speech by children.

Right from birth babies start communicating. As children grow, they start developing various skills for effective communication. These skills

include l**istening/ looking, eye contact, turn taking skills, joint attention** and use of **gestures**. Once children have developed their foundation skills, they begin to understand that words have meaning and start to build up a vocabulary base, joining words together to convey a variety of meanings. At the later stage children learn to apply grammatical rule in using the vocabulary for communication. Beside the rapid development of vocabulary and grammatical awareness, children begin to use language for conversational purposes.

Ultimately the acquisition of all these different competencies permit children to use speech, language and communication skills to involve self and participate in ongoing social process and develop meaningful relationships with other people around.

1.11 Stages in the development of language and important milestones

Language is a tool for communication. It is defined as a socially shared code or conventional system for representing ideas, concepts through the use of arbitrary symbols and rule-governed combinations of those symbols. Each language, viz, English, Kannada, Telugu, and Hindi etc., has its own symbols and rules for symbol combination.

Let us get to know how language develops in children.

Language develops in gradual hierarchical steps from infancy to puberty. A newborn child has no language but communicates his/her basic needs through cry. Speech, i.e., vocal language develops naturally without any formal training. Majority of children exhibit several identifiable stages in speech and language development as shown in the following table.

Table 2: Stages of speech and language development

Sl. No.	Stage	Age
1	Cooing	6 weeks
2	Babbling	6 months
3	Intonational patterns	8 months
4	1 – word utterances	1 year
5	2 – word utterances	18 months
6	Word inflections	2 years
7	Questions and negatives	2.6 years
8	Complex constructions	5 years
9	Matured speech	10 years

Language has several components viz. phonology, morphology, syntax, semantics, and pragmatics. Within each of the five components of language, development is rarely linear. At times, one aspect or a combination may be the major focus of development, as in the early stage when semantics and pragmatics appear to be the organizing features of child language. Later stage has numerous syntactic structures. This growth slows down in the school age years. In the following sections, we shall explore language development within generally recognized periods of development: toddler, preschooler, school-age child and adult. In the toddler period, the child concentrates on vocabulary growth based on the meanings he already possesses. These referent words are used to express the intentions that the child has previously expressed through gestures. During the preschool period, the child concentrates on development of language form. Although this process continues during school years at a slower rate, the content and use aspects of language development become more prominent.

Speech and language development: Largely, the aspects discussed above may be identified as speech, language and communication milestones stage-wise, as follows:

0-6 months

- Repeats the same sounds
- Frequently coos, gurgles, and makes pleasure sounds
- Uses different cry to express different needs
- Smiles when spoken to
- Recognizes voices
- Localizes sounds by turning head
- Listens to speech
- Uses phonemes /b/, /p/, and /m/ in babbling
- Uses sounds or gestures to indicate wants

7-12 months

- Understands no and not
- Responds to simple requests
- Understands and responds to own name
- Listens to and imitates sounds
- Recognizes words for common items
- Babbles using long and short groups of sounds
- Uses a song like pattern when babbling
- Uses speech sounds rather than only crying to get attention
- Listens when spoken to
- Uses sound approximations
- Begins to change babbling to jargon
- Uses speech intentionally for the first time
- Uses nouns almost exclusively
- Has an expressive vocabulary of 1-3 words
- Understands simple commands

13-18 months

- Uses adult like intonation patterns
- Uses echolalia and jargon
- Uses jargon to fill gaps in fluency
- Omits some initial consonants and almost all final consonants
- Produces mostly unintelligible speech

- Follows simple commands
- Receptively identifies 1 to 3 body parts
- Has an expressive vocabulary of 3 to 20 or more words
- Combines gestures and vocalization
- Makes requests for more of desired items

19-24 months

- Uses words more frequently than jargon
- Has an expressive vocabulary of 50 to 100 or more words
- Has a receptive vocabulary of 300 or more words
- Starts to combine nouns and verbs
- Begins to use pronouns
- Maintains unstable voice control
- Uses appropriate intonation for questions
- Is approximately 25-50% intelligible to strangers
- Answers "What's that" questions
- Enjoys listening to stories
- Knows body parts
- Accurately names a few familiar objects

2-3 years

- Speech is 50-75% intelligible
- Understands one and all
- Verbalizes toilet needs
- Requests items by name
- Points to pictures in a book when named
- Identifies several body parts
- Follows simple commands and answers simple questions
- Enjoys listening to short stories, songs, and rhymes
- Asks 1 or 2 word questions
- Uses 3 or 4 word phrases
- Uses some prepositions, articles, present progressive verbs, regular plurals, contractions, and irregular past tense forms
- Uses words that are general in context

- Continues use of echolalia when difficulties in speech are encountered
- Has a receptive vocabulary of 500 – 900 or more words
- Has an expressive vocabulary of 50-250 or more words
- Exhibits multiple grammatical errors
- Understands most things said to him or her
- Frequently exhibits repetitions, especially starters, I, and first syllables
- Speaks with a loud voice
- Increases range of pitch
- Uses vowels correctly
- Consistently uses initial consonants
- Frequently omits medial consonants
- Frequently omits or substitutes final consonants
- Uses approximately 27 phonemes
- Uses auxiliary including the contracted form
- Uses some regular past tense verbs, possessive morphemes, phonemes, pronouns, and imperatives

3-4 years

- Understands object functions
- Understands differences in meanings
- Follows 2 and 3 part commands
- Asks and answers simple questions
- Frequently asks questions and often demands detail in responses
- Produces simple verbal analogies
- Uses language to express emotions
- Uses 4 to 5 word sentences
- Repeats 6 to 13 syllable sentences accurately
- Identifies objects by name
- Manipulates adults and peers
- May continue to use echolalia
- Uses up to 6 words in a sentence
- Uses nouns and verbs most frequently

- Is conscious of past and future
- Has a receptive vocabulary of 1,200 to 2000 or more
- Has 800 to 1500 or more expressive vocabulary
- May repeat self often, exhibiting blocks, disturbed breathing, and facial grimaces during speech
- Increases speech rate
- Whispers
- Masters 50% of consonants and blends
- Speech is 80% intelligible
- Sentence grammar improves, although some errors still persist
- Appropriately uses is, are, and am in sentences
- Tells two events in chronological order
- Engages in long conversations
- Uses some contractions, irregular plurals, future tense verbs, and conjunctions
- Consistently uses regular plurals, possessives, and simple past tense verbs

4-5 years

- Imitatively counts to 5
- Understands concept of numbers up to 3
- Continues understanding of spatial concepts
- Recognizes 1 to 3 colors
- Has a receptive vocabulary of 2800 or more words
- Counts to by rote
- Listens to short, simple stories
- Answers questions about function
- Uses grammatically correct sentences
- Has an expressive vocabulary of 900 to 2000 or more words
- Uses sentences of 4 to 8 words
- Answers complex 2 part questions
- Asks for word definitions
- Speaks at a rate of approximately 185 words per minute
- Reduces total number of repetitions

- Enjoys rhymes, and nonsense syllables
- Produces consonants with 90% accuracy
- Significantly reduces number of persistent sound omissions and substitutions
- Frequently omits medial consonants
- Speech is usually intelligible to strangers
- Talks about experiences at school, at friend's house, etc.
- Pays attention to a story and answers simple questions about it
- Uses some irregular plurals, possessive pronouns, future tense, reflexive pronouns, and comparative morphemes in sentences

Description of Speech sounds and its development

1.12 Stages in the acquisition of speech sounds/phonology and important milestones

Table 3: Acquisition of speech sounds by children

Sl. No.	Age	Stage	Speech
1	0-1 month	New born	Reflexive behavior like sucking and swallowing, non-differentiated crying, vegetative sounds (burps, gurgle sounds).
2	2-3 months	Cooing	Definite stop and start to oral movement, velar to uvular closure or near closure, back consonants and back and middle vowels with incomplete resonance.
3	4-6 months	Babbling	Greater independent control of tongue, prolonged strings of sounds, more lip or labial sounds, experiments with sounds.
4	6-10 months	Reduplication babbling	Repetitive syllable production, increased lip control, labial, alveolar and plosives /p/, /b/, /t/, /d/, nasals, /j/
5	11-14 months	Phonetically consistent forms and first words	Elevates tongue tip, variegated babbling, intonational patterns, phonetically consistent forms, sound-meaning relationships, predominance of /m, w, b, p/, first words primarily CV (pa), VC (am), CVCV (mama).
6	2 years		Acquires /p, h, w, m, n, b, k, g/
7	3 years		Acquires /d, f, j, t, n, s/.
8	4 years		Acquires /v, S, tS, z/
9	5 years		Acquires /r, l, dz, th/
10	6-8 years		Acquires /Z/, consonant blends.

Speech is a verbal means of communicating or conveying meaning. It requires precise neuromuscular coordination. Speech consists of speech sound combinations, voice quality, intonation, and fluency. Each of these components is used to modify the speech message, as learnt previously. As the child matures, he gains increasing control of the speech mechanism and is able to produce or articulate sounds more effectively. Although he gains much motor control in first year, the child does not achieve adult like stability until mid childhood. Speech sound acquisition can be summarized as follows:

1.13 Description of speech sounds

1.13.1 Voicing

Try saying aaaaaaaa. Keep your fingers on neck. Do you feel the vibration? Such sounds produced by the vibration of the vocal folds are called voiced sounds. Now say sssssssssssss. Do you feel the vibration? No? These speech sounds which are produced by the open vocal folds are termed unvoiced sounds. Unvoiced sounds include /k/, /kh/, /c/, /ch/, /t/, /th/, /p/, /ph/, /s/, /ʃ/, /s/ and /h/ are called half-voiced speech sounds. Unvoiced speech sounds form about 28% of all the speech sound. It means that the vocal folds need not vibrate in the production of each and every speech sound. Hence, there must be some other mechanism in the vocal tract which shapes the expiratory air.

1.13.2 Manner of articulation

We have already learnt that speech sounds are produced by the combined action of various systems. Let us now understand the classification of speech sounds. Try saying aaaaaa, iiiiii, uuuuuuuu. Feel your tongue movement. If necessary watch the tongue movements while saying speech sounds using a mirror. What do you observe? Yes,

very good. The tongue is kept low in the oral tract in producing these sounds. The oral tract is almost open. Such speech sounds are called **Vowels**. They are used in all languages. The most common vowels are /a/, /i/, and /u/. Do you use De:vana:gari script to write alphabets in your language? The first few speech sounds listed in the script are vowels. Remember your nursery school? You used to write a, a:, I, I: etc. Figure 36 illustrates the shape of the oral tract in producing vowels.

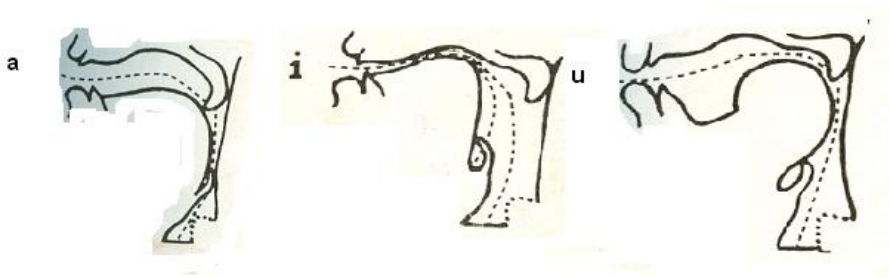


Figure 36: Illustration of shape of oral tract in producing /a/, /i/, & /u/

So **vowels are speech sounds produced with open oral tract**. The nasal tract is closed most of the time. But some languages have nasalized vowels. You can compare a vowel to water flowing through a hosepipe.

Do you have speech sounds other than vowels in your language? Can you say few of them? Yes, /p/, /s/, /m/, and /r/. Speech sounds other than vowels are called **consonants**. In the De:vana:gari script, consonants start from /k/ and end with /h/. These are speech sounds produced with obstruction in the oral tract. Consonants have different manners. For example, when you say /k/, /g/, /t/, /d/, /p/, and /b/ the oral tract is completely closed. Therefore, air is held behind the articulator. When you open the articulator the air comes out. Because you are stopping the air, these consonants are called **Stop consonants.** Stop

consonants are available in most of the world's languages. You can again think of an analogy of a hosepipe. Turn the water on. Hold your finger and block the water for some time. Take out your finger after some time. A gush of water flows out. Isn't it? This is equivalent to a stop consonant. You can also think of a snap of a finger or eye blink. Thus, **stop consonants are speech sounds produced by closing the oral tract, building pressure behind it, and releasing the pressure by opening the articulator.**

Do you have /c/ and /j/ in your language? These are essentially produced in the same way as stop consonants. But the release is different. Have you noticed that the middle of the tongue lifts and contacts the palate? The palate is like a dome. Therefore, it takes more time for the tongue to reach the palate and come back to the original position. Thus, the release of articulator is slow. These are called **Affricates**.

Try saying ssss, hhhhhh. Keep your finger in front of the lips. Can you feel the air? To produce these sounds, the tongue is lifted; but it doesn't completely stop the air. There is a small constriction between the tongue and the palate/lips. The expiratory air when passing through this small constriction jets out at high pressure. These sounds are called **Fricatives.** Fricatives are not many in Indian languages. The most common fricatives are /s/, and /h/. Again think of the analogy of a hosepipe. Hold your finger at the end of the pipe to water plants at a distance. The water jets out with high pressure. I am sure you are familiar with a whistle. The whistle sound is produced in the same manner. Thus, **fricatives are speech sounds produced with a narrow constriction in the oral tract.**

Vowels, stop consonants, affricates and fricatives are produced with the velopharyngeal port closed. Therefore, no air passes through the nasal tract. Now say mmmmmmm. Place your finger in front and on the nostrils. Do you feel the air? You can also feel the vibration on the nostrils. The air is now channelized through the nasal tract. The velopharyngeal port is open. Observe the articulator in the oral tract. The articulator completely closes the oral tract. Such speech sounds are called **Nasal continuants**. Nasal continuants are used in most of the world's languages. Common nasals include m, n, and ŋ. You are using altogether a different mechanism in producing nasal continuants. They are called continuants because you can produce them continuously. Try doing the same with /k/. You will end up with k, k, k, k, k. You can't continue with /k/. Thus, **nasal continuants are speech sounds produced with closed oral tract and open nasal tract.**

Do you use other speech sounds in your language? Yes? Some of these are combinations of two vowels (for example ai, au). They are called **Diphthongs**. /y/ and /v/ are also combinations of two vowels. /y/ is a combination of I and a; v is a combination of u and a. In a diphthong /ai/, you can clearly hear both vowels. In /y/ you can't. What is the difference? In a diphthong the articulator moves slowly from one vowel to another but in /y/, or /v/ the articulator moves fast. Therefore, /y/ and /v/ are also called **Glides**.

Have you seen a drone? Imagine an upside drone in the oral tract. The middle part of the oral tract is closed. Air passes through the sides. Such speech sounds are termed **Laterals.** It is because the air passes from both sides of the tongue. /l/ and /l̪/ are examples of laterals. Thus,

laterals are produced by blocking the oral tract in the middle and channelizing the air from the sides.

Try imitating the sound of a car or a bus. I am sure you would have done it as a child. What do you do in this imitation? The tip of the tongue is repeatedly contacting the palate. Try saying rrrr. It is called a **Trill.** A trill is a speech sound produced by repeated contacts.

We have understood that speech sounds can be classified as vowels and consonants. Consonants have various manners. It is very easy to remember these manners if you look at the script of your language. Hindi alphabets are provided along with manner of articulation in table 1. Study the table. You can remember the various manners of speech sounds.

1.13.3 Place of articulation

We have already learnt about the place of articulation. Therefore, I will not repeat it here. However, we shall review the various places of articulation in the oral tract by looking at the schematic diagram of the vocal tract.

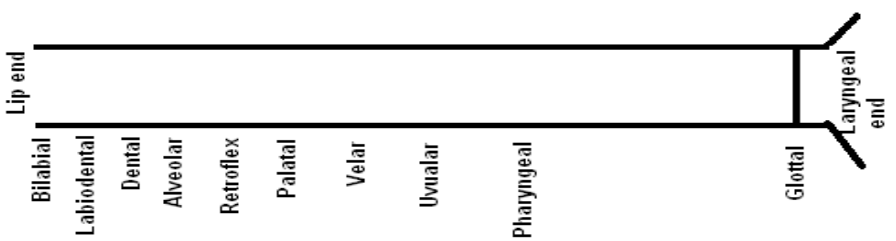
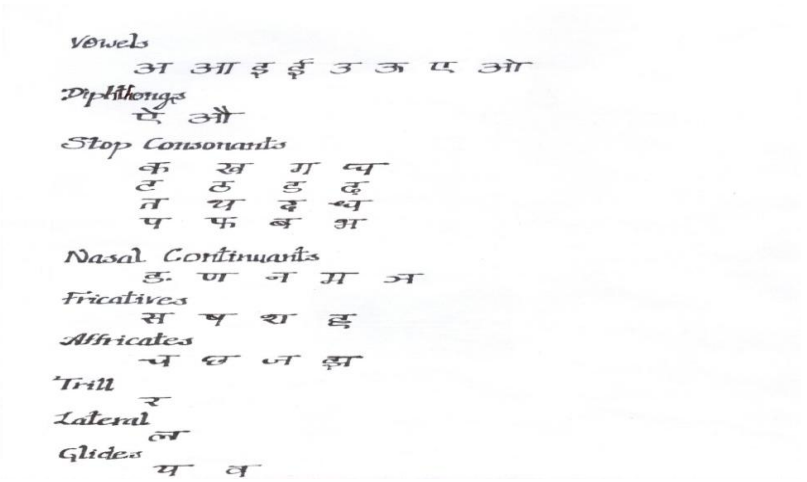


Figure 36: Schematic diagram showing place of articulation

Table 4: Hindi alphabets in De:vana:gari script



1.14 Development of communication

Now let us learn about the development of communication. Communication appears to be present at birth. The newborn baby and his/her mother begin communicating almost immediately. In addition, the newborn will search for the human voice and demonstrate pleasure or mild surprise when s/he finds the face of the sound source. As mother responds to the infant's early reflexive behaviors, the infant learns to communicate its intentions. Gradually, through repeated interactions, the infant refines these communication skills. Within the first few months of life, infants are able to differentiate contrasting phonemes, different intonation patterns, and speech from non-speech. Infants are also able to discriminate different voices. Infants learn different gaze patterns used in communication and also learn the signal value of head movements. Both head and hand movements are important for early communication because these structures are relatively advanced in their maturation. These discrimination abilities and preferences provide bases for early communication.

By the time the child is 3 to 4 months of age, interactions based on eye gaze form early dialogues that evolve into conversational exchanges. Children progress from reflexive, non-intentional communication to conventional, verbal intentions by the second year of life. Three developmental stages of early communication intentions exist. Initially, the child's behaviors including cry are **undifferentiated**, and his intentions are unknown. Next, the child uses **gestures and vocalization** to express intent. This stage is significant because the child's intention to communicate is accompanied by eye contact. Finally in the third stage, **words** are used to convey intentions previously expressed in gestures. Language structure is acquired as more efficient means of communicating these intentions.

The preschooler learns to use language including emphasis, and stress to improve the message quality. Even 4-year old children can modify their speech and language when conversing with much younger language-learning children.

It is in the school age period that the child makes the greatest advances in the use of the paralinguistic (prosodic and other supra-segmental aspects aiding linguistic utterances), nonlinguistic (aspects such as attention, memory, etc.) and meta-linguistic (the ability to reflect upon the knowledge of structure and use of language) aspects of communication. The older child can use his communication skills to create a mood, role-play, or express sarcasm. Gestures are used to enhance or to add emphasis to the message. He adjusts his message and its manner of delivery to his listener and tries to predict the effects of his transmission. Although the meta-linguistic abilities appear in the

preschool years, full awareness does not occur until about age 7 or 8. The school age child demonstrates an increasing ability to judge the grammatical acceptability of sentences, reflecting a growing knowledge of language structure.

In summary, the child communicates from the time of birth. Early communication does not depend on the use of language or speech. In fact, communication provides the vehicle within which initial language develops. As language skills improve, there is also a corresponding improvement in overall communication abilities.

1.15 Factors affecting acquisition of speech, language & communication

The following is a list of some general factors affecting/hindering language acquisition, its use and maintenance.

1. Inadequate stimulation (talking and playing with the child)
2. Delayed general development (global developmental delay) with respect to physical (motor skills) and cognitive development (Mental retardation)
3. Specific difficulty with language learning (Specific language impairment). Not very interested in language, prefers other modalities e.g., physical activities with reduced verbal output.
4. Poor control/or co-ordination of speech muscles as lips, tongue.
5. Medical conditions (organic causes cited below)
6. Inadequate awareness of communication, lacks ‘communication intent’
7. Impaired hearing, e.g., ear infection, fluid in ear, impacted earwax

8. Changes in child's environment, e.g., moving/shifting of town/ places
9. Exposure (sudden) to too many languages
10. Inadequate opportunity for speech, e.g., the child everyone talks to, the 'babied' child has a more dominant sibling etc.
11. Emotional factors, e.g., behavioral problems, anxiety, pressure to perform etc.
12. Short attention span
13. Family history of speech and language delays or difficulties

Table 5: Causes of various speech and language problems

Sl. No.	Manifestation	Delayed/Inadequate speech & language	Articulation problem	Hyper nasality	Voice problem	Fluency Problem
	Organic causes					
1	Brain injury	+	+			
2	Cerebral palsy due to brain damage	+	+	+	+	+
3	Mental retardation	+	+		+	
4	Hearing loss	+	+	+	+	
5	Oral structure defects: Cleft palate Short soft palate Tongue tie Tongue thrust Microglossia Macroglossia Dental problems	 + -	 + + + + + + +	 + +	 -	 +
6	Problems in the larynx (voice box)				+	
Non- organic causes **a) Environmental factors**						
1	Lack of stimulation	+	+	+	+	
2	Faulty parental reaction	+	+			+
3	Over protection	+	+	+		+
4	Poor modeling			+		+
5	Sibling rivalry	+		+		+
6	Social, cultural & Linguistic influences	+	+		+	+
b) Functional Causes						
1	Faulty learning and habits	+	+		+	+
2	Emotional disturbances	+	+		+	+

The above factors can be classified into "organic" causes and "non-organic" factors/causes i.e., environmental and functional causes. These different causes and their manifestations can be visualized concisely as follows.

1.16 Let us sum up

In this unit we have learnt the definitions of speech, language and communication. We learnt about various components of language. We learnt that voice, articulation, and fluency are parameters of speech. Also, intonation, stress, rhythm and pause are aspects of prosody. How much time did we take to learn this? 20 hours? Think how much time you take to say the word 'speech', a few milliseconds. Isn't it? ***It is amazing that the speech production mechanism works so fast. You should keep the system intact. The system will help you speak better.***

In this unit we have also learnt about the development of speech, language and communication. From this we learnt that even newborn child can communicate with his mother in some form. Later, as the child grows, that communication will be more meaningful, when the child uses both speech and language. For an effective communication, both speech and language are important. Most of the children will master speech and language skills or abilities when they are at the age of 6 to 8 years. And we also learnt about the different causative factors that are affecting speech, language and communication development.

1.17 Unit end exercises

1. Define speech, language, and communication.
2. What are the differences between speech, language and communication?

3. Describe the speech chain.
4. What are the functions of communication?
5. Describe different types of language.
6. What is a vowel?
7. Write any two-stop consonants in your language.
8. What is normal speech?
9. What are the parameters of speech?
10. What is fluency?
11. What is normal speech?
12. What are the prerequisites of communication?
13. What are the functions of communication?
14. Define voice, articulation, and fluency.
15. What are the parameters of voice?
16. Is your pitch high or low? Why?
17. What is the normal rate of speech?
18. What is phonology?
19. What is Semantics?

1.18 References

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Speech Chain - https://aanugraha.files.wordpress.com/2008/ 02/speech chain.png?w=700

Unit 2: Anatomy and physiology of speech mechanism

Objectives

Unit 2: Anatomy and physiology of speech mechanism

Objectives

After going through this unit you will be able to:

- Know the different systems involved in speech production
- Explain the structure and functions of the speech mechanism
- Describe the voicing, place and manner of speech sounds

2.1 Introduction

Speech is complex motor act which is produced with highly coordinated and synchronized activity of various systems. The respiratory system provides the source for the airstream that is essential for voice production. The expiratory air is modified by the phonatory system at the level of larynx into phonation or voice production with the help of vibration of the vocal cords. This voice is modified further by the resonatory system consisting of upper respiratory vocal tract (larynx, pharynx, oral and nasal cavities) to provide specific quality to the voice. This modified voice is further changed into different speech sounds by the articulatory system consisting of articulators like the lips, tongue, palate and velophryngeal mechanism. This whole process will produce varied combinations of sounds in a serial order based on the language being processed. Further, all these four systems are controlled and coordinated by the nervous system at the central and peripheral levels for the proper understanding and production of speech during the day-to-day communication contexts. You know that speech and language are essential for our day-to-day activities. Do you know the organs that are involved in speech production?

2.2 Systems involved in speaking

Several systems in our body help in speech production. These include:

- nervous system
- respiratory system
- phonatory system
- articulatory
- resonatory system

- You can speak to a child and he understands and answers to your questions. Is it not? Can you make a cow speak? Of course the cow may understand some simple commands and may have different types of mews. But, does the cow speak like a child. No. Why is it so? What is special in the child? Yes. Good. It is the human brain. The **nervous system** is important in speaking.
- Try saying sssssssssssssssss. Keep your finger in front of the lips. Can you feel the air? Where is the air coming from? It is the respiratory air. Good. Hence the **respiratory system** is essential.
- I am sure you have spoken in whisper a lot of times. But can you always speak in whisper? No. Is it not? Your speech is not loud and you get tired if you speak in whisper. Now let us play a game. Keep your finger on your neck and try saying aaaaaa. Do you feel the vibrations? Good. These are the vibrations of the vocal folds in the neck. The vibratory or **phonatory system** is important for speech.
- Have you heard an elderly person without teeth speaking? Do you hear clear pronunciations? No? Why is it so? Good. Because he does not have teeth. Similarly young children speak with unclear pronunciation. But everyone knows that the child is not yet grown and therefore he says [titti] for [kitaki], [ka:ku] for [fra:ku] and so on. So what do you think is important for speech? Yes. The tongue,

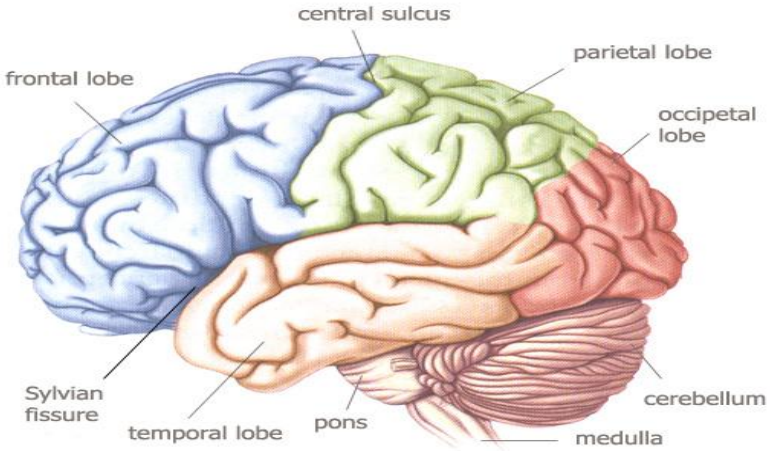
the lips etc. These are called articulators. The **articulatory system** is important for speaking.

2.3 Structure and functions of the speech mechanism

We have understood what speech is. Now let us understand how speech is produced. We shall see how various systems contribute to speech production

2.3.1 Nervous system

When we have a desire to speak, the nervous system starts working. It consists of brain and nerves. The brain is inside the head or skull. Brain has two hemispheres – the left and the right. Each hemisphere has 4 parts or lobes – (a) frontal lobe which is situated in front, (b) temporal lobe, just behind the ears, (c) occipital lobe, at the back, and (d) parietal lobe, in the center. Some regions in these lobes help in speech production. Wernicke's area (21, 22), in the temporal lobe, chooses the words to be spoken. It also prepares the word order and sends the message to speech motor area. These include Broca's area (44) and area number 4 in the frontal lobe. These areas convert the message into motor actions. In other words, they generate and send commands to other systems of speech production. These commands reach the muscles of other systems through nerves. Therefore, the nervous system controls the speech production. It is like a commander in an army. It issues orders to other systems. Without these orders other speech systems can't work. Thus, the nervous system is very important in speech production. Figure 13 shows the speech areas in the brain.



Source:https://www.bioon.com/book/biology/whole/image/1/1-8.tif.jpg

Figure 13: Important speech areas in the brain

Table 7: The Cranial nerves and their functions

No.	Cranial Nerve	Major Functions
I	Olfactory	Smell
II	Optic	Vision
III	Oculomotor	Eyelid and eyeball movement
IV	Trochlear	Innervates superior oblique turns eye downward and laterally
V	Trigeminal	Chewing, touch & pain in face & mouth
VI	Abducens	turns eye laterally
VII	Facial	controls most facial expressions secretion of tears & saliva, taste
VIII	Vestibulo-cochlear (auditory)	Hearing, equilibrium sensation
IX	Glossopharyngeal	Taste, senses carotid blood pressure
X	Vagus	senses aortic blood pressure, slows heart rate stimulates digestive organs, taste
XI	Spinal Accessory	controls trapezius & sternocleidomastoid controls swallowing movements
XII	Hypoglossal	controls tongue movements

The nervous system issues command to respiratory, laryngeal, and articulatory or resonatory systems. There are **twelve pairs of cranial nerves** carrying sensory or motor information from or to the muscles of

these systems. These originate from the nervous tissue of the brain. In order reach their targets they must ultimately exit/enter the cranium through openings in the skull. Hence, their name is derived from their association with the cranium. The 12 pairs of cranial nerves with their functions are as follows:

The **motor components** of the cranial nerves are derived from cells in the brain. These cells send their axons (bundle of axons outside the brain is a nerve) out of the cranium where they will ultimately control muscle (e.g., eye movements), glandular tissue (e.g., salivary glands) or specialized muscle (e.g., heart or stomach).

The **sensory components** of cranial nerves originate from collections of cells that are located outside the brain. These collections of nerve cell bodies are called sensory ganglia. The sensory ganglia of the cranial nerves send out a branch that divides into two branches: a branch that enters the brain and one that is connected to a sensory organ. Examples of sensory organs are pressure or pain sensors in the skin and more specialized ones such as taste receptors of the tongue. Electrical impulses are transmitted from the sensory organs through the ganglia and into the brain via the sensory branch that enters the brain. There are two exceptions to this rule that should be noted - the special senses of smell and vision.

In summary, the motor components of cranial nerves transmit nerve impulses from the brain to target tissue outside of the brain. Sensory components transmit nerve impulses from sensory organs to the brain.

Check www.gwc.maricopa.edu/class/bio201/cn/cranqzr2.htm for quiz on cranial nerves.

Neurons are nerve cells that transmit nerve signals to and from the brain at up to 200 mph. The neuron consists of a **cell body (or soma)** with branching **dendrites** (signal receivers) and a projection called an **axon**, which conducts the nerve signal. At the other end of the axon, the **axon terminals** transmit the electro-chemical signals across a **synapse** (the gap between the axon terminal and the receiving cell). The **axon**, a long extension of a nerve cell, takes information away from the cell body.

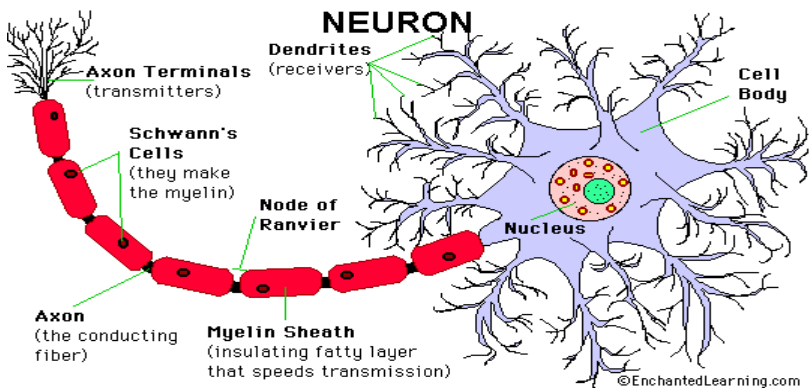


Figure 14: A neuron and its parts

Source: http://www.enchantedlearning.com/subjects/anatomy/brain/gifs/Neuron.GIF

Bundles of axons are known as nerves or, within the CNS (central nervous system), as nerve tracts or pathways. Dendrites bring information to the cell body.

Myelin coats and insulates the axon (except for periodic breaks called nodes of Ranvier), increasing transmission speed along the axon. Myelin is manufactured by Schwann's cells, and consists of 70-80% lipids (fat) and 20-30% protein.

The **cell body (soma)** contains the neuron's nucleus (with DNA and typical nuclear organelles). Dendrites branch from the cell body and receive messages. A typical neuron has about 1,000 to 10,000 synapses (that is, it communicates with 1,000-10,000 other neurons, muscle cells, glands, etc.). Figure 14 shows the parts of a neuron.

Now let us see the role of respiratory system in speech production.

2.3.2 Respiratory system

The **respiratory pathway** includes a series of structures involved in inspiration and expiration. The air enters the **nostrils,** passes through the **naso-pharynx,** the **oro- pharynx,** through the **glottis** into the **trachea,** into the right and left **bronchi,** which branches and rebranches into **bronchioles,** each of which terminates in a cluster of **alveoli**

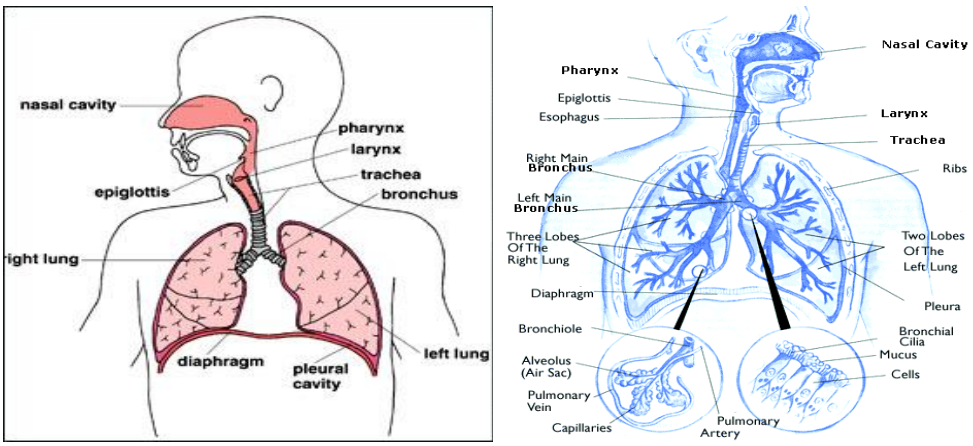


Figure 15: Respiratory system
Source: http://schoolworkhelper.net/the-respiratory-system-structure-and-function/,https://www.pinterest.com/explore/respiratory-system/

Only in the alveoli does actual gas exchange takes place. There are some 300 million alveoli in two adult lungs. These provide a surface

area of some 160 m^2 (almost equal to the area of a tennis court and 80 times the area of our skin!). Figures below show the respiratory system.

Breathing

In mammals, the diaphragm divides the body cavity into the **abdominal cavity** containing the viscera (e.g., stomach and intestines) and the **thoracic cavity** containing the heart and lungs

The inner surface of the thoracic cavity and the outer surface of the lungs are lined with **pleural membranes** which adhere to each other. If air is introduced between them, the adhesion is broken and the natural elasticity of the lung causes it to collapse. This can occur from trauma. And it is sometimes induced deliberately to allow the lung to rest. In either case, reinflation occurs as the air is gradually absorbed by the tissues.

Because of this adhesion, any action that increases the volume of the thoracic cavity causes the lungs to expand, drawing air into them.

- During **inspiration** (inhaling), the external intercostals muscles contract, lifting the ribs up and out and the diaphragm contracts, drawing it down.
- During **expiration** (exhaling), these processes are reversed and the natural elasticity of the lungs returns them to their normal volume. At rest, we breathe 15-18 times a minute exchanging about 500 ml of air.

- In more **vigorous expiration**, the internal intercostal muscles draw the ribs down and inward and the wall of the abdomen contracts pushing the stomach and liver upward.

Under these conditions, an average adult male can flush his lungs with about 4 liters of air at each breath. This is called the **vital capacity**. Even with maximum expiration, about 1200 ml of **residual air** remain.

The table below shows what happens to the composition of air when it reaches the alveoli. Some of the oxygen dissolves in the film of moisture covering the epithelium of the alveoli. From here it diffuses into the blood in a nearby capillary. It enters a red blood cell and combines with the hemoglobin therein. At the same time, some of the carbon dioxide in the blood diffuses into the alveoli from which it can be exhaled.

Table 8: Composition of atmospheric and expired air

Component	Atmospheric Air (%)	Expired Air (%)
N_2 (plus inert gases)	78.62	74.9
O_2	20.85	15.3
CO_2	0.03	3.6
H_2O	0.5	6.2
Total	100.0	100.0

(Note: only a fraction of oxygen inhaled is taken up by the lungs)

Central control of breathing

The rate of cellular respiration (and hence oxygen consumption and carbon dioxide production) varies with level of activity. Vigorous

exercise can increase by 20-25 times the demand of the tissues for oxygen. This is met by increasing the rate and depth of breathing.

It is a rising concentration of **carbon dioxide,** not a declining concentration of oxygen, that plays the major role in regulating the ventilation of the lungs. The concentration of CO_2 is monitored by cells in the **medulla oblongata**. If the level rises, the medulla responds by increasing the activity of the motor nerves that control the intercostals muscles and diaphragm.

However, the **carotid body** in the carotid arteries has receptors that respond to a drop in oxygen. Their activation is important in situations (e.g., at high altitude in the unpressurized cabin of an aircraft) where oxygen supply is inadequate but there has been no increase in the production of CO_2.

Local control of breathing

The smooth muscle in the walls of the bronchioles is very sensitive to the concentration of carbon dioxide. A rising level of CO_2 causes the bronchioles to dilate lowering the resistance in the airways and thus increasing the flow of air in and out.

To summarize, the function of the respiratory system is respiration. Respiration is the process of breathing for gas exchange. It has two phases- inspiration and expiration. Air is breathed in during inspiration through the nose to the lungs where oxygen is separated from air. Carbon dioxide (CO_2) is breathed out during expiration. Air is pushed out of the lungs during expiration. Thus, the respiratory system acts like

a pump. It pushes the air in and pumps out the air. Lungs expand during inspiration and contract during expiration. We inspire about 60 times per second. The lungs can be compared to a rubber band or a harmonium. Figure 16 illustrates the function of the lungs.

Inspiration Expiration

Figure 16: Illustration of the function of lungs

I hope that you have understood what respiration is. Now let us understand how respiration is useful in speech production. Earlier we learnt that speech is nothing but modified air. In quiet respiration, the air is breathed in and out through the nose. But, in speech production, expiration can be through mouth or nose. In quiet breathing, inspiration and expiration share 50% each. But, inspiration is shorter and expiration is longer for speech purposes. Thus, the respiratory system supplies energy for speech production. Which is this energy? Yes. It is **Air.** Have you ever thought of the pressure of air required to produce speech. It is about **5-8 cm of H_2O**. You can take a graduated U tube and fill it with water. Blow the air and see when it is displaced by about 5-8 cm. This is the pressure requirement for speech. What happens to this air further? It is modified in the laryngeal and resonatory systems. Now let us learn about the modification of air in the laryngeal system.

2.3.3 Phonatory system

The laryngeal or phonatory system consists of the larynx or the voice box. The voice box is situated in between the trachea and the oral tract. The larynx is situated at the upper end of the trachea. It lies against the 3-6 cervical vertebrae in men. Its position is somewhat higher in women and children than in men. The position of the larynx in the neck varies with age, gender, head position and swallowing. The average length, transverse diameter and antero-posterior diameters are 44 mm, 43 mm and 36 mm, respectively, in males. The corresponding measures in females are 41 mm, 36 mm, and 26 mm, respectively. There is no difference in the size of the larynx between boys and girls until puberty when the antero-posterior diameter in the male almost doubles.

The biological functions of the larynx include **protection of the airway** and **building intra-thoracic pressure** for excretion and carrying out strenuous physical activities. The **Non biological** functions include **speech production** and **singing**

Anatomy of larynx

- Let us understand the structure of larynx. It is made of a bone, cartilages, muscles, membranes and joints. Hyoid bone supports larynx.
- **Hyoid bone:** It is the U shaped **single bone** (Figure 17) present above the thyroid cartilage. It is suspended from the tips of Styloid processes of the temporal bones by **Stylo-hyoid ligament.** It is not connected to any other bone directly. Hyoid bone is supported by many muscles and it can make variety of movements.

- Hyoid bone has 3 parts: a body and 2 pairs of horns. The 2 pairs of horns attach the Hyoid bone to the Thyroid cartilage.

Figure 17: Front view of Hyoid bone

There are three unpaired and three paired cartilages in the larynx. The table below shows the list of cartilages and their location in the larynx.

Laryngeal cartilages

The skeletal framework of larynx (figure 13 a, b) is formed of cartilages, which are connected by ligaments and membranes and are moved in relation to one another by both intrinsic and extrinsic muscles. It is lined with mucous membrane which is continuous above and behind with that of the pharynx and below with that of the trachea.

Table 9: Cartilages of larynx

Cartilage	Number	Location
Epiglottis	single	Behind the hyoid bone and base of the tongue
Thyroid	single	Front of the neck in the midline
Cricoid	single	Above the trachea; below thyroid cartilage
Arytenoids	paired	Rests on the back surface of cricoid cartilage
Corniculates	paired	Rests on the arytenoid cartilages
Cuneiform	paired	Embedded in aryepiglottic folds

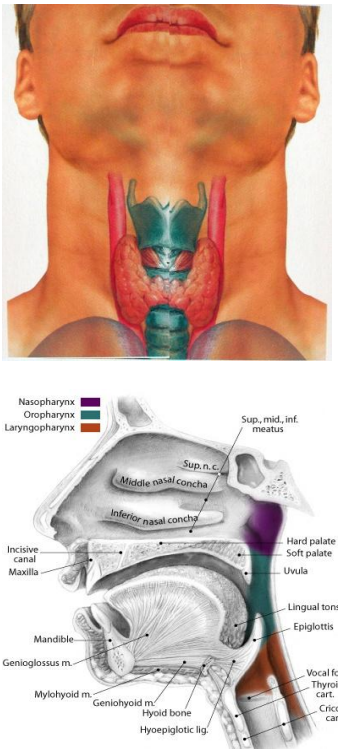


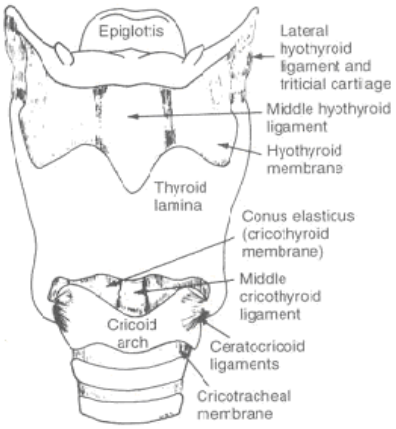
Figure 18: view of speech mechanism
Source:http://www.voicescienceworks.org/uploads/5/2/6/0/52608601/48528_orig.jpghttp://www.surgicalnotes.co.uk/files/images/pharynx.jpg

The thyroid cartilage

This shield-like cartilage is the longest of the laryngeal cartilages and consists of two laminae, which meet in the midline inferiorly, leaving the easily palpable thyroid notch between them above. It protects the voice box in the front. The angle of fusion of the laminae is about 90^{o} in men and 120^{o} in women. In the male, the fused anterior borders form a projection that is easily palpable, and is called **laryngeal prominence** or **Adam's apple**. The cartilage has the superior and inferior cornu. The superior cornu is long and narrow and curves upward, backwards and

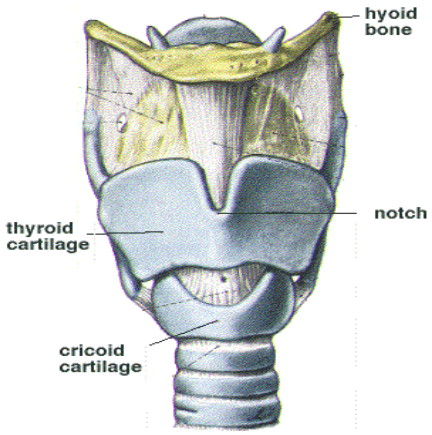
medially. The lateral thyroid ligament is attached to this. The inferior cornu is shorter and thicker and curves downwards and medially. This articulates with the cricoid cartilage.

The thyro-epiglottic ligament is attached to the inner aspect of the thyroid notch. The fusion of the anterior ends of the two vocal ligaments produces the anterior commissure tendon, which is of importance in the spread of carcinoma.



http://www.yorku.ca/earmstro/journey/images/larynx.gif

Figure 19: Skeletal framework of larynx



Source:http://1.bp.blogspot.com/_kM0AmKyBkgE/SD6_FiCmVqI/AAAAAAAAASU/3J-f-5zYIjI/s320/cartilages2.jpg

Figure 20: The anterior view of larynx

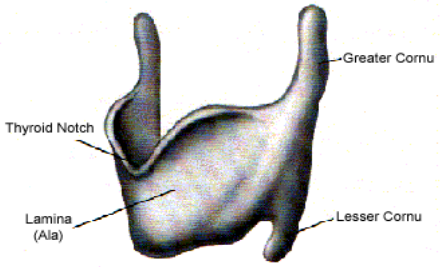


Figure 21: Side view of Thyroid

Source: https://o.quizlet.com/3xodU13L8looNt6crpIcVQ_m.png

The cricoid cartilage

The cricoid cartilage (figure 22) is the only complete cartilaginous ring present in the air passage. It forms the inferior part of the anterior and lateral walls and most of the posterior wall of the larynx. Likened to a signet ring, it comprises a deep broad quadrilateral lamina posteriorly and a narrow arch anteriorly. It articulates with the inferior cornu of thyroid cartilage. Rotation of the cricoid cartilage on the thyroid cartilage can occur about an axis passing transversely through the joints. A vertical ridge in the midline of the lamina attaches with the longitudinal muscle of the esophagus. This produces a shallow concavity on each side for the origin of the posterior cricoarytenoid muscle. The entire surface of the cricoid cartilage is lined with mucous membrane.

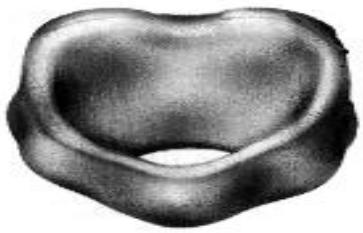


Figure 22: The Cricoid cartilage
Source: http://www.thiemeteachingassistant.com/images/thumbs/978-1-60406-746-0c039_f016a.jpg

The arytenoid cartilage

The two arytenoid cartilages (figure 23) are placed close together on the upper and lateral borders of the cricoid lamina. Each is an irregular three-sided pyramid with a forward projection, the ***vocal process***, attached to the vocal folds, and also a lateral projection, the ***muscular process*** to which are attached the posterior cricoartytenoid and lateral

crico-artytenoid muscles. Between these two processes is the antero-lateral surface, which is irregular and divided into two fossae by a crest running from the apex. The upper triangular fosse gives attachment to the vestibular ligament and the lower to the vocalis and lateral crico-arytenoid muscles. The apex is curved backwards and medially and is flattened for articulation with the corniculate cartilage to which is attached the aryepiglottic folds. The medial surfaces are covered with mucous membrane and form the anterior boundary of the inter-cartilaginous part of the rima glottides. The posterior surface is covered entirely by the transverse arytenoid muscle.

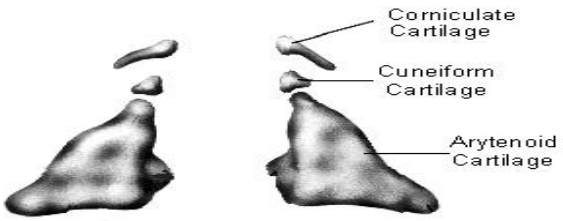


Figure 23: Front views of Arytenoids, Corniculates and Cunieforms
Source:https://embryology.med.unsw.edu.au/embryology/images/a/a1/Gray0950arytenoid_cartilage.jpg

The arytenoids rotate and make medial and lateral movements. The open human glottis resembles an inverted **V** shape. A firm posterior cricoarytenoid ligament prevents forward movement of the arytenoid cartilage.

The corniculate and cuneiform cartilages

The corniculate cartilages (figure 23) are two small conical nodules of elastic fibrocartilage which articulate as a synovial joint, or which are sometimes fused with the apices of the arytenoids cartilages. They are situated in the posterior parts of the aryepiglottic folds of mucous

membrane. The cuneiform cartilages are two small-elongated flakes of elastic fibrocartilage placed one in each margin of aryepiglottic fold.

The cartilage of the epiglottis

The epiglottis is a thin, leaf-like sheet of elastic fibro cartilage which projects upward near the tongue and the body of the hyoid bone (figure 24). It is attached by the thyro-epiglottic ligament, below the thyroid notch. The upper broad part is directed upwards and backwards. Its superior margin is free. The sides of the epiglottis are attached to the arytenoid cartilages by the aryepiglottic folds of mucous membrane, which, together with the free edge of the epiglottis, form the anterior boundary to the inlet of the larynx. The posterior surface of the epiglottis is concave and smooth but a small central projection, the tubercle, is present in the lower part. The bare cartilage is indented by a number of small pits into which mucous glands project. The anterior surface of the epiglottis is free and is covered with mucous membrane. An elastic ligament, the hyoepiglottic ligament, connects the lower part of the epiglottis to the hyoid bone in front. The space between the epiglottis and the thyrohyoid membrane is filled with fatty tissue. The epiglottis is not functionally developed in man in that respiration, deglutition and phonation can take place almost normally even if it has been destroyed.

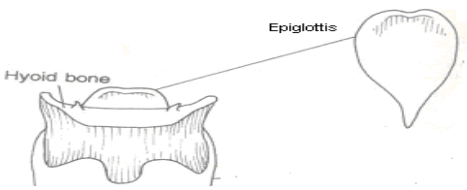


Figure 24: The epiglottis

Source: http://1.bp.blogspot.com/-RVqG3vZP6ys/TYtxxQFGbdI/AAAAAAAADao90H6LGmWk/s1600/anterior%2Bsurface%2Bof%2Bepiglottis.png

Joints/ligaments of larynx

The cartilages are connected to each other with the help of joints, muscles and membranes (Figure 25). Let us know some of the important joints, muscles and membranes from table 10.

Table 10: Important Ligaments and joints of larynx

Joints/ ligaments	Connects	Action
Crico-thyroid ligament & joints	Thyroid to Cricoid	Helps in changing the pitch of voice
Crico-arytenoid joints & ligaments	Cricoid to Arytenoid	Important for opening and closing of vocal folds
Vestibular ligaments	Arytenoids to Thyroid	Helps in changing the pitch of voice
Vocal ligaments	Arytenoids to Thyroid	Helps in changing the pitch of voice

trinsic ligaments connect the cartilages to the hyoid and trachea. The **thyrohyoid membrane** stretches between the upper border of the thyroid and the upper border of the posterior surfaces of the body and greater cornu of the hyoid bone.

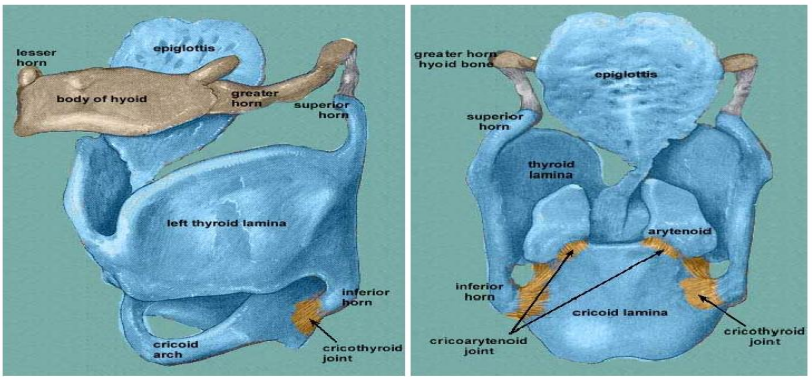


Figure 25: Side and back views of laryngeal joints

Source: https://www.phon.ucl.ac.uk/courses/spsci/expphon/images/fig3.1.png

The membrane is composed of fibro-elastic tissue and is strengthened anteriorly by condensed fibrous tissue called the median thyrohyoid ligament. The posterior margin is also stretched to form the anterior thyrohyoid ligament which connects the tips of the superior cornua of the thyroid cartilage to the posterior ends of the greater cornu of hyoid.

The **crico-tracheal ligament** unites the lower border of the cricoid cartilage with the first tracheal ring. The **hyoepiglottic ligament** connects the epiglottis to the back of the body of the hyoid.

The intrinsic ligaments connect the cartilages and strengthen the capsules of the inter-cartilaginous joints. They form the broad sheet of fibroelastic tissue and the fibroelastic membrane which lies beneath the mucous membrane of the larynx and creates an internal framework.

The **fibroelastic membrane** is divided into an upper and lower part by the laryngeal ventricle. The upper quadrilateral membrane extends between the border of the epiglottis and the arytenoid cartilage. The upper margin forms the frame of the ary-epiglottic fold, which is the fibrous skeleton of the laryngeal inlet. The lower margin is thickened to form the vestibular ligament which underlies the vestibular fold or false cord. The lower part is altogether a thicker membrane, containing many elastic fibers. It is commonly called the cricovocal ligament, **crico-thyroid ligament** or conus elasticus. It is attached below to the upper border of the cricoid cartilage and above it is stretched between the midpoint of the laryngeal prominence of the thyroid cartilage anteriorly and the vocal process of the arytenoids behind. The free upper border of this membrane constitutes the vocal ligament, the framework of the vocal fold or true cord. Anteriorly, there is thickening of the membrane,

the cricothyroid ligament, which links the cricoid and the thyroid cartilages in the midline.

The interior of the larynx

The cavity of the larynx extends from the pharynx at the laryngeal inlet to the beginning of the lumen of the trachea at the lower border of the cricoid cartilage and is divided by the vestibular and vocal folds into three compartments. The superior vestibule is above the vestibular folds; the ventricle or sinus of the larynx lies between the vestibular and vocal folds, and the subglottic space extends from the vocal folds to the lower border of the cricoid cartilage (figure 26). The tissue between the vestibular folds is called the rima vestibuli and that between the vocal folds is the rima glottidis or glottis. The paraglottic and pre-epiglottic spaces which are of importance in the spread of tumours lie within the larynx.

The laryngeal inlet is bounded superiorly by the free edge of the epiglottis and on each side by the aryepiglottic folds. Posteriorly, the inlet is completed by the mucous membrane between the two arytenoid cartilages. There is a plentiful supply of mucous glands in the margins of the aryepiglottic folds.

The superior vestibule lies between the inlet of the larynx and the level of the vestibular folds. It narrows as it extends downwards and the anterior wall which is the posterior surface of the epiglottis. This is much deeper than the posterior wall which is formed by mucous membrane covering the anterior surface of the arytenoids cartilages. The lateral walls are formed by the inner aspect of the aryepiglottic folds.

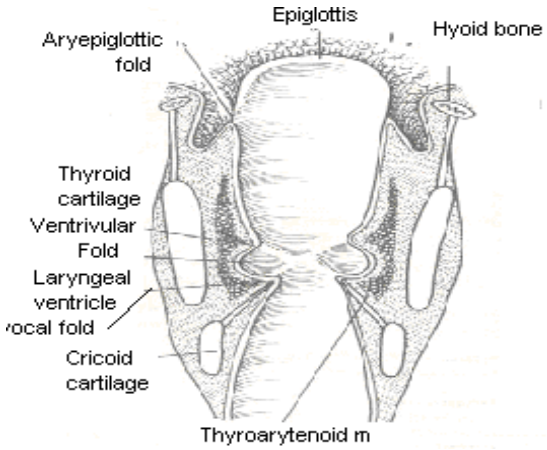


Figure 26: The cavity of the larynx

Source: https://o.quizlet.com/uaG608Mg.2SE22JdodozPg_m.png

The pre-epiglottic space is a wedge-shaped space lying in front of the epiglottis and is bounded anteriorly by the thyrohyoid ligament and the hyoid bone. Above a deep layer of fascia, the hyoepiglottic ligament connects the epiglottis to the hyoid bone. It is continuous laterally with the paraglottic space which is bounded by the thyroid cartilage laterally, the conus elasticus and quadrangular membrane medially and the anterior reflection of the pyriform fossa mucosa posteriorly. It embraces the ventricles and saccules.

The middle part of the cavity (and ventricle) lies between the vestibular and vocal folds which cover the ligaments of the same name. On each side it opens through a narrow horizontal slit, into an elongated recess, the laryngeal ventricle or sinus. From the anterior part of the ventricle, a pouch, the saccule of the larynx, ascends between the vestibular folds and the inner surface of the thyroid cartilage. It may extend as far as the upper border of the cartilage and in some monkeys and apes, it extends even further into the neck, as far as the maxilla. In man, the saccule

occasionally protrudes through the thyrohyoid membrane. The mucous membrane lining the saccule contains numerous mucous glands, lodged in sub mucous alveolar tissue. Fibrous tissue surrounds the saccule and a limited number of muscle fibers pass from the apex of the arytenoids cartilage across the medial aspect of the saccule to the aryepiglottic fold. The muscle is presumed to compress the saccule and to express the secretion of its mucous glands over the surface of the vocal folds.

The **vestibular folds** are two thick, pink folds of mucous membrane, each enclosing a narrow band of fibrous tissue, the vestibular ligament, which is fixed in front to the angle of the thyroid cartilage, just below the attachment of the epiglottic cartilage, and behind to the anterolateral surface of the arytenoids cartilage just above the vocal process.

Figure 27: Structure of the vocal folds

Source:http://svas.com.au/wp-content/uploads/2011/03/healthy2.png

The **vocal folds** are two sharp, white folds of mucous membrane closely attached to the vocal ligaments which extend from the middle of the angle of the thyroid cartilage to the vocal processes of the arytenoids cartilages. The vocal ligaments are the free upper margins of the cricovocal membrane consisting of a band of yellow elastic tissue,

covered on the lateral side to the vocalis muscle. The ligaments are, therefore, capable of stretching and their alteration in shape is fundamental to the production of voice. The vocal folds are covered with stratified squamous epithelium. As a result of the absence of a submucous layer and blood vessels, the vocal fold is pearly white colour in the living subject.

Vocal folds are made of mucous membranes, ligaments and muscles and have lot of blood vessels and nerve fibers. When seen under a microscope, 5 different layers can be identified. They include the following:

1. Epithelium
2. Superficial layer of Lamina propria (Reinke's space)
3. Intermediate layer of Lamina propria
4. Deep layer of Lamina propria
5. Vocalis muscle

The glottis is an elongated fissure between the vocal folds anteriorly and the vocal processes and bases of the arytenoids cartilages posteriorly. The average length of the glottis varies between 23 mm in the male and 16-17 mm in the female. In the resting state, the vocal processes are usually 8 mm apart. The glottis alters shape with phonation and respiration.

The lower part of laryngeal cavity or subglottic space extends from the level of the vocal folds to the lower border of the cricoid cartilage. Its upper part is elliptical in form, but its lower part widens and becomes circular in shape and continuous with the cavity of the trachea. It is

lined with mucous membrane, and its walls consist of the cricothyroid ligament above and the inner surface of the cricoid cartilage below.

The muscles

The muscles of the larynx may be divided into extrinsic, which attach the larynx to neighbouring structures, and intrinsic which move the various cartilages of the larynx.

Extrinsic muscles

The extrinsic muscles are the **sternothyroid, thyrohyoid** and **inferior constrictor** of the **pharynx.** In addition, a few fibers of the **stylo-pharyngeus** and **palatopharyngeus r**each forward to the posterior border of the thyroid cartilage.

Table 11: Intrinsic muscles of larynx

Muscle	Origin	Insertion	Action
Posterior crico-arytenoid (PCA)	Back surface of Cricoid lamina	Back surface of the muscular process of Arytenoids	opens the glottis by opening the vocal folds
Lateral crico-arytenoid (LCA)	upper border of the Cricoid arch	Front surface of the muscular process of the Arytenoids	closes the glottis by closing the vocal folds
Cricothyroid (CT)	Front and sides of the Cricoid arch	Thyroid lamina and lower horns of thyroid	Increases the length and tension of the vocal folds
Vocalis	inner surface of the Thyroid	Front surface and vocal process of Arytenoid	Increases tension of vocal folds
Transverse arytenoid	Muscular process of one Arytenoid	Muscular process of the opposite Arytenoid	closing the vocal folds
Oblique arytenoid	Muscular process of one Arytenoid	Muscular process of the opposite Arytenoid	closing the vocal folds
Thyroarytenoid	inner surface of the Thyroid	Front surface and vocal process of Arytenoid	Relaxes the vocal folds

Because the larynx is attached to the hyoid bone by the thyrohyoid membrane, any muscle, which elevates the hyoid, such as the mylohyoid, geniohyoid and stylohyoid, will also elevate the larynx, while the sternohyoid and omohyoid will depress it.

The actions of the extrinsic laryngeal muscles can, therefore, be summarized into two categories: **elevators of the larynx** which include the thyrohyoid (if hyoid is fixed), stylopharyngeus, palatopharyngeus, mylohyoid, geniohyoid and stylohyoid muscles and **depressors of the larynx** which include the sternothyroid, sternohyoid and omohyoid muscles.

Mucous membranes of the larynx

The mucous membrane lining the larynx is continuous above with that of the pharynx and below with that of the trachea. It is closely attached over the posterior surface of the epiglottis, over the corniculate and cuneiform cartilages, and over the vocal ligaments. Elsewhere it is loosely attached and therefore liable to become swollen.

The epithelium of the larynx is either squamous, ciliated columnar or transitional. The upper half of the posterior surface of the epiglottis, the upper part of the aryepiglottic folds and the posterior commissure are covered with squamous epithelium. The vocal folds, which have a fusiform outline, are also covered with squamous epithelium. The height of the vocal fold diminished towards the anterior commissure mainly because the inferior edge of the vocal fold slopes upwards. The lower edges of the anterior end of the folds form the apex of the triangular fixed part of the subglottis. The remainder of the epithelium of the laryngeal mucous membrane is ciliated columnar.

Table 12: Important membranes of larynx

Laryngeal membranes	Location
Mucous membrane (Ciliated Columnar Epithelium)	Present in the entire larynx
Cricovocal membrane (ConusElasticus)	Originates from Cricoid cartilage and connects the Cricoid, Thyroid, and Arytenoid cartilages together. Inserts into the true vocal folds
Quadrangular membrane	Connects Epiglottis and Thyroid to the Arytenoid cartilages at the back

Mucous glands are freely distributed throughout the mucous membrane and are particularly numerous on the posterior surface of the epiglottis, where they form indentations into the cartilage, and in the margins of the lower part of the aryepiglottic folds, and in the saccules. The vocal folds do not possess any glands, and the mucous membrane is lubricated by the glands within the saccules. The squamous epithelium covering the vocal folds is therefore vulnerable to desiccation. Some taste buds, similar to those in the tongue, are scattered over the posterior surface of the epiglottis, and in the aryepiglottic folds.

Blood supply

The blood supply (figure 20) is derived from the laryngeal branches of the **superior and inferior thyroid arteries and the cricothyroid branch of the superior thyroid artery**. The superior thyroid artery arises from the external carotoid artery, and the inferior thyroid artery arises from the thyro-cervical trunk of the first part of the subclavian artery. On the left side, thoracic duct is an important relation to the commencement of the inferior thyroid artery. It lies in front of either the artery or the thyro-cervical trunk, crossing them from medial to lateral side.

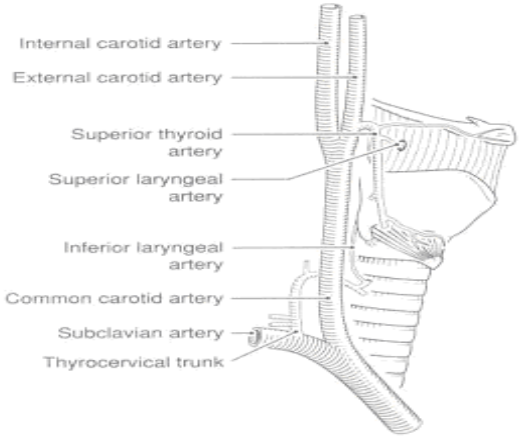


Figure 28: Blood supply to larynx
Source:https://classconnection.s3.amazonaws.com/342/flashcards/945342/png/thryoid_vessels1361502905028.png

The superior laryngeal artery arises from the superior thyroid artery. It passes deep to the thyrohyoid muscle and together with the internal branch of the superior laryngeal nerve, pierces the thyrohyoid membrane to supply the muscles and mucous membrane of the larynx and to anastomose with branches of its opposite side and with those of the inferior laryngeal artery. The latter arises from the inferior thyroid artery at the level of the lower border of the thyroid gland and ascends on the trachea, together with the recurrent laryngeal nerve. It enters the larynx beneath the lower border of the inferior constrictor muscle and supplies the muscles and mucous membrane. The cricothyroid artery passes from the superior thyroid artery, across the upper part of the cricothyroid ligament and anastomose with branch of the opposite side.

The veins leaving the larynx accompany the arteries. The superior vessels enter the internal jugular vein by way of the superior thyroid or facial vein the inferior vessels drain by way of the inferior thyroid vein into the brachiocephalic veins. Some venous drainage from the larynx is by way of the middle thyroid vein into the internal jugular vein.

Lymphatic drainage

The part of the larynx above the vocal folds is drained by vessels which accompany the superior laryngeal vein, piercing the thyrohyoid membrane and emptying into the upper deep cervical lymph nodes whereas the zone below the vocal folds drains, together with the inferior vein, into the lower part of the deep cervical chain often through the prelaryngeal and pretracheal nodes.

The nerve supply (figure 29) of the larynx is from the Vagus by way of its **superior and recurrent laryngeal** branches. The superior laryngeal nerve arises from the inferior ganglion of the Vagus and receives a branch from the superior cervical sympathetic ganglion. It descends lateral to the pharynx, behind the internal carotid and at the level of the greater horn of the hyoid, divides into a small external branch and a larger internal branch. The external branch provides motor supply to the cricothyroid muscle while internal branch pierces the thyrohyoid membrane above the entrance of the superior laryngeal artery and divides into two main sensory and motor branches. The upper branch supplies the mucous membrane of the lower part of the pharynx, epiglottis, vallecula and vestibule of the larynx. The lower branch descends in the medial wall of the pyriform fossa beneath the mucous membrane and supplies the aryepiglottic fold and mucous membrane down to the level of the vocal folds.

The **internal laryngeal nerve** also carries fibers from neuromuscular spindles and other stretch receptors in the larynx. The nerve ends by piercing the inferior constrictor muscle of the pharynx, and unites with

an ascending branch of the recurrent laryngeal nerve. This branch is called Gaten's anastomosis or loop and is purely sensory.

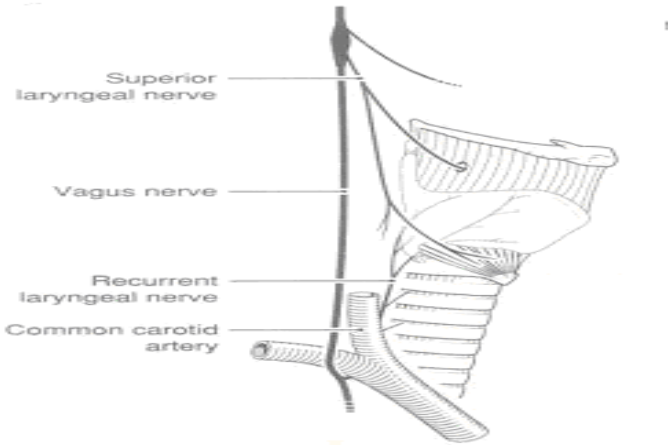


Figure 29: Nerve supply to larynx
Source: http://image.slidesharecdn.com/vocalcordparalysis2-130919124712-phpapp02/95/vocal-cord-paralysis-7-638.jpg?cb=1379594900

The **recurrent (inferior) laryngeal nerve** on the right side leaves the Vagus as the latter crosses the right subclavian artery and then loops under the artery and ascends to the larynx in the groove between the oesophagus and trachea. On the left side, the nerve originates from the Vagus as it crosses the aortic arch. It then passes under the arch and the ligamentum arteriosum to reach the groove between the oesophagus and trachea. In the neck, both nerves follow the same course and pass upwards accompanied by the laryngeal branch of the inferior thyroid artery, deep to the lower border of the inferior constrictor, and enter the larynx behind the cricothyroid joint. The nerve then divides into motor and sensory branches.

The motor branch has fibers derived from the cranial root of the accessory nerve with cell bodies lying in the nucleus ambiguous these

supply all the intrinsic muscles of the larynx with the exception of the cricothyroid. The sensory branch supplies the laryngeal mucous membrane below the level of the vocal folds and also carries afferent fibers from stretch receptors in the larynx.

As the recurrent laryngeal nerve curves round the subclavian artery or the arch of the aorta, it gives off several cardiac filaments to the deep part of the cardiac plexus. As it ascends in the neck, it gives branches which are more numerous on the right than the left, to the mucous membrane and the muscular coat of the oesophagus and trachea and some filaments to the inferior constrictor.

To summarize, keep your fingers on your neck. You can feel a prominence. This is a part of the larynx. The larynx is made up of bone, cartilages and muscles. It is suspended in the neck. The most important part of the larynx is vocal folds. Larynx has a pair of vocal folds. Just now you have felt the prominence in the neck. Keep your index and middle fingers in an inverted **V** shape so that the fingers are on the prominence of the neck and they are joining in the front. You can assume that the vocal folds are exactly in the same shape inside the neck.

What do these vocal folds do? Firstly they open during breathing. Second, the inspiratory air might have dust. The vocal folds push this into the nose or mouth through sneeze or cough. Do you get a cough/ sneeze when you have cold? Or when it is very dusty? Yes? Your vocal folds are responsible for this. They are like a soldier guarding the border. They protect the lungs. These are the basic functions of vocal folds. But how do they help in speech production?

The vocal folds are like strings of a Veena. They vibrate when the air passes through them or open and close. Remember the expiratory air comes out of the lungs. This is a stream of air and equivalent to noise. When the vocal folds close the air is stopped and when it is open the air is let out.

Thus, the vocal folds change the stream of air into puffs of air or voice. You can equate this to a door opening and closing. If you have a door opening and closing continuously, air enters in when it is open. You can actually do this action and watch. When you do it very fast (100 times per second) you will start hearing the puffs of air. You can also clap your hands. This is similar to closing and opening. ALAS! You can't clap for more than 50-60 times per second.

The function of vocal folds is amazing. It can vibrate anywhere between 80 times per second to 800 times per second. The length of the vocal folds is about 10-17 mm. The length changes with age and gender. It is short in children and long in adults. These small vocal folds produce amazing tones. OOPS! You can't even imagine closing and opening a door 300 times per second mechanically. Perhaps you require a machine to do this. But the vocal folds do this. You talk for hours without realizing the work of the miniature vocal folds. Won't you thank the vocal folds? Keep it healthy. It will give a clear and normal voice.

Voice production

Voice is defined as the modification of the pulmonary air stream. Therefore, respiration (breathing) is very important for voice

production. Vocal folds open during inspiration and close during expiration. During voice production, vocal folds open and close continuously. This is called vocal fold vibration. The closing and opening cause respiratory air to be obstructed and released. Airflow is stopped when vocal folds are closed and air is released when vocal folds open. Continuous flow of air is converted into puffs. The vocal fold vibrations modify the respiratory air as puffs and it creates sound. Sound produced is called the **Voice**.

Voice has 3 parameters - pitch, *loudness and quality*. Pitch is related to number of vocal fold vibrations. Loudness is related to airflow and quality is the pleasantness of voice

Differences between human infant larynx and adult larynx

The infant larynx and trachea are much smaller than that of an adult. At birth, the infant's larynx is approximately one third the size of an adult. Glottis of the neonate (new born) is narrower and vocal cords are about 6-8 mm long. The vocal process of arytenoid cartilages forms half the length of the vocal cord in the infant larynx but it takes up about ¼ of the length of the vocal cord in the adult. The membranous length of the vocal folds is very less in infants and this explains the sharp, shrill voice of infants. Laryngeal structures of the infant are more flexible and less fibrous making the infant airway more susceptible to narrowing from edema and less easily palpable. The infant's larynx is positioned higher in the neck compared to an adult. The epiglottis is proportionally narrower than that of an adult and assumes either a tubular form or the shape of the Greek letter omega.

We started with the understanding of nervous system. We learnt that it issues commands to other systems. We also learnt that the respiratory system provides the air for speech. The laryngeal system converts this air into voice. Now let us understand the function of resonatory and articulatory systems.

2.3.4 Resonatory system

Pharynx, oral cavity and nasal cavity are the resonators and collectively called the vocal tract. Vocal tract is the main structure responsible for resonance of speech. In speech production the vocal tract acts as a filter and selectively modifies the laryngeal sound. This process of selective modification of laryngeal sound is called the transfer function of vocal tract.

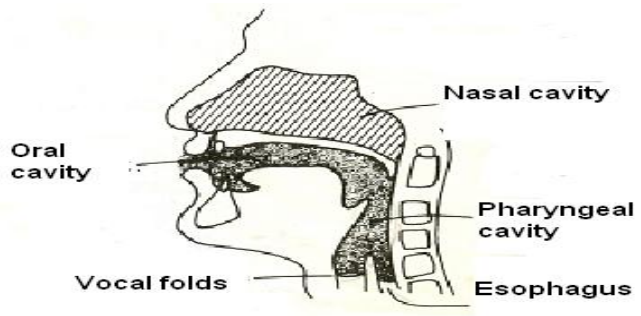


Figure 30: The resonatory system
Source: http://www.proprofs.com/flashcards/upload/q3400891.png

The resonatory system includes (a) pharynx, the space above larynx, (b) mouth or the oral cavity, and (c) nose or the nasal cavity. There is a door between the oral and the nasal tract. This is called the velopharyngeal port. When it is open the expiratory air passes through the nasal tract. When it is closed, the expiratory air passes through the oral tract. Figure 30 shows the resonatory system.

2.3.5 Articulatory system

Mouth is the orifice (opening) through which food and air enter the body. The mouth opens to the outside at the lips and empties into the throat at the back. There are two cavities in the mouth the buccal cavity and the oral cavity.

The oral cavity (figure 31a) is primarily a space through which food and air travel. But several structures are found in this space such as, upper and lower teeth, the tongue, salivary glands, mucosal glands, the hard palate and soft palate. The boundaries are lips in the front, cheeks at the sides, while hard palate and soft palate form the roof and tongue is the floor. The oral cavity is continuous with the pharyngeal cavity.

The lateral walls of the oral cavity are created by the cheeks. The inner walls of the cheeks are coated with moist stratified squamous epithelium. The oral cavity and buccal cavity are entirely lined by mucous membranes containing numerous small glands including the salivary glands. The secretions from these glands keep the mouth moist and clear of food and other debris. The mouth's moist environment and the enzymes within its secretions help to soften food, facilitating swallowing and beginning the process of digestion.

Tongue

Tongue is a muscular organ in the mouth, the primary organ of taste and important in the chewing and swallowing of food and the production of speech. The tongue is covered by mucous membrane. It extends from the hyoid bone at the back of the mouth upward and forward to the lips. The upper and the lower front surfaces are free but

it is attached to adjacent parts of the mouth at the sides. The extrinsic muscles attach the tongue to external points, and the intrinsic muscle fibers, which run vertically, transversely, and longitudinally, allow great range of movement. The upper surface is covered with small projections called papillae, which give it a rough texture. The color of the tongue, usually pinkish-red but discolored by various diseases, is an indication of health. The tongue serves as an organ of taste, with taste buds scattered over its surface and concentrated toward the back of the tongue. In chewing, the tongue holds the food against the teeth and in swallowing, it moves the food back into the pharynx, and then into the esophagus when the pressure of the tongue closes the opening of the trachea, or windpipe. It also acts, together with the lips, teeth, and hard palate, to form speech sounds (articulation).

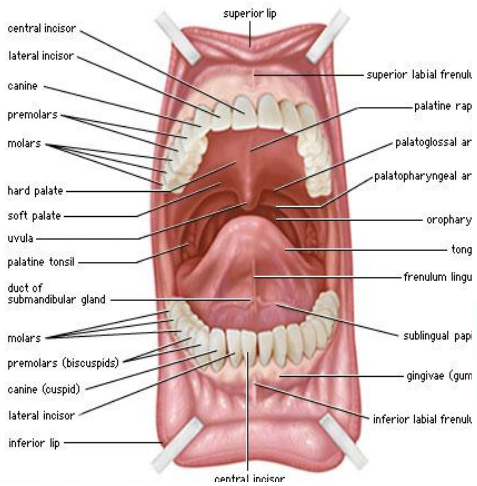


Figure 31a: Anterior view of oral cavity

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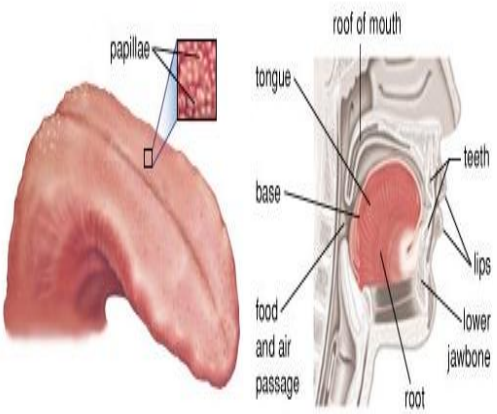

Figure 31b: Superior & Sagittal views of tongue
Source:http://media-2.web.britannica.com/eb-media/24/85424-004-C3370EE8.jpg

Table 13: Muscles of tongue and their functions

Muscle	Origin	Insertion	Action
Extrinsic muscles			
Styloglossus	Styloid process	Sides of the tongue	Elevates the tongue
Hyoglossus	Hyoid bone	Poster half of tongue	Depresses and elevates the tongue
Genioglossus	Genial tubercle of Mandible	Tip-base of tongue, Hyoid	Protrudes tongue, raises Hyoid
Palatoglossus	Soft palate	Poster and lateral aspects of tongue	Elevates the tongue
Intrinsic muscles			
Superior Longitudinal	Root of tongue	Tip of tongue	Shortens and curls tongue upwards
Inferior Longitudinal	Root of tongue	Tip of tongue	Shortens and curls tongue downwards
Transverse	Lingual septum	Dorsum, lateral margins of tongue	Elongates; raises and narrows sides of tongue
Vertical	Dorsum of tongue	Lower surface of tongue	Flattens and broadens tongue

The oral tract is like a box. Tongue is the base of the box; palate is the roof, teeth and lips are the front parts. Of these, the tongue and lips can move. Basically these organs are used for chewing. But it also helps in speech production. We shall learn how the articulatory system helps in speech production.

The oral tract is about 17 cm in length. One can move the tongue at various places in various ways in the oral tract. Assume that the oral tract is at rest. That is, there is no movement of articulators in the tract. As said earlier, the oral tract is like a box. Now say /g/ sound several times. Do you feel the back of the tongue touching the palate? What is happening to the box now? The tongue movement has split the box in to two parts or two small boxes. Isn't it? The characteristics of the filter/box, namely the oral tract, changes now. You are aware that the expiratory air is modified as voice enters the oral tract. **Voice** has

energy at different frequencies. Like a sieve, the oral tract acts as a **filter** passing energy in some frequencies and absorbing energy at other frequencies. The air coming out of the lips, speech is **voice+ filter** function. Let us look at another example. Say /d/ several times. What happens to the filter now? It is split into two boxes as in /g/. But, is the shape of the box similar to that in /g/? No, so what has happened? You have created a different filter. This filter passes energy at some frequencies. But it is not similar to /g/. Thus speech, the air, radiating from lips is different from /g/ because the filter is different. Figure 32 illustrates the filters created in the oral tract in producing /g/ and /d/.

Figure 32: Illustration of the filters in the production of /g/ and /d/

Therefore, the oral tract creates different filters by placing the tongue in different places. Because the filters are different, the speech sounds are different. Without oral tract, it would have been impossible to generate different speech sounds.

Lips

Lips are one of the most visible of all human organs and perhaps the most emotionally expressive. Lips are composed of only skin, muscles and mucosa. The upper lip (Labium superioris) is somewhat smaller than the lower lip (Labium inferioris). The colored border between the lips and the surrounding skin existing only in humans is the vermilion border, or simply **vermilion**. Just above the upper lip, a vertical groove

is present which is called the **philtrum**. The reddish tint of the lips comes from underlying blood vessels. The inside portion of both lips is connected to the gums.

The lips are fragile when compared to other areas of skin on the body as there are no hairs, sweat glands or sebaceous glands to protect them. Lips are controlled by their own muscles, which are considered part of the muscles of facial expression. The principal lip muscle is the **orbicularis oris**.

Functions of the lips are gustatory, closing the mouth air-tight, keeping out unwanted objects and creating speech sounds.

Teeth

The teeth tear and grind ingested food into small pieces that are suitable for digestion. There are a total of 16 teeth each on the upper and lower jaws in an adult. The appearance of teeth varies in shape and size.

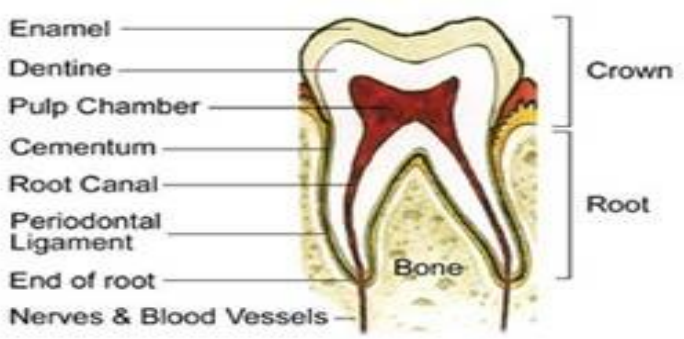

Figure 33: Sagittal section of a tooth

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Each tooth has two main parts, the crown and the root. The crown and the root meet at the neck of the tooth, which is normally just below the gum margin (figure 33).

The crown: is the part of the tooth that we see in the mouth. It is made up of the enamel, dentine and pulp. **Enamel** is the outer layer of the tooth; **Dentin** is the inner layer and the main part of the tooth. **Pulp** is part of the inside of the tooth that contains the nerve. **Root** is the part of the tooth that secures it into the jaw.

Now we have learnt the functions of different systems. Have you noticed something? The basic function of the respiratory system is respiration; that of the laryngeal system is protection; that of the articulatory system is chewing or mastication. They are not meant for speech production. But it is amazing that they take on additional functions of speech production. Therefore, speech is called an **overlaid function.**

Palate

The palate is the roof of the mouth. It separates the mouth from the nasal cavity allowing separate passages for air and food. The anterior (front) roof is hard and bony and called the **hard palate**. The posterior (back) roof is soft and muscular and called the **soft palate**.

Hard palate, alveolar ridge, and teeth act as sound reflectors during speech production. Velum, cheeks, lips, and the tongue act as sound absorbers. Thus articulators that reflect and absorb sounds along with the variable size and shape of mouth make oral cavity the most versatile resonator.

Hard Palate

The hard palate is pale pink/white in color and formed by the four bones: **Palatine processes (2) of Maxillae** anteriorly and **horizontal plates (2) of Palatine bones posteriorly.** These bones fuse together during the embryonic stage and the point of meeting of all the bones is the **Palatine raphe**. The hard palate is covered by mucous membrane. It helps in swallowing and an important site for speech resonance and articulation (palatal, retroflex sounds).

- Failure of the palatine process of maxillary bones to unite at midline (Palatine raphe) during embryological development causes clefts of hard and soft palates. Speech resonance and articulation will be abnormal in cleft palate.
- Some children may have high arched palate which again causes articulation errors.
- A 'blue tint' on the midline indicates abnormal blood supply due to submucous cleft. Speech resonance and articulation will be affected in such cases.

Soft Palate (Velum)

The soft palate (figure 31a) is continuous with the hard palate. Rich blood supply gives Velum its red color. It is a soft muscular structure covered by mucous membrane. At the posterior middle border of the soft palate, there is a conical projection known as the **uvula**. The **Palatine aponeurosis** which is present throughout the velum is responsible for velopharyngeal closure. Both the soft palate and the uvula are forced upward when the action of swallowing occurs. The Aponeurosis becomes firm and stretches to close oropharynx from

nasopharynx and prevents regurgitation of food/water through nose. This action is called the **velopharyngeal** (VP) or **palatopharyngeal closure**.

Along each side of the uvula there are two muscular folds which protrude downward, known as the glosso-palatine arch (anterior) and the pharyngo-palatine arch (posterior). The **palatine tonsil** can be found located in between these two muscular folds. The tonsils provide defence to the body by fighting against the bacteria in the swallowed food and water.

Velum is normally raised (VP port closed) for production of oral speech sounds. But it is lowered (VP port open) to allow airflow through nasal cavity during the production nasal speech sounds.

The table 14 provides details of the muscles that are responsible for velar movement with their origin, insertion and action.

Table 14: Muscles of Soft Palate

Muscle	Origin	Insertion	Action
Tensor Veli Palatini	Scaphoid fossa, Eustachian tube	Palatine aponeurosis	Tenses soft palate
Levator Veli Palatini	Petrous portion of Temporal bone	Palatine aponeurosis	Raises soft palate
Uvulus	Postr nasal spine, Palatine aponeurosis	Mucosa of Uvula	Shortens Uvula
Palato-glossus	Under surface of Soft palate, Palatine aponeurosis	Dorsum and sides of tongue	Elevates tongue and narrows palatine arches
Palato-pharyngeus	Palatine aponeurosis	Pharyngeal walls; Thyroid cartilage	Constricts palate-pharyngeal folds

Paralysis of the muscles of soft palate, short soft palate, can lead to **hypernasality**. In such conditions, velum consistently allows airflow

through the nasal cavity. The other structure which contributes to resonance of speech is the nasal cavity.

Nasal cavity and Nose

The nasal cavity (figure 34) serves the function of cleaning the air we breathe before it reaches the lungs. It does this with the help of the respiratory mucosa, which lines the walls of the nasal cavity. Within this mucosa small hair-like cilia moves in a wave-like motion, moving mucus to the back of the throat. Dust, bacteria, and other chemicals get trapped in the mucus.

Floor of nasal cavity (also roof of the mouth) is made up of bones of the hard palate: a) horizontal plate of the palatine bone posteriorly, b) palatine process of the maxilla anteriorly. Olfactory membrane is located on the roof of the nasal cavity. This contains cells/receptors which are in contact with the **Olfactory bulb and nerve** to provide sense of smell.

Nasal cavity is divided in to two by a vertical sharp cartilage called the **nasal septum**. The nose consists of bones and cartilages, two small nasal bones and extensions of the maxillae form the bridge of the nose, which is the bony portion. Connective tissue and skin cover the entire nose. Air enters nasal cavity anteriorly from the outside through two openings, the nostrils/external nares. Nasal cavity opens into nasopharynx through internal nares (posteriorly).

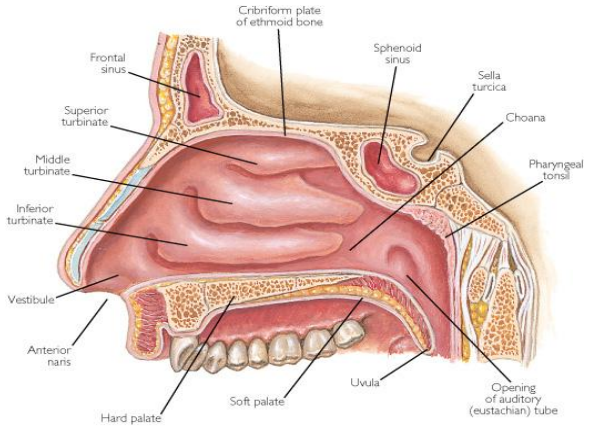

Figure 34: Sagittal view of nasal cavity
Source: http://i01.i.aliimg.com/img/pb/697/241/481/481241697_779.jpg

There are three turbinates (conchae) in each nasal passage on the sides of the nasal cavity. These turbinates warm (humidify) the inhaled air thereby killing germs in the inhaled air.

Para-nasal sinuses are air-filled cavities in the frontal, maxillae, ethmoid, and sphenoid bones. These sinuses surround the nasal cavity and open into it. The main functions of the sinuses are to reduce the weight of the skull, produce mucus, influence voice quality by acting as resonating chambers and production of nasal consonants m, n, ŋ.

2.4 Let us sum up

In this unit we learnt about the various systems that help in speech production. We also learnt about the voicing, manner and place of articulation of speech sounds. I am sure that now you are confident of describing the systems involved in speech production and the voicing, place, and manner of speech sounds in your language.

2.5 Unit end exercises

1. Name the systems involved in speech production.

2. What are the 4 lobes located in each hemisphere?
3. Where is Broca's area located in the brain?
4. Mention the 3 paired cartilages in the larynx.
5. What are the structures involved in the resonatory system?
6. Name the articulators involved in speech production.
7. What is a vowel?
8. Write any two-stop consonants in your language.

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Unit 3: Disorders of speech and language

Objectives

Unit 3: Disorders of speech and language

Objectives

After going through this unit the student will be able to:

- identify different types of speech disorders in children and adults
- identify different types of language disorders in children and adults
- Know the characteristics of different types of speech and language disorders

3.1 Introduction

Speech-language deficits are the most common forms of communication disorders of childhood disabilities and affect about 5% to 8% of preschool children. The consequences of untreated speech-language problems are significant and lead to behavioral challenges, mental health problems, reading difficulties, and academic failure including in-grade retention and high rates of school dropout. Yet, such problems are ones that are least well detected in primary care, even though intervention is available and provide very good results.

Speech-language impairments embrace a wide range of conditions that have, at their core, challenges in effective communication. As the term implies, they include speech disorders which refer to impairment in the articulation of speech sounds, fluency, and voice as well as language disorders which refer to impairments in the use of the spoken (or signed or written) system and may involve the form of language (grammar and phonology), the content of language (semantics), and the appropriate

social use of language (pragmatics). These may also be described more generally as communication disorders which are typically classified by their impact on a child's receptive skills (ie, the ability to understand what is said or to decode, integrate, and organize what is heard) and expressive skills (ie, the ability to articulate sounds, use appropriate rate and rhythm during speech, exhibit appropriate vocal tone and resonance, and use sounds, words, and sentences in meaningful contexts). There are common conditions in infants, toddlers, and preschoolers that are associated with receptive and expressive communication challenges.

A spoken language disorder (SLD), also known as an oral language disorder, represents a significant impairment in the acquisition and use of language across modalities (e.g., speech, sign language, or both) due to deficits in comprehension and/or production across any of the five language domains (i.e., phonology, morphology, syntax, semantics, pragmatics). Language disorders may persist across the lifespan, and symptoms may change over time.

When SLD is a primary disability, not accompanied by an intellectual disability, global developmental delay, hearing or other sensory impairment, motor dysfunction, other mental disorder or medical condition, it is considered a specific language impairment (SLI).

3.2 Types of speech and language disorders

There are varieties of ways how speech and language disorders can be classified. One way is as follows:

1) Speech disorders
    a) Voice disorders

b) Articulation disorders
c) Fluency disorders
d) Resonance disorders

2) Language disorders
a) Developmental

b) Acquired

3.3 Speech disorders

As we saw in unit 1 and 2, speech disorders can be classified as voice, articulation and fluency disorders. Let us understand each of them.

3.3.1 Voice disorders

Voice is the laryngeal modification of the pulmonary air stream which is further modified by the configuration of the vocal tract. The production of voice is dependent on four primary factors, i.e., (a) central nervous system control, (b) pulmonary air pressure, (c) vocal fold vibrations and (d) transfer function of vocal tract. Hence, voice is considered as a multi-dimensional series of measurable events, i.e., a single phonation could be analyzed in different ways.

We distinguish the voices of babies, children, adolescents, adult men and women, and aged men and women. Each of these groups has distinctive characteristics. They are different from each other, yet they are normal as long as they meet our expectations for the group. On the other hand, when the pitch, loudness or quality of voice differs from that which is customary in the voices of others of the same age, gender, or cultural background, we classify it as deviant or defective.

3.3.1.1 Prevalence of voice disorders

Clinical experience suggests a reasonable estimate of voice disorder will fall between 6 and 10 percent of communication disorders. Voice disorders are heard frequently in the adult population, but since these problems rarely interfere with understanding what is said, lay people pay little attention to most of them. One reason probably is that acute temporary conditions as cold, laryngitis, breathiness, hyponasality, and other vocal variations are so common they are not source of concern. Unfortunately, the chronic and sometimes serious diseases that affect the same areas and cause the same types of vocal deviations also tend to be ignored.

3.3.1.2 Causes of voice disorders

The onset and development of voice disorders can be "sudden" or "slow/gradual." Examples of characteristics of sudden onset may be trauma, infection, CVA, injurious inhalation, intubation, conversion reaction, or a severe allergic reaction. On the other hand degenerative neurologic diseases/disorders, musculo-skeletal tension, vocal abuse and misuse, growths of folds, gastro-esophageal reflux, and chronic allergies may characterize slow onset.

All disorders do not have known etiologies, and some may occur as a result of numerous etiologies. Very few disorders are attributed to one known cause. We may classify the existing disorders into two major categories as **functional voice disorders** and **organic voice disorders**, each of which will contain several subcategories. It should be noted that some disorders might appear in both categories as a result of multiple etiologies.

3.3.1.3 Types of voice disorders

Voice is termed "disordered" when the vocal pitch, loudness or quality of an individual is altered/changed in such a way that it is thought to be abnormal to the listener. Thus, the main varieties of voice disorders include pitch, loudness and quality disorders. Again, these could be because of organic or physiological reasons or functional misuse of the intact structures. Some of the commonly seen types of voice disorders include Puberphonia, Spastic dysphonia, hyper/hyponasal voice disorders, harsh, hoarse or breathy voice qualities etc.

3.3.2 Speech disorders related to mouth

Natal complications affect the structure and functions of mouth and result in speech problems. The disorders of the mouth are disorders that affect the lips, tongue, teeth, jaw and palate. Examples are cleft lip, macroglossia, microglossia, improper alignment of teeth, cleft palate, submucous cleft etc.

3.3.2.1 Cleft lip and palate

A cleft lip is a split in the upper lip; a cleft palate is a split in the roof of the mouth. They occur during early development in the womb, when the upper lip or palate does not join together properly. Cleft lips or palates occur in 1 in 600 to 1000 births, making it one of the most common major birth defects. Clefts can occur on one side of the mouth (unilateral cleft) or on both sides of the mouth (bilateral cleft).

Types of clefts:

- cleft lip without a cleft palate

- cleft palate without a cleft lip
- cleft lip and palate

In most cases, cause of cleft lip/palate is unknown. It is found to be hereditary in some cases. Cleft lips and palates are most common in Asians. They are less common in whites and least common in blacks. Boys are more often affected than girls.

Symptoms

- Feeding problems
- Regurgitation of food and water
- Ear infections and hearing loss
- Delayed development of speech and language
- Articulation errors
- Nasal emissions
- Hypernasality

Management of cleft lip and palate involves surgical correction. The management team includes professionals such as pediatrician, maxillofacial surgeon, orthodontist, ENT specialist, speech-language pathologist and audiologist, and dentist.

Sub mucous cleft

A submucous cleft of the soft palate is characterized by a midline deficiency or lack of muscular tissue and incorrect positioning of the muscles. A submucous cleft of the hard palate is defined as a bony defect in the midline or center of the bony palate. This can sometimes be felt as a notch or depression in the bony palate when the palate is

palpated with a finger. Often a submucous cleft palate is associated with a bifid or cleft of the uvula. The cause is unknown but it can be hereditary. The major symptoms are same as above and so also the management.

3.3.2.2 Tongue abnormalities

a) Microglossia: In Microglossia the size of the tongue is abnormally small. A tiny tongue will pose many difficulties related to speech and swallowing.

Symptoms

- Swallowing difficulties
- Articulation errors

There is no treatment for this condition, and the affected person will have to be trained to use the tongue to the best of his/her abilities.

b) Macroglossia: Macroglossia is a condition where the tongue is bulky and enlarged. This is more common than microglossia. It can be congenital or acquired. Acquired macroglossia occurs in conjunction with some other conditions like a tumor of the tongue, hemangioma and acromegaly. The cause for congenital macroglossia is unknown.

Symptoms

- Teeth abnormalities
- Swallowing difficulties
- Articulation errors

The treatment of macroglossia involves the removal of the cause that gives rise to this condition. Sometimes, surgical stripping of the tongue to reduce the heavy musculature is also done.

c) **Ankyloglossia:** Ankyloglossia results when the lingual frenulum fuses with the floor of the mouth. However, complete fusion rarely occurs; a partial ankyloglossia or "tongue-tie" is a much more common condition.

Symptoms

- Lisping
- Articulation errors

The treatment is to surgically release the connection between the frenulum and the floor of the mouth.

d) **Cleft tongue:** It is a condition where the tongue has a cleft running right across it horizontally or vertically. Complete cleft is extremely rare. Partial cleft presents as a deep groove in the middle of the tongue and is a common feature in the oro-facial-digital syndrome. Cleft tongue is of little importance other than causing difficulty in eating as food gets stuck in the cleft.

3.3.3 Disorders of Articulation

Articulation means movement. In the context of speech, articulation is the movement of the speech mechanism to produce the sounds of speech. The various structures of the speech mechanism, including the soft palate, the tongue, and the lips, come together, move apart, and change their shapes to create various sounds of speech.

Most children learn the speech sounds of their language with ease and with no special instructions. However, some children find the task extremely difficult and frustrating. In fact, problems of articulation in school children are among the most frequently treated disorders of communication and are referred to as **Misarticulation**.

Articulation is disordered when a person cannot correctly produce one or more of the speech sounds of his or her language. Errors of many speech sounds that form patterns or clusters are often described as **Phonological disorders**. Articulation disorders are speech disorders, not language disorders, because articulation is a part of speech production.

Articulation disorders can pose a serious problem for the listeners. The speech of a child who misarticulates more than one speech sound may be unintelligible to listeners.

Classification of articulation disorders

Articulation disorders can be classified based on types of misarticulations noticed or causative factors as follows.

A. Types of articulation disorders

In determining individual sound errors, the clinician listens to the production of each phoneme and judges whether it is correct or not. The errors are then grouped according to four types, commonly referred to as **SODA**.

A sound **'Substitution'** involves the production of a wrong sound in place of a right one. For example, child who says 'ladio' for 'radio' is

substituting ‘l’ for ‘r’. An **‘Omission’** is an absence of a required sound in a word. For example, a child who says ‘ka’ for ‘car’ or ‘boo’ for ‘boot’, omits the ‘r’ and ‘t’. Here the omitted sounds are in the final position within the words. A **‘Distortion’** is a sound production that does not match its normal production. In other words, distortions are imprecise productions. A ‘slushy’ production of ‘s’ in soup, for example, is a distortion. In **‘Addition’**, a sound that does not belong to a word is added. For example, the child who says ‘iskuul’ for ‘school’ is adding an extra sound at the beginning of the word. The production of each sound is judged as correct, distorted, substituted or omitted and a sound is added to a word is also noted.

The position of the misarticulated sound within the word as initial, medial or final, are also determined. This procedure is called as ‘**Sound-by-Sound analysis**’. This type of analysis is better suited to those clients who show only few errors of articulation. For clients who misarticulate many sounds, an analysis of the overall pattern of misarticulation may be more appropriate.

B. Causes of articulation disorders

The causes of misarticulation can be divided into the following categories:

1) Structural abnormalities: Structural abnormalities such as clefts in the lip, palate may lead to misarticulation of sounds. Often structural abnormalities include tongue-tie, abnormally large tongue, and small tongue. Impairment in the teeth like missing teeth or overbite and under bite may result in misarticulating.

2) Sensory abnormalities: Sensory causes such as hearing loss lead to misarticulation of sounds.

3) Psychosocial factors: Psycho-social factors include age, gender, socio-economic status, sibling influence and family transmission. More children in lower economic status are bound to have misarticulations.

4) Neuro-motor abnormalities: There can be misarticulation due to damage to the central nervous system or peripheral nervous system specifically to the 5^{th}, 7^{th}, 9^{th}, 11^{th}, and 12^{th} cranial nerves. If the misarticulation is due to neurological problems, it is referred to as **Dysarthria** and if it is due to higher brain level programming defect, it is referred to as **Apraxia** of speech.

5) Cognitive and linguistic factors: Children with misarticulation may also be impaired with language skills, which involve the knowledge of phonological rules and sentence structure.

6) Other factors:

Age: Phonological development is a gradual process and it continues to develop until the age of 8 years.

Gender: Females are slightly ahead of males in acquisition of speech sounds.

Idiopathic: Sometimes without any obvious reason the child will have misarticulations and it is termed as idiopathic.

3.3.4 Fluency disorders

Fluency disorders are one of the common types of speech disorders. The word “fluency” is derived from the Latin root, “flu ere” meaning

flow. In communication, it refers to the smooth and easy flow of an utterance. It is defined as effortless, continuous speech produced at a rapid rate. As seen earlier, fluency has two basic parameters (a) **Timing**, comprising of continuity, rate and rhythm and (b) **effort** comprising of mental and physical effort.

Effort: Effort refers to mental as well as physical effort. Mental effort refers to the effort in the coding process, while physical effort refers to the muscular efforts of the phonatory, respiratory and laryngeal systems. Errors in any of these can break down fluency.

Continuity: Continuity refers to a smooth movement from phoneme to phoneme, between syllables, across words, and from phrase to phrase. Disruptions in continuity are pauses, hesitations, repetitions, prolongations, interjections, incomplete phrases, dysrhythmic phonations that also break fluency.

Rate of speech: Rate of speech is measured either by the number of syllables uttered per second, or syllable/words uttered per minute. Very slow or very fast rate of speech also disrupts normal fluency.

Despite this definition of normal fluency, it is seen that even the so-called normal speakers tend to be diffluent sometimes in conditions of fear, stress, etc. Sometimes we tend to speak slowly for emphasis of our speech, or we may pause to attract the attention of our listeners to the next word. But these are normal disruptions and are not called disorders of fluency.

The different types of disfluent behaviors seen include stuttering like disflencies (SLDs) and other disfluencies (ODs) which are generally seen in all individuals but more common in very young children when developing speech and language. The SLDs consist of sound/syllable repetition, prolongation and blocks or articulatory fixations and ODs comprise audible or inaudible pauses, hesitations and interjections. These ODs are seen more frequently in young children during the preschool age, as a part of their normal development of fluency. This is called **Normal non-fluency (NNF)** and is related to the acquisition of speech and language. The presence of ODs and SLDs are the primary differentiating feature of NNF and **Stuttering.**

3.3.4.1 Stuttering

Stuttering is a fluency disorder characterized by repetitions, prolongations, and blocks or articulatory fixations and may also be characterized by involuntary body movements or secondaries. Stuttering usually begins in childhood. The onset is gradual. It may begin following shock, fright or illness. It may also be a result of imitation. Conflict also results in stuttering. The total incidence of stuttering amounts to around 5 percent of the general population, and its prevalence is highest in preschool years. Males are seen to show more stuttering than females. This may be due to the delayed myelinization in males in comparison with females, or due to the parental pressures being more on the male child. Stuttering is seen more in families of persons with stuttering than in families of persons with no stuttering. Also, high incidence of stuttering has been reported in twins, especially monozygotic twins.

Characteristic features of stuttering

The most commonly observed characteristic features include: sound syllable and mono-syllabic word repetitions, dysrhythmic phonations, tense pauses, prolongations, abnormally fast speaking rate, abnormal sounds or pitch level, and tensing of muscle groups that are not involved with speech production. In addition it is observed that the disfluencies are seen more in initial words in an utterance, more on content words than on function words and more in the words beginning with consonants than with vowels

Secondary behaviors that occur with stuttering

Secondary behaviors are those behaviors which do not involve the speech mechanism but are seen during stuttering. They reflect anxiety. These are some of the secondary behaviors seen in PWS: jerky or other movements of the head, blinking of eyes or wrinkling of forehead, distortions of the mouth, quivering of the nostrils, facial grimaces, and abnormal limb movements e.g. tapping of foot.

In addition, PWS may exhibit avoidance tendencies like maintaining poor eye contact with the listener, avoiding speaking situations. They may also exhibit anxiety and tension during speaking like sweating, shivering, raise of heart beat etc.

Causes of stuttering:

Various theories proposed tell us about the probable causes and factors affecting and precipitating stuttering. In olden times, the “tongue” was supposed to be the cause for stuttering. Later several theories were postulated for stuttering.

Cerebral Dominance Theory: Orton & Travis (1978) proposed that stuttering was due to failure of establishment of dominance of one cerebral hemisphere over another. Some authors also found stuttering in children forced to change their handedness.

Demands – Capacities Model: Starkweather (1990) found that stuttering was caused by the discrepancy between the demands placed on the child and his capacities to fulfill these demands.

Breakdown Hypothesis: These theories propose an organic cause for stuttering. They believe that stuttering is caused by constitutional predisposition already present in the child, which is aggravated by environmental factors like stress, fear, etc.

Repressed Needs Hypothesis: It proposes stuttering as a neurotic symptom which is rooted deeply in unconscious needs. Stuttering, according to this hypothesis, is an integrated, purposeful activity that a person performs because he unconsciously wishes to do so.

Approach Avoidance Conflict/Laerning theories: According to this concept, stuttering is a learnt behavior, which is acquired by conditioning. Primary stuttering is learnt by a process called classical conditioning, while secondary stuttering is caused by operant conditioning.

3.3.4.2 Cluttering

Cluttering is a fluency disorder, frequently co-occurring with stuttering characterized by the person's unawareness of his disorder, a short attention span, and disturbances in perception, articulation, and formulation of speech processes preparatory to speech and based on a hereditary predisposition. Cluttering is the verbal manifestation of

central language imbalance, which affects all channels of communication (reading, writing, musicality and behavior in general (Weiss, 1964).

Etiology: The exact etiology of cluttering is not known. Some of the factors reported by authors include (a) immature or impaired central nervous system, and (b) incongruity between thinking and speaking.

Characteristics of cluttering

Obligatory symptoms: Weiss proposed 5 obligatory symptoms including excessive repetitions, lack of awareness, weakness of concentration and shortness of attention span, perceptual weakness and poorly organized thinking.

Additional symptoms include excessive speech rate, excessive Interjections like the use of and, or, um, etc., vowel stops (pauses before initial vowel), articulatory and motor disabilities, grammatical difficulties, vocal monotony, jerky respiration and delayed speech development.

Associated symptoms include reading disorder, writing disorder, lack of rhythmical and musical ability, restlessness and hyperactivity, deviations in EEG findings, lag in maturation and heredity and genetic factors

3.3.4.3 Neurogenic stuttering

Neurogenic stuttering is associated with neurological events. It is acquired, and can result from damage to central nervous system. Stuttering should be labeled as acquired only when the onset of the

disfluent speech occurs following some neurological trauma or insult. It is also termed as SAAND, that is, stuttering associated with acquired neurological disorders. It is generally seen in adults due to stroke, tumors, or other neural conditions.

Speech characteristics of neurogenic acquired stuttering

1) Repetitions and prolongations are not restricted to initial syllables
2) The phonemic foci of disfluencies may differ from developmental stuttering
3) There is no particular relationship between disfluency and the grammatical function of word, so that small function words may be as troublesome as content words.
4) Self-formulated speech may be easier than automatic speech tasks
5) There is no adaptation effect
6) The speaker may not necessarily be anxious about his stuttering
7) There may not be any secondary symptomatology such as facial grimacing and fist clenching
8) Absence of situational or individual variability
9) No change in stuttering under fluency- inducing conditions like singing, shadowing and choral reading, etc.

3.4 Language disorders

Language development can be arrested/hindered by several factors such as brain damage caused during prenatal, natal and postnatal period leading to conditions like mental retardation, cerebral palsy, dysphasia/aphasia in childhood. It could also be affected due to sensory defects such as congenital hearing impairment and oral structural defects such as cleft palate. Severe socio-emotional disorders in

childhood like autism could also bring about delayed and deviant language development. Some children also exhibit learning disabilities leading to serious academic failures during schooling. Such conditions could be evidenced by few or several of the following speech and language characteristics/manifestations during infancy to adolescence/adulthood.

Lack of onset of speech or delay in the onset of speech is seen as partitional/total mutism with limited vocalization or total lack of speech. With delayed onset, if speech is developed, abnormal, inadequate and/or deviant language behavior is evidenced such as any of the following:

- Incorrect/inappropriate speech characteristics including voice, articulation and prosodic abnormalities
- Limited speech output; failure to thrive, progress with age in terms of stages of language development, length and complexity variety of utterances, inadequate mastery of grammatical inflections, inadequate acquisition of grammatical categories of nouns, verbs, adjectives, adverbs, prepositions, etc.
- Atypical vocabulary and grammatical development seen as patchy acquisition of vocabulary on a single or a few selected topics (e.g., only nouns as names of objects, interest/fascination with numbers, alphabet, dates etc)
- Stereotyped and repetitive use of language such as echolalia, use of stock utterances of few topics only and repeated questions and others

- Use of neologisms (new and nonexistent words in the language of exposure) who's meaning is obscure to others
- Lack of spontaneous and responsive speech seen as an inability/ failure to initiate and sustain conversation indicating problems with interpersonal, two way communications in a given situation
- Difficulties with speech comprehension seen in the failure to comply with requests, questions, and an inability to derive meaning from others' speech or failure to understand others' speech etc.
- Abnormalities in use of nonverbal aspects in communication as in the poverty of facial expressions and gestures as pointing, showing, impaired emotion recognition and expression, failure to understand basic gestures and facial expression etc.
- Difficulties with reading and/or writing
- Poor scholastic achievement

Observation of any of these features by parents/teachers, doctors or any other professionals warrants a consultation with speech-language pathologist and audiologist. Several of these atypical features of language manifestations are found in specific combinations in the different clinical conditions of disabilities as mentioned earlier.

The term language disorder therefore applies to a heterogeneous group of individuals who show diverse problems in the acquisition (developing) of comprehension (understanding) or production (expression) and use of various aspects of language singly or in different permutations and combinations.

Language disordered individuals (children and adults) have major problems in language:

- Poor listening skills
- Limited skills in understanding spoken language
- Limited expressive language skills
- Limited or lack of use of morphological elements of language
- Limited use of sentence structures
- Inappropriate use of language
- Deficient use of language
- Limited conversational skills
- Limited skills in narrating experiences

In addition, certain language-disordered children and adults might also manifest some abnormal patterns of language, limited cognitive skills and later, problems of reading and writing.

Now let us see some of the most common types of childhood conditions associated with variety of language disorders.

3.4.1 Mental retardation

Learning to talk is a complicated task. It is not easy to achieve the proper blend of message content form and appropriate social use. The term “mental retardation” refers to the nature of the condition as lowered intellectual capacity or below average mental capacity.

Children with mental retardation have immature, arrested or delayed intellectual development. They are slow in all areas of development including motor skills, social and behavioral aspects, self-care and language, and in all forms of adaptive (coping) behavior. There is a

wide range in the effect and extent of retardation from very mild or borderline deficiency to profound impairment.

Mental retardation has many causes. In some children, retardation may be genetic such as in Down's syndrome. A number of other factors such as infections, trauma, metabolic disorders etc, during prenatal, natal and post natal period can cause mental retardation.

The language of the child who is retarded may be limited in every aspect, though the extent of the deficiency depends upon the degree of retardation and the quality of special educational services offered and the age at which the child receive them.

Children with mental retardation are generally slow in learning the speech sounds of the language. Once learned, they are likely to show many errors of articulation. Some of the general characteristics of speech and language include:

- Omit, substitute or distort speech sounds
- Morphologic features are frequently missing
- Slow in saying their first words
- Produce fewer words
- Learn new words at a slower rate and have less varied, more concrete vocabulary i.e., names of objects etc than abstract concepts such as feelings, emotions etc.
- Slower in combining words into phrases and sentences
- Experience difficulty in both understanding and producing various syntactic structures of language such as long sentences containing relative clauses etc.

- Sentence structures are limited to simple forms
- The pragmatic problems of children with mental retardation can be striking

The following problems are often noticed.

- These children are usually very reluctant to use the learned language skills freely or in social situations.
- They show difficulty in initiating conversation and maintaining a topic of conversation.
- They often give abrupt, short answers to questions and responses may be inappropriate to time, place and person.

A large body of research has shown that most children with retardation do not show any abnormal or unique types of languages but their language resembles that of younger children. That is they use language forms similar to those exhibited by normal children at an earlier age equivalent to their mental age rather than chronological age. Though the progress is slow, the child follows the same sequence of language development as the non-retarded.

3.4.3 Autism

Originally described by a child psychiatrist named Leo Kanner (1941), autism is a profound emotional and behavioral disorder. It starts in early childhood, typically before the age of 3 years and sometimes later. The dominant feature of many peculiar nonverbal and verbal behaviors of the infant with autism is a serious lack of appropriate social behavior, desire to relate to people, including parents.

While a normal infant enjoys looking at the mothers face or her smile, the infant with autism fixes his gaze on the mother's earring or key. When hugged by others, the child stiffens. The child with autism prefers solitude to social contacts. The disturbing uniqueness of the child with autism is apparent in many aspects.

- The child may want to be left alone with some objects s/he finds endlessly fascinating.
- The child may not point to things or ask for help, but wants very little from people.
- The child is typically self absorbed or lost in some apparently meaningless physical activity.
- The child may spend hours in a corner arranging and rearranging blocks in the same routine a hundred times.

They may show unwanted what are called self stimulatory behaviors (SSB) as follows:

- Child with autism do not show imaginative play like other children.
- The child may hold hands in front of the face and make snake like movements for hours on end.
- An entire morning may be spent sitting on the floor and rocking back and forth.
- The child with autism is deeply disturbed by a change in the routine. Everything must be the same, day after day.

In addition, some (not all) children with autism show:

- Self-injurious behaviors, i.e., they are prone to hurt themselves constantly as nail biting, scratching, etc.
- They may bang their heads against walls, pull their hair etc.

- Some children show talent in some areas such as they may have excellent memory for numbers or may be able to draw extremely well etc.

In the beginning, the parents are likely to suspect deafness, because the infant may not respond to voice or speech. But soon they realize that their child prefers nonhuman sounds and noises to human speech.

Profound **language disturbances** are a major characteristic of autism. The unique language and communication of children with autism include the following characteristics:

- On their own, most children with autism do not learn language at the usual rate.
- They do not use whatever they have learned to communicate with others.
- The child with autism is more likely to learn words that refer to objects rather than those that refer to concepts, people or human relations.
- Some apparently difficult words are more easily acquired than those that are easier to learn. The child may correctly use words like square, hexagon but not home, sister etc.
- The words learnt are used in a restricted sense for eg., the child may use the word ‘ ball ’ to refer to only his/her own red ball of medium size. A smaller or bigger or a blue ball is not at all a ball for the child.
- One of the most striking and early language problems is **echolalia.** Echolalia is parrot like repetition of what others say.

Child may echo, TV commercials, words phrases, questions picked up from adult's utterances.

- Children with autism generally speak in short, simple sentences and tend to omit various grammatical features such as ' and', ' is', etc.
- The sentences may have wrong word order. A child may say, "Table on Hats" or "Put toy is in".
- A notable aspect of his language is pronoun reversal. They typically refer to themselves as "you", "he" or "she" and others as "I".
- Pragmatic deficits such as use of inappropriate language, lack of eye contact, lack of initiation of conversation and other deficits are very striking in children with autism.

3.4.3 Developmental Aphasia / Specific Language Impairment

Some children start off to a bad start on the road of life by having birth injuries. Others start well but fall victim to severe illnesses or accidents along the way. When the brain is damaged by any trauma, there is always a possibility of speech and language delay.

Aphasia is a language disorder that results from brain injury where the person loses some or most of his/her language.

Some children have a developmental language disorder that cannot be explained by deficits in sensory perceptions, intellectual abilities, or motor or social emotional functioning. These children are often referred to as having developmental aphasia or specific language impairment as it is commonly called in recent times. Their difficulties with language

appear as they develop and parents begin to notice problems with their language development around the age of 2 years.

- These children show difficulty in listening and understanding spoken language.
- These children use fewer words and have trouble in communicating their wants and needs. They often sound telegraphic in their speech as they use nouns and verbs but not grammatical morphemes.

The exact cause remains a mystery. Current information suggests that the brains of language-disordered children develop differently from those of most people.

3.4.4 Acquired Childhood Aphasia (ACA)

Children who are developing normally can lose language skills because of brain injury. These are the children who acquire aphasia. ACA is thus a language disorder in children secondary to brain insult, but appearing after a period of normal language development. Again, the brain insult may be the result of head injury, cerebral infections such as meningitis, convulsion disorder etc.

Most children with ACA exhibit non-fluent aphasia, which is characterized by:

- Sparse and effortful speech
- Impairment in auditory comprehension
- Syntactic problems such as simplified syntax
- Impairment in naming

- Disturbances in reading & writing

Clinical features of ACA are manifested differently than those of adult aphasia.

3.4.5 Attention deficit disorder (ADD)

Children with ADD are characterized by inattention and impulsivity and hyperactivity occurs in a subset of ADHD children. Language disorders are often seen in association with ADD.

Children with ADD are highly distractible, finding it difficult to focus and sustain their attention and to direct their activities to the task at hand. The distractibility and impulsivity not only interferes in schoolwork, but also in games and conversation.

Children with ADD may show a delay in acquisition of language, with all aspects of language being impaired. Children with ADD often shift from topic to topic without warning and interrupt others who are trying to talk. They appear to have greater difficulty with the specific aspects of language use.

We saw some of the most striking features of language disorders seen in children with autism, mental retardation, neurological impairment etc. Many other factors are either associated with or suspected to cause language disorders in children. Children with low birth weight, often seen in premature children, face the risk of delayed language development. Children of alcoholic mothers also face the same risk.

Child who experiences reduced social contact may also show a slower than normal rate of language acquisition.

3.4.6 Cerebral palsy (CP)

Some children, as a result of brain damage acquired in prenatal, natal or early postnatal life, have motor or physical defect known as cerebral palsy. This is a complex entity and has been difficult to define adequately. Definition of cerebral palsy is of a motor disorder, which is manifestation of non-progressive brain damage sustained in early life. Expressed differently, it is a non-progressive motor disorder consequent upon early brain damage. Scholars recognize that although the original brain damage is accepted as non-progressive, the clinical picture will usually be modified with age.

Causes of cerebral palsy

The cause of cerebral palsy is thought to be multi-factorial and associations with many events have been demonstrated. The most important of these intra-uterine causes in early pregnancy, threatened abortions, generalized maternal illness, episode of toxicity in the third trimester of pregnancy, antepartum hemorrhage, intra-uterine growth retardation, premature onset of labor and difficulties during labor and delivery itself. Various events in post natal life have also been shown statistically to be associated with the development of cerebral palsy, including perinatal respiratory difficulties, hypoglycemia, hypothermia, infection of the central nervous system, severe seizures in early infancy, high levels of bilirubin in the neonatal period, and brain injury. Many of these are common, especially those occurring in the antenatal period, but seldom cause any form of brain damage.

A detailed and careful record of the pregnancy, delivery and postnatal care of any child suspected of having cerebral palsy is essential. However, it is important not to attribute automatically the cause of a child's cerebral palsy to any one factor but to recognize that the etiology in many is uncertain. In some forms, there is stronger etiological association than in others, and in some cerebral palsy may be the result of a genetically determined malformation of the brain.

Classification of cerebral palsy

The clinical classification of cerebral palsy is based on the major type patterns of motor dysfunction that are seen in individual children: hemiplegia, diplegia, quadriplegia, spastic, dyskinesia, ataxia and mixed types. Children with cerebral palsy are often commonly referred to as "spastics".

Hemiplegia: The arm is usually affected more than the leg and one of the earliest signs in hemiplegia may be abnormal fisting in the affected hand.

Quadriparesis/ Quadriplegia: This is sometimes referred to as 'double hemiplegia'. Most children so affected ultimately have very severe spasticity and the arms are more affected than legs. While the term implies that all four limbs are affected this is seldom in a symmetrical fashion. The etiological factors that might be present in this variety of CP are extensive and similar to those in hemiplegia. This is often associated with profound mental retardation.

Ataxic diplegia: Diplegia associated with added cerebellar impairment is also recognized. It has been suggested that this condition may be

genetically determined in some children. Hypotonia is an early feature but improves slowly with age. There is marked delay in motor development. When early grasping takes place there is a definite tremor, which should suggest cerebellar dysfunction. Spasticity is not as marked as in more well known diplegia. The gait will be broad based and stamping.

Dyskinetic cerebral palsy: The characteristic feature of this form of cerebral palsy is irregular and involuntary movements of a number of muscle groups in the body. While some of these are present only on movement, some may be virtually continuous. The term **athetoid** is often used. This describes the typically slow and writhing movements, more commonly of distal muscles. In many children there are also quick and jerky movements, predominantly in the proximal muscles, so called chorea. In addition, slow, often writhing movements may affect the muscles of the trunk and is called as dystonia.

Mixed cerebral palsy: The diagnosis of mixed cerebral palsy is usually reserved for children who cannot be placed into any of other specific categories.

Problems associated with cerebral palsy: CP is often associated with **v**ision and hearing problems, alterations in sensation and perception, speech and language disorders, learning disabilities, reduced intelligence, epilepsy and emotional problems.

Speech and language disorders in cerebral palsy

The age of acquisition of meaningful expressive language varies greatly from soon after one year to two and a half years in child of normal

intelligence. Receptive language or comprehension will significantly precede speech. There are several recognized patterns of speech delay. The range may be from a persistence of infantile speech patterns with poor articulation but normal comprehension, or an apparent inability to decode incoming auditory stimuli. However, the commonest cause of delayed speech development will be a general intellectual impairment. In clinical practice, speech delay may be one of the most common presentations of the developmental delay.

Deafness is the second largest cause of speech and language disorders. Severe cerebral palsy, particularly spastic quadriparesis and dyskinetic cerebral palsy, is often associated with a speech and language disorder. In addition, children with severe physical handicap may suffer, as already described, from a degree of deprivation such that language development may be markedly impaired. Language development will be impaired even in a normal child who suffers social deprivation. As part of the surveillance of the development of all children, patterns of speech development are carefully monitored. The early recognition of delay is important along with investigations as to its cause. It is especially important, as speech delay may be an indicator of an underlying treatable condition.

3.5 Let us sum up

In this unit we have learnt about the varieties of different speech and language disorders. We learnt about speech disorders like articulation, voice and fluency disorders and language disorders caused by mental retardation, autism, specific language impairment, cerebral palsy etc.

We also learnt about the speech and language characteristics of these disorders in children and adults.

3.6 Unit end exercises

1) What are speech and language disorders? Give examples.
2) Mention the basic features of mental retardation and differentiate it from autism.
3) Define specific language impairment
4) What are the characteristics of acquired childhood aphasia?
5) Differentiate between stuttering and cluttering.
6) Write a short note on voice disorders
7) Write a short note on cerebral palsy
8) List the speech and language characteristics of Autism
9) What is misarticulation? Mention the causative factors for articulation disorders.

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Unit 4: Assessment of speech disorders

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Unit 4: Assessment of speech disorders

Objectives

After studying this unit the student would

- learn assessment procedures for various types of speech disorders
- be able to differentially diagnose different types of speech disorders

4.1 Introduction

As per American Speech and Hearing Association's (ASHA) knowledge competency standards for the assessment of communication disorders, speech-language clinicians are required to consider the "etiologies, characteristics, anatomical/physiological, acoustic, psychological, developmental, linguistic and cultural correlates" (ASHA Standards, 2008b). Assessment or evaluation could be done using qualitative and quantitative measures. Qualitative methods are usually carried with no/ minimal instrumentation. Quantitative evaluation facilitates better diagnosis and rehabilitation methods as it involves the use of instrumentation.

The main objectives of assessment could be screening children or adults for various problems and do a detailed diagnostic evaluation when they fail in the screening test. Newborn screening, school screening and camps are places where individuals are quickly screened with some criterion referenced tools and only when someone fails in that, more elaborate diagnostic evaluations are undertaken to check for the severity

of the problem, associated conditions, to make prognostic appraisal about the condition in order to plan management.

4.2 Need for assessment

The need for assessment in general is manifold. These, from the clinical point of view include:

(a) Confirmation of the presence of the problem
(b) Differential diagnosis
(c) Describe the nature of the problem and nature of the individual with problem
(d) Predicting severity of the problem
(e) Describe the co-morbidity of the disorder with other disorders and conditions
(f) Determining the course of the problem
(g) Making a prognostic appraisal
(h) Choosing appropriate management procedures
(i) Pre and post therapy comparisons to assess improvement
(j) Research purposes

From the research point of view, the need for assessment is basically to understand the nature of the problem, develop models and theories to explain the phenomena and to develop evidence based therapeutic procedures.

4.3 Objectives of assessment

A set of evaluation objectives for the assessment in case of adult, adolescent, and school-age children proposed include:

(1) Establishing rapport with the client

(2) Obtaining background and case history information

(3) Describing the client's speech characteristics

(4) Understanding the client's home, social, and work environment

(5) Identifying conditions and variables affecting the client's speech

(6) Understanding the impact of communication disorder on the individual's life

(7) Providing information about the nature of the problem and its treatment

(8) Recommending a plan of action for the client.

4.4 Tools for assessment

It is very important to have various tools which are very essential for the diagnosis and differential diagnosis of the problem for various aspects of speech and language suitable for various age, gender and linguistic groups. As far as possible any tool for assessment should be, objective, reliable, subject-independent, and permit differentiation of conditions. There are many tools for assessment of disorders like the rating scales, instruments, protocols, checklists and questionnaires to evaluate various aspects of speech, language and communication aspects in children and adults. These will be described below under different disorders assessed for the sake of convenience and easy of understanding.

Whatever may be the purpose of assessment, the clinician should address two basic aspects in assessment:

(a) The speech/language behaviour

(b) The concerned individuals (child or adult with the disorder).

For the sake of convenience some of the commonly used tools are listed under the different domains assessed and it is advisable for the practicing clinicians to keep these protocols or assessment tools and judiciously use them for a comprehensive assessment of individual clients depending on the need. Some of the important tools for assessment in addition to proper clinical training in observation and interview skills to gather appropriate information are:

- A thorough case history proforma for children and adults with different disorders
- Norm/criterion referenced culture and language appropriate tools and test procedures

4.4.1 Case history

It is recommended to use a detailed history covering various factors from the initial onset, development, and the current status of the problem. In case of children, the history should include details of the home environment and family background (ex., genetic factors, family dynamics, and attitudes), and variability of the conditions. Also important is the information about the nature and effects of past treatments. The referral information is important for the treatment process. Self-referrals could indicate good prognosis in terms of courage and resolve to undergo treatment, where foundations for change are already established. In contrast, if the client is consulting mainly to please others such as an employer or family member who may have urged the client to seek help, then the process could already be jeopardized. In such cases the clinician has to devote more time educating both the client and those who referred him or her about the

nature of treatment, and the critical matter of the client's independent motivation and readiness to undertake the arduous process of change. There are published proformae available and the practicing clinicians could adapt the suitable ones for their use.

The potential areas to be included during the initial interview and case history with the client are:

(a) Identifying information
(b) History of the problem (age and nature of onset and development)
(c) Family history of communication problems and status
(d) Treatment history (earlier treatments, its nature, duration and impact)
(e) Current status of the problem (whether the problem has increased/ decreased/ fluctuating/ static
(f) Any other associated speech, language, hearing disorders, or learning disability
(g) Perspectives of the client and significant others regarding the problem
(h) Impact of the disability on quality of life of the individual and the family

After collecting a detailed history of the problem, it is essential to collect a representative speech sample from the individual in order to calculate various measures of the behavior. It is necessary to include different types of speech samples (reading, narration, conversation and writing).

4.4.2 Tests or instruments

There are various tests/tools or equipments/instruments to measure various parameters of speech. These are described under the respective heads below.

4.5 Assessment of voice disorders

Because so many things can affect vocal health, investigating a voice problem is a complex process. Detailed history covering voice usage in daily life is important. The other relevant information would include:

- relevant medical history
- vocal technique in speaking
- amount and kind of everyday voice use
- how vocal problems are affecting everyday life and performance
- general lifestyle and its impact on the voice
- amount of singing/acting/story-telling, etc. per day/week
- vocal technique in performance
- style of singing, nature of performance
- history of performing during illness
- performance anxiety and emotional connections with the voice
- performing in background noise. e.g., singing with amplified instruments, singing in a big choir
- extreme or extended voice use—screaming, character voices, etc.
- history of vocal training

4.5.1 Assessment of respiratory system

Voice is produced on the expiratory phase of respiration and hence, respiration is a vital and important pre-requisite for voice production.

The efficient management of an adequate air supply is a basic prerequisite for normal speech. Hence, it is necessary to evaluate the functions of respiratory system to differentiate between normal and abnormal conditions.

4.5.1.1 Qualitative Measures

Usually when assessing the spontaneous speech and/reading tasks, the type of respiratory pattern the patient/client uses should be noted. Deviations from normal, in either direction may be due to an underlying inefficient respiratory pattern or a lack of coordination between inspiration and expiration.

4.5.1.2 Type of breathing

1. **Clavicular breathing** involves the use of secondary/accessory muscles (upper thoracic and neck muscles) for respiration. This results in weak, shallow respiration and therefore, poor respiratory support for voice and speech production. Many hyper-functional voice cases use this inefficient form of breathing (Haynes, 1992).

2. **Thoracic breathing** is characterized by expansion of the mid thoracic region. This is the most commonly used breathing pattern that should be adequate to support most speaking situations. It may not be sufficient to support the professional demands of elite vocal performers like singers and actors.

3. **Diaphragmatic/Abdominal breathing** involve thoracic enlargement by expansion of the lower thoracic and abdominal cavities during respiration. This pattern allows for the greatest

exchange of air during the respiratory cycle, while being a mechanically efficient form of breathing. It is particularly useful for those who make heavy demands on the respiratory system for singing, acting, etc., (Boone & McFarlane, 1988; Prater & Swift, 1984).

4.5.1.3 Pattern of breathing

1. **Shallow breathing** allows for little storage of air in the system and hence, results in poor control of voice or speech.
2. **Deep breathing** involves maximal utilization of the respiratory mechanism through thoracic or diaphragmatic breathing.

4.5.1.4 Speech tasks

1. **Maximum phonation duration** refers to the maximum time a subject can sustain a tone on one breath. Usually normal adult subjects would sustain a vowel for >15 seconds and children about >10 seconds. However, these values may vary considerably between people, among age groups and as a function of trials. Short maximum phonation time reflects inefficiency of the phonatory or respiratory system. Increased values could be noted in efficient voice users and / professional voice users.
2. **S/Z ratio** is the ratio of maximum sustained phonation time of /s/ to maximum sustained phonation time of /z/. A normal speaker would be expected to sustain both the voiceless /s/ and the voiced /z/ for approximately equal durations, resulting in a ratio of 1. The normal range is 0.9 to 1.2. However, presence of disturbance of vocal fold vibratory behavior and/or inability to close the glottis

leads to reduced /z/ duration and the consequent S/Z ratio becomes increasingly high.

4.5.1.5 Quantitative measures (Aerodynamic measures)

Vital capacity is the maximum amount/volume of air that can be expelled after a deep inhalation and is expressed in terms cubic centimeters/milli liters or liters. Factors like, age, gender, height, posture, health, life-style, practice, activity, etc. affect vital capacity to a considerable extent. It is a basic indicator of respiratory ability and amount of air available for voice production. Generally vital capacity in normal adults ranges from 1500 - 4000 ml (cc). Decreased vital capacity is noticed in conditions of respiratory abnormalities. Persons with good physical fitness, elite vocal performers (singers, actors) would usually have increased vital capacities.

Mean Air Flow Rate (MAFR) is the amount/volume of air expelled per unit time during phonation at a comfortable pitch and loudness. It is usually indicative of the coordination between respiratory and laryngeal mechanism. Normative values range between 80 ml (cc)/sec to 200 ml (cc)/sec. MAFR is reduced in hyper-functional voice disorders and increased in hypo-functional voice disorder conditions. MAFR could be inferred only when vital capacity is normal.

4.5.2 Evaluating functions of laryngeal system

Vocal folds, a multi-layered structure, are capable of vibrating in different modes simultaneously and are responsible for production of voice. Since voice is a multi-dimensional entity, it could be analyzed/ assessed in different domains.

Voice encompasses on physical domain - frequency, intensity, duration, harmonics, periodicity of vocal fold vibrations, and on psycho-acoustic domain - pitch, loudness, quality, and resonance. Hence, voice could be assessed both qualitatively and quantitatively.

4.5.2.1 Qualitative assessment

Qualitative assessment of voice usually involves analyzing the psycho-acoustic/ perceptual correlates of voice - pitch, loudness and quality. Perceptual analysis would usually involve the use of rating scales.

4.5.2.2 Assessment of pitch

Pitch is the psychological correlate of frequency. Pitch is usually judged in correspondence with frequency as, average frequency is average pitch, high frequency is high pitch and low frequency is low pitch. Assessment of pitch includes ascertaining pitch disturbances and quantifying the disturbances using rating scales. Pitch is higher in children, lower in adult males and in between in adult females. Females have a pitch range of 2 - 2½ octaves, males 1 - 1½ octaves and children about 3 octaves. **Total pitch range** is an important index of laryngeal health as it is one of the first parameters of vocal function to be affected in voice disorders. Pitch should be stable during phonation. Pathological changes in vocal folds could affect pitch stability. **Pitch breaks** refer to momentary pauses/gaps/breaks in pitch during sustained productions of vowels. Pitch break is an indicator of discontinuous vocal fold vibration.

4.5.2.3 Assessment of loudness

The psychological correlate of intensity is loudness. Changes in loudness are related to intensity changes as, high intensity means loud voice, average intensity is moderately loud voice and low intensity is soft voice. **Loudness range** is the difference between the lowest and highest levels of loudness and would quantify the dynamic range of loudness. Tasks like, spontaneous speech, reading of a standard passage, counting of numbers 1-9 with 1 being softest and 9 being loudest (gradual increase in loudness with the ascending values of numbers) would aid in quantifying the loudness range. 7-point categorical/ equal appearing intervals (EAI) rating scale may be applied to describe the loudness range. **Loudness variability** is the smooth variation/fluctuation in loudness in contextual speech. Variations in loudness contribute to expressive speech.

4.5.2.4 Assessment of vocal/voice quality

Vocal quality is the perceptual correlate of harmonics, resonance and symmetry of vocal fold vibrations. Characterization of voice quality is one of the key facets of perceptual assessment of voice and an integral aspect of any voice evaluation. Normal vocal quality encompasses many dimensions related to physical, physiological, acoustic, emotional and social factors. Normal vocal quality is a voice with no apparent pathology and no unusual voice characteristics or habits. Common categorization of disorders of vocal/voice quality includes hoarse, harsh and breathy.

Breathy quality: When pulmonary air stream is passed through the open glottis without the laryngeal modification, voice is perceived to be

breathy. Hypo-functional conditions of vocal folds results in breathy voice quality.

Harsh quality: Voice is perceived as harsh when vocal folds are hyper-adductive and result in excessive low pitch productions.

Hoarse quality: Hoarseness is a combination of both harsh and breathy qualities.

Terms such as creaky, tense, husky, guttural, strained, etc. are also used to describe the vocal quality. Appropriate rating scales would enable further quantification of extent of vocal quality deviancy. However, loudness and quality of voice are relative in nature and controversy exists among researchers regarding their measurements.

4.5.2.5 Quantitative assessment (acoustic analyses)

The use of instrumentation in voice analyses and extraction of physical parameters of voice is also known as acoustic analyses. Although acoustic signs are, at best, imperfect measures of underlying vocal fold physiology, there is a great deal of correspondence between the physiology and acoustics and much can be inferred about physiology based on acoustic analyses. Moreover, acoustic parameters are probably easiest to record and analyze objectively. Acoustic analysis involves the extraction of (a) fundamental frequency and related measures, (b) amplitude/intensity and related measures, (c) perturbation measures of frequency and amplitude, and (d) other measures such as tremors and soft phonation index.

A. Fundamental frequency and its related measures

a. **Fundamental frequency** is the frequency at the fundamental mode of vocal fold vibration. However, for practical measurements, habitual frequency is considered. Fundamental frequency of voice (F0) changes with age. Lowering of F0 is gradual till the onset of puberty after which there is a sudden marked lowering of F0. The fundamental values are distinguished by gender, only after the age of 11 years, although small gender difference might occur before that age as depicted in Table 15.

Mean F0 for males should be between 80 Hz and 180 Hz whereas for females it should be between 180 Hz and 280 Hz. Pathology may affect the vibrating frequency, with the result that males or females will produce either too high or too low a frequency.

Table 15: Mean F0 (Hz) for different age groups in males & females

Age group in years	Males	Females
4-7	233	248
7-11	255	238
11-13	247	240
14-15	177	244
16-25	139	244
26-35	142	230
36-45	147	243
46-55	150	235

b. **Frequency range in phonation and speech (Hz**) is the difference between the highest and lowest values of F0 in phonation and contextual speech. Humans are capable of producing a wide variety of acoustic signals and therefore, variations in F0 are acceptable.

Variation is limited during phonation task but a wide range is obtained during speaking and reading. Normal males should be able to produce a phonation range of 1 - 1½ octaves and females 2 - 2½ octaves.

c. **Frequency perturbation measures -** Perturbations in frequency indicate peak-peak variations in frequency. Frequency or (period) perturbation, commonly called jitter, is the variability of fundamental frequency (reciprocally, of the fundamental period) from one cycle to the next. Jitter measurements are concerned with short-term variation. **Jitter percent** measures the very short-term cycle-cycle irregularity of pitch period of voice and the normal value is **3%**.

B. Amplitude/ -intensity and its related parameters

Intensity is the description of power per unit area and expressed in decibels (dB). Vocal intensity is dependent on the interaction of subglottal pressure, the biomechanics and aerodynamics at the level of the vocal folds and the status of the vocal tract. In voice assessment intensity level of sustained phonation and speech are measured. The intensity levels of connected speech are quite different from those of sustained phonation or of isolated monosyllables.

a. **Mean intensity (dB*)*** is the sound pressure level and individual is capable of producing during phonation at comfort level.
b. ***Intensity Range (dB)*** is the difference between the maximum and the minimum SPL that an individual can produce during phonation or contextual speech. It is about 50-60 dB during conversational speech.

c. **Amplitude perturbation variations** - Stability of vocal signal could be assessed by amplitude variations/perturbations. Measures of amplitude perturbation generally called ***shimmer*** are analogous to those of fundamental frequency perturbation measures. Like frequency perturbation scores, shimmer values serve to quantify short-term amplitude instability that does not alter the qualitative features of the vocal waveform. **Shimmer (Sh dB)** is the period-period (very short-term) variability of the peak-peak amplitude within the analyzed voice sample and the normal value is **± 3 dB.**

4.6 Evaluating functions of Resonatory system

4.6.1 Qualitative assessment of resonance

Resonance, along with harmonics, symmetry of vocal fold vibrations and efficient control of subglottal pressure ascertains the quality of voice and is chiefly determined by the supralaryngeal structures. Abnormalities in resonance are classified as (a) hyper-nasality, (b) hyponasality, (c) mixed nasality, (d) cul-de-sac resonance, and (e) assimilated nasality.

Features like nasal emissions, facial (nasal) grimaces are noted. The defective resonance is then rated using an appropriate scale. The functions of resonatory system could be checked for its normalcy by some of the non-speech tasks like sucking, swallowing, and blowing of cheeks and balloon.

4.6.2 Quantitative assessment of resonance: This can be done by obtaining measures such as **TONAR** (The Oral and Nasal Airflow/ pressure

ratio), **Nasalance** - Nasal airflow to the total airflow, and Nasal to oral airflow ratio.

Traditionally, the major component of voice analysis dealt solely with a perceptual description of voice characteristics. Although perceptual characterization of voice is still an essential component of any voice diagnostics, it is no longer the only parameter. Instrumental measures help to verify the perceptual judgments and subjective hypotheses. Voice analysis has evolved into an objective domain owing to the advances in technology. Despite the technological advances, absolute quantification of voice is still elusive. The reasons for this could be innumerable factors related to the type of clinical set-up, availability of resources, expertise of clinician, time, patient factors, etc. But if the available assessment protocols are applied effectively and the results are interpreted with caution, correlating with the available resources, new avenues would emerge enabling better understanding of the mechanize of voice production.

Voice disorders can be classified according to the cause, or the parameters of voice as disorders of pitch, loudness and quality. The standards or norms have already been dealt in the earlier section.

4.7 Assessment of Articulation disorders

The articulatory system is assessed for both structure and function of speech mechanism including articulators. The assessment of articulation should involve the number of articulatory errors, type of errors (SODA), consistency of errors and speech intelligibility. The conditions of communication and status within the culture should also

be considered to judge articulation problems with regard to age, gender, socioeconomic status and cultural factors.There are different steps involved in the detailed assessment of articulation.

4.7.1 Orofacial examination: The clinician examines the client's facial and oral structures to rule out gross organic problems. The clinician checks for shape and mobility of lips, tongue and soft palate and general symmetry of facial structures. Hard and soft palates are viewed for signs of structural abnormalities like cleft palate (a hole in the palate). Sometimes examination may reveal submucous cleft, which is an opening in the palate covered by mucous membrane. Both the latter conditions are congenital abnormalities classified as resonance disorders giving rise to voice and articulation disorders among others.

4.7.2 Hearing screening: Hearing impairment is one of the important causes of articulation disorders. Hence, the client's hearing is screened using brief audiological screening procedure, failing which a detailed assessment is carried out.

4.7.3 Assessment of sound production: Conversational speech samples and standardized tests are the two major sources of information in articulation disorders. Conversational speech provides a natural means of assessing speech sound production. Several standardized tests of articulation are commonly available. E.g., Kannada diagnostic articulation test.

4.7.4 Articulation Tests - These can be classified as follows:

4.7.4.1 Screening Test: The purpose of this test is to decide whether the phonemic capacity of the individual is within the acceptable limits of

that particular age group. It consists of list of sounds that are frequently misarticulated. It can be used as quick screening procedure to find out whether the child has misarticulation or not.

4.7.4.2 Diagnostic Test: It is a detailed test which tests each phoneme in different positions and finds out the sounds that are misarticulated and it acts as baseline for therapy. E.g., Kannada Articulation Test.

4.7.4.3 Predictive Screening Test: This is to test whether the child requires therapy or not. Cut-off score is used to check this.

4.7.4.4 Stimulability Test: Visual and graphic cues are given to the child and if the child is not able to produce with cues, then the child is said to be not stimulable. The clinician provides the child's misarticulated sounds correctly and asks the child to imitate. If s/he imitates the sound correctly, then the child is said to be stimulable. This gives information on the outcome of the therapy. The child who is stimulable will have better prognosis compared to one who does not.

4.8 Assessment of Fluency disorders

Types of disruptions in the fluent speech help establish stuttering in a child. The presence of core features or the typical stuttering like disfluencies (SLDs, including sound/syllable repetitions, blocks and prolongations) would help distinguish a child with stuttering from a normally fluent child. The normally fluent children show more of part/whole word and phrase repetitions than sound syllable repetitions. Pauses (filled and unfilled) are more evident in normally fluent children than prolongations. Conture (2001) also reports that interjections and revisions are also more often seen in children with normal nonfluency.

However, all types of disfluencies may be present to varying extents in both children with stuttering and normal nonfluency.

4.8.1 Parameters assessed in fluency disorder: Stuttering is a multi-dimensional speech disorder affecting various aspects of communication and a comprehensive assessment is very crucial. The following are some of the areas of assessment to be undertaken.

4.8.1.1 Type of disfluency*:* Van Riper (1982) describes the "core behaviors" (SLDs) in stuttering as: repetitions (sound/syllable/part word repetitions until the following sound is produced), prolongations (sound continues but the articulators do not move, usually for more than half a second) and blocks (inappropriate stopping of voice/articulatory movements). Other types of disfluencies, known as normal disfluencies as they are seen in most of the individuals would include interjections, revisions, audible and inaudible pauses may also be observed. All of the above would seem involuntary and out of control.

4.8.1.2 Frequency of disfluencies*:* Individuals who stutter differ from each other on the frequency of stuttering. These are the number of times the disfluencies (generally the SLDs) are exhibited by an individual in a known length of sample. Usually the frequency of stuttering is greater than 5%. Higher the frequency more severe is the stuttering. There are different frequency measures that can be made on the disfluencies exhibited and the most commonly used is the percent syllables stuttered (%SS) or the syllables stuttered per minute (SSM). Following are some of the formulae adopted to calculate stuttering frequency in routine clinical evaluation.

$$\text{Frequency of disfluencies (SS/min)} = \frac{\text{Total no. of syllables stuttered in a minute}}{\text{Total no. of syllables spoken in a minute}}$$

$$\text{\% Words stuttered} = \frac{\text{Total no. of disfluencies}}{\text{Total no. of words spoken}} \times 100$$

$$\text{`\% Fluency frequency index} = \frac{\text{Total no. of fluent words spoken}}{\text{Total no. of words spoken}} \times 100$$

4.8.1.3 Percent disfluency is another measure of frequency of disfluency

$$\text{Percent disfluency} = \frac{\text{Total number of disfluencies}}{\text{Total number of words}} \times 100$$

The following fluency tracking table can be used to mark dis/dysfleuncies.

.	.	/	.	.	.	.	.	.	/
.	.	.	.	.	/	.	.	.	.
.	/	.	.	.	.	.	.	/	.
.	.	.	/	.	.	.	.	.	.
/	.	.	.	.	.	/	.	.	.

There are 10 columns and 5 rows in the table providing 50 blocks. Each fluent word is marked '.' and each disfluent word is marked '/'. For example, in this table there are 8 disfluencies in 50 words. Therefore, percent disfluency will be 8/50 0 x 100 = 16 %.

4.8.1.4 Duration of disfluencies*:* The average duration of disfluency may be around one to two seconds and longer the duration of disfluencies, the more severe is the stuttering. It is measured as (1) the average duration of the three longest stuttered intervals measured in seconds or (2) the

average length of 10 stuttered intervals. An alternative to measuring fluent time periods is the measurement of disfluent time.

4.8.1.5 Physical concomitants*:* The associated non-speech behaviours or physical concomitants, or secondary behaviors have been reported as 'overt reactions' the PWS has acquired/learnt to release/prevent the core behaviors. The quality/quantity of various concomitant behaviors such as eye blinks, nose flare, facial grimaces, and abnormal limb/body movements should be assessed to give overall severity of stuttering. Although physical concomitants are not present in nearly 50 of PWS, the presence of it adds significantly to the perception of severity.

4.8.1.6 Rate of speech: It is an important dimension requiring assessment. Fluent syllable emission rate, disfluent syllable emission rate and overall rate of speech in syllables per minute are preferred indices. This describes how the rate of speech varies across various moments of stuttering. The rate of speech can be measured in syllables per second (SPS), syllables per minute (SPM) or words per minute (WPM) by calculating the syllables/words uttered in one second or one minute and SPM is the most acceptable measure. The normal ranges for these rate measures include 4-8 SPS, 240-480 SPM and 80-280 WPM. However, the norms vary depending on the age and language. When measuring rate, clinicians should keep in mind that variations are expected with speech context. Adult speech rates have been observed to be significantly faster in conversation than in narrative contexts. The speech rates differ significantly in different contexts, in the decreasing order such as oral reading, conversation, and picture description. The rate measures are key elements in the diagnosis of cluttering.

Articulatory rate refers to the speed of perceptually fluent utterances free of all disfluencies, hesitations, breaks, and detectible pauses longer than 250 msec. The typical metric for articulatory rate is either syllables per second or phones per second. Articulatory rates do not directly reflect oral movements for speech, but reflect those movements better than overall speech rates. Further, it is reported that diadochokinetic rates (DDK) signify the capacity of the individual in terms of repetitive movements of the articulators while the articulatory rates indicate the performance. It is also reported that many PWS speak faster than they are capable of producing the articulatory movements.

4.8.1.7 Length of stutter-free utterance: The measure of the length of stutter-free utterance provides information about how inconsistent the stuttering problem is. In the initial stages of development of stuttering or in milder forms stuttering is noticed occasionally whereas the length decreases as it becomes more severe or chronic. It can act as a prognostic indicator in the management of stuttering as the length of stutter-free utterance increase with reduction in stuttering following treatment.

4.8.1.8 Avoidance behaviors: Poor eye contact/looking away, word substitutions, using fast rate and totally avoiding or postponing speaking situations are some of the typical avoidance behaviors noticed in most PWS. Even very young children close to onset may exhibit these behaviors which could enable the clinician to make an early detection of the problem and in turn in its management.

4.8.1.9 Stuttering variability – Individuals with stuttering almost always show variability of symptoms with respect to person, language or situations

and on specific sounds or words. Therefore, the clinicians have to get information regarding the client's difficulties in different speaking contexts. There are many protocols to get his information, including the Stutter's Self-Ratings of Reactions to Speech Situations, the Southern Illinois University Speech Situation Checklist and the Reactions to Selected Speaking Situations. The information obtained in these protocols would enable the clinician to ascertain the situation specific difficulties faced by the individual clients which are necessary for targeting during stuttering treatment.

4.8.1.10Anxiety/tension: Many PWS exhibit sweating, shivering, raised heart beats, tense posture and fidgeting, which typically indicate raised autonomic nervous system reaction to the speech problem. Anxiety has been considered as a negative emotion consisting of mainly two components i.e., state and trait anxieties. An anxiety to a specific situation which may elicit certain factors related to social interface is called as state anxiety. In contrast, trait anxiety is not related to situational factors and is considered as persons' basic level of anxiety which develops gradually over a period of time. An increased level of state anxiety exhibited mainly in social situations has been reported in those who stutter as compared to those who do not. When an individual is exposed to threatening or demanding stimuli, stuttering becomes more severe and when the stimulus is less threatening stuttering is reported to be reduced. Some anxiety-provoking situations such as speaking in front of audience or speaking with higher authority, or to a listener who seems to be impatient or critical, are associated with increased stuttering. In contrast, the frequency of stuttering is generally

reduced while talking to a familiar person or someone not in authority which are not anxiety-provoking situations.

4.8.1.11 Temperament and emotional stability: Most children these days have very low emotional tolerance and are often hypersensitive. This could probably result from over protection and expectations on the child's performance in any activity of interest to the parents. This might be true with adults as well, where the stress and coping mechanism play a vital role. Understanding the temperament of the individual allows the clinician to evaluate the nature of stuttering in that person better. Increased physical tension during stuttering instances might be expected of a person due to his reactive temperament, and may lead to chronic stuttering. While on the other hand, an individual with placid temperament may be more relaxed and will probably ignore/accept stuttering, thereby outgrowing/coping with the problem more easily.

4.8.1.12Awareness and attitude towards stuttering: Awareness of the problem, anxiety that arises before, during, and after stuttering spells and the attitude that one develops will reflect on the individual's and the concerned people's emotional reactions towards stuttering. These emotional reactions may range from fear, guilt, and embarrassment to complete helplessness, and depression. These negative feelings need to be combated during therapy. Analysis of these will facilitate the unlearning of the fear-based stuttering behaviors. Attitudes of older clients could be assessed by getting answers to questions like: (1) in what ways stuttering affect the client's everyday behavior, (2) what perceptions of disability and handicap the individual has developed, (3)

what their feelings about speaking and stuttering are, and (4) what they know or believe about their stuttering.

Attitudes are one of the most important variables related to stuttering and the most challenging to assess. There are many published lists of scales or measures of attitudes which are useful in the comprehensive assessment which in turn will help in overall management of the problem.

4.8.1.13 Stuttering Severity: It refers to the level of disruption in the fluency of continuous speech because of stuttering. There is a high correlation between the objective quantity of stuttered speech and perceptual ratings of stuttering severity. The perceptual scale is based on observing the client speak or read and then assigning a rating on stuttering severity. The simplest is a 3-point scale with the ratings as mild, moderate and severe. Some recommend a 5-point scale (very mild, mild, moderate, severe, and very severe) that considers the frequency of stuttered events, the effort involved, and the presence of concomitant behaviors.

4.9 Let us sum up

The assessment of speech disorders is a challenging task to the clinicians. It basically helps the clinician not only to diagnose but differentially diagnose various conditions, assess the severity of the condition, and co-existing conditions in order to plan management. It will also enable them to predict prognosis and in research purposes. Various subjective and objective tools are available and also being

developed to facilitate diagnoses of voice, articulation and fluency disorders.

4.10 Unit end exercises

1. Briefly mention the need for assessment
2. What are the main objectives of assessment of speech-language disorders?
3. Mention the main tools used in the assessment
4. What are the different parameters you need to consider while assessing voice disorders?
5. What are different types of tests available for the assessment of articulation disorders?
6. Assessment of fluency disorders is a complex task. Justify.

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Unit 5: Assessment of language disorders

Unit 5: Assessment of language disorders

Objectives

After studying this unit the student would be able to

- Understand the need for assessment of language disorders
- Know the tools used in the assessment of various language disorders
- Differentially diagnose various language disorders

5.1 Introduction

Speech-language pathologists (SLPs) play a critical role in the screening, assessment, diagnosis, and treatment of preschool and school-age children with spoken language disorders (SLD). The professional roles and activities in speech-language pathology include clinical/educational services (diagnosis, assessment, planning, and treatment), prevention and advocacy, and education, administration and research.

A spoken language disorder (SLD), also known as an oral language disorder, represents a significant impairment in the acquisition and use of language across modalities (e.g., speech, sign language, or both) due to deficits in comprehension and/or production across any of the five language domains (i.e., phonology, morphology, syntax, semantics, and pragmatics). Language disorders may persist across the lifespan, and symptoms may change over time. When SLD is a primary disability, not accompanied by an intellectual disability, global developmental delay, hearing or other sensory impairment, motor dysfunction, or other mental disorder or medical condition—it is considered a specific language impairment (SLI).

5.2 Types of Language disorders

An SLD may also occur in the presence of other conditions, such as

- Autism spectrum disorder (ASD)
- Intellectual disabilities (ID)
- Developmental disabilities (DD)
- Attention deficit hyperactivity disorder (ADHD)
- Traumatic brain injury (TBI)
- Psychological/emotional disorders
- Hearing loss

Each of these affected populations may exhibit unique characteristics and behaviors, but all share common characteristics of language problems. The relationship between spoken and written language is well established. Children with spoken language problems frequently have difficulty learning to read and write. Additionally, children with reading and writing problems often have difficulty with spoken language, particularly as it relates to higher-order spoken language skills, such as expository discourse. Some children with language disorders may have social communication difficulty, because language processing, along with social interaction, social cognition, and pragmatics, comprise social communication.

Learning disabilities (LD) and language disorders are also closely linked, although the exact relationship between the two is not fully agreed upon. Language disorders are typically diagnosed before learning disabilities and frequently impact a child's academic performance. At that point, the child is often identified as having a learning disability, even though a language disorder often underpins the

academic struggles, especially those associated with learning to read and write.

5.3 Objectives of assessment

There are several goals in a diagnostic assessment depending on the set up and objectives of the same. These include:

- Verifying that a speech-language impairment exists
- Describing the strengths and challenges of the child's speech and language
- Differential diagnosis
- Describe the nature of the individual with problem
- Describe co-morbidity of other disorders and conditions
- Determining the course of the problem
- Evaluating the severity of the problem
- Ascertaining the etiology
- Recommendations for treatment plan
- Providing prognosis
- Predicting severity
- Pre-post therapy comparison to check improvement
- Provide outcome measures for purchasers
- Research purposes

5.4 Screening

Screening of spoken language skills is conducted if a language disorder is suspected. Screening does not result in a diagnosis, but rather indicates the potential need for further assessment.

Screening typically includes

- gathering information from parents and/or teachers regarding concerns about the child's languages and skills in each language

- conducting a hearing screening to rule out hearing loss as a possible contributing factor to language difficulties
- administering formal screening assessments that have normative data and/or cut off scores and demonstrated evidence of adequate sensitivity and specificity
- using informal measures, such as those designed by the clinician and tailored to the population being screened (e.g., preschool vs. school age/adolescence)
- screening of articulation if indicated

Screening may result in recommendations for

- complete audiologic assessment
- comprehensive language assessment
- comprehensive speech sound assessment, if the child's speech sound system is not appropriate for his/her age and/or linguistic community

5.5 Tools for assessment

Assessment requires obtaining a sample of communication skills across settings through a number of procedures. It is critical to collect information not only from standardized, formal tools but also to gather more authentic, real-life information to facilitate meaningful and accurate decisions. Typically, case history information, parent interviews, checklists from other providers, systematic observation, hearing screening, and examination of the speech mechanism is included. Formal norm-referenced tests are used to assess phonology, grammatical understanding and production, and pragmatic language use. Norm-referenced instruments utilize measurements that provide a

ranking of a child in reference to a group's performance. They are standardized in regard to the testing and scoring procedures and present normative scores that describe the average performance of groups of age, gender and socioeconomic status of normal children. Examples include REELS (Receptive – Expressive Emergent Language scales) by Bzoch and League (1972), and 3D-LAT (3 dimensional Language Acquisition Test) by Geetha Herlekar (1990). The collection of data from the authentic assessment tools and the formal measures provide a comprehensive picture of the speech-language needs of a young child with communication impairment. For appropriate diagnosis of the problem it is essential to:

- obtain information from multiple sources across settings to specify communication strengths and challenges
- make diagnoses, identify probable causes, determine severity, describe the likely prognosis, and provide recommendations
- probe speech, language, hearing, and processing abilities during assessment

Assessment is the measurement of a child's knowledge, abilities, and achievements. The purpose of assessment for young children is two-fold: (1) to identify or rule out the existence of a language or communication problem and (2) to understand the nature of language problem in order to guide intervention decisions. Assessment should provide information about child's relative knowledge of specific skills across domains as well as guidelines for planning intervention.

The specific tools used in the assessment of various communication disorders include:

1. **Case history** is a systematic process of collecting information pertaining to an individual's speech, language or communication disorder. It generally includes:

    - birth and medical history
    - family history of speech, language, reading, or academic difficulties
    - family's concerns about the child's language (and speech)
    - languages and/or dialects used in the home, including
        - age of introduction of a second language, as appropriate
        - circumstances in which each language is used
    - teachers' concerns regarding the impact of child's language difficulties in the classroom

2. **Interview** - From a clinical diagnostic sense it is a purposeful exchange of information between two or more persons, a directed conversation that proceeds in an orderly fashion to obtain data, to convey certain information and to provide release and support.

3. **Observation** – The client's behaviours are systematically observed through auditory and/or visual modalities in terms of frequency of occurrence, its duration, latency, reaction time through appropriate sampling procedures.

4. **Testing** are standardized tools used for formal/informal assessment of the target behaviour based on norm or criterion referenced comparison

American Speech and Hearing Association's (ASHA) preferred practice patterns for the speech-language pathologists (2004) indicates that comprehensive speech-language pathology assessment should include the following components:

- Case history, including medical status, education, socioeconomic, cultural, and linguistic backgrounds and information from teachers and other related service providers
- Patient/client/student and family interview
- Review of auditory, visual, motor, and cognitive status
- Standardized and/or non-standardized measures of specific aspects of speech, spoken and non-spoken language, cognitive-communication, and swallowing function, including observations and analysis of work samples
- Identification of potential for effective intervention strategies and compensations
- Selection of standardized measures for speech, language, cognitive-communication, and/or swallowing assessment with consideration for documented ecological validity and cultural sensitivity
- Follow-up services to monitor communication and swallowing status and ensure appropriate intervention and support for individuals with identified speech, language, cognitive-communication, and/or swallowing disorders

5.6 Use of a standardized assessment

1. It is an empirically developed evaluation tool with established reliability and validity. Standardized language assessments can be used to identify the broad characteristics of language functioning, but should not be used solely to make the diagnosis of spoken language disorders. Given the nuanced and subtle nature of strengths and deficits that many children demonstrate, standardized assessments alone are not sufficient to capture the variety of language details that constitute an individual's profile.

2. It is essential to consider the language spoken and/or dialect used by the child before selecting a standardized assessment. Translation of a standardized assessment invalidates the results. Standard scores may not be reported when the assessment has been translated.
3. Under most conditions, the use of standardized tests alone is not a comprehensive approach to determine whether an individual has communication impairment. There can never be one-to-one translation for language items. Languages vary across a wide range, including order of acquisition of vocabulary, morphology, and syntactic structures.
4. No test can be completely culture-free and well-developed standardized tests are not often available. One must recognize that most formal testing is unfamiliar to individuals who have not had exposure to the mainstream educational context. The testing includes both nonverbal and verbal components.
5. Determining whether a child has a language disorder is usually based on standardized assessment instruments. To qualify for services, children typically have to perform at least one standard deviation below the mean on a standardized measure of language. Some standardized measures of language are better than others in identifying children with language disorders.
6. Standardized tests are not the best way to determine specific areas of deficits because they focus primarily on syntactic-semantic aspects of language rather than on discourse, pragmatic, and prosodic aspects that can only be assessed through conversational and narrative sampling procedures.

Dynamic assessment procedures are particularly useful to determine goals and intervention procedures.

7. Assessments may vary based on the age of the child. For preschool children, observing play behaviors and interactions with parents and siblings provides important information about the child's social, cognitive, and interactive development. Emergent literacy skills should also be assessed (e.g., conventions of print, letter names). Narrative abilities can be assessed by having young children retell a story using a wordless picture book. For school-age children, language should be assessed not just with a clinician, but also with peers and in the classroom. A variety of discourse genres should be evaluated with spoken and written samples of language. Figurative aspects of language should also be evaluated.

5.7 Team approach

The assessment of language disorders involves many team members, including speech-language pathologist (SLP), audiologist, pediatrician, neurologist, ENT specialist, psychologist, physio-occupational therapist, teachers and parents. Each of the team members will assess various aspects of the child's abilities and confirm or rule out any associated sensory, motor, cognitive and social aspects that may underlie the problem.

5.8 Comprehensive assessment

Individuals suspected of having a language impairment based on screening results are referred for a comprehensive, linguistically appropriate assessment by a speech-language pathologist and other

professionals as needed. Assessment of language skills should be culturally relevant and functional and involve the collaborative efforts of families/ caregivers, classroom teachers, SLPs, special educators, and other professionals. There are many conditions which are associated with language disorders/deviancy like hearing impairment, mental retardation, cerebral palsy, autism, specific language impairment and learning disabilitiy. A detailed assessment in specific areas like sensory, motor, cognitive, linguistic and social skills are very essential with age, gender and socio-culturally appropriate norm-referenced tools. A team of professionals is necessary in various combinations to identify and assess the co-existing conditions in each client. Proper referrals have to be made by the clinician to identify and assess the co-existing conditions. This will enable the clinician to differentially diagnose specific clinical conditions as well as evaluate the severity of the associated disability in order to plan management. There are various language assessment tests/tools available for various age and cultural groups in various languages and dialects. They specifically assess one or more aspects of language like comprehension, expression, reading and writing. Assessment typically includes the following, with consideration made for the age and linguistic development of the child:

1. Relevant history
2. Hearing screening or detailed assessment if needed
3. Intellectual assessment
4. Motor coordination in limbs and oral mechanism
5. Oral mechanism examination
6. Spoken language testing, including
    - Phonology- including phonological awareness

- semantics
- morphology
- syntax
- pragmatics- discourse-level language skills (conversation, narrative, expository)

A literacy assessment (reading and writing) is included in the comprehensive assessment for language disorders because of the well-established connection between spoken and written language. Components of a literacy assessment will vary, depending on the child's age and stage of language development, and can include pre-literacy, early literacy, and advanced literacy skills.

A speech sound assessment may also be included, given that speech sound errors can be a result of a phonological disorder, an articulation disorder, or a combined phonological/ articulation disorder. The following procedures and data sources may be utilized in the comprehensive assessment for spoken language disorders (SLD):

5.8.1 Language sampling - The elicitation of spontaneous language in various communication contexts is essential for the comprehensive language assessment (e.g., free play, conversation/dialogue, narration, and expository speech). It is necessary to derive language measures such as Mean Length of Utterance (MLU), Type-Token Ratio (TTR), Developmental sentence scoring (DSS]), clausal density and use of subordinate clauses, to complement data obtained from standardized language assessments.

5.8.2 Dynamic assessment is a language assessment method in which an individual is tested, skills are addressed, and then the individual is re-tested to determine treatment outcome (i.e., test-teach and re-

test). Dynamic assessment can help distinguish between a language difference and a language disorder and can be used in conjunction with standardized assessment and language sampling.

5.8.3 Systematic observation/contextual analysis is observation in the classroom and in various other contexts to describe communication and identify specific problem areas. Descriptions of language functioning are made across a variety of settings and tasks are used to identify contextual variables that play a part in the student's communication abilities and to complement findings from other assessment procedures.

5.8.4 Ethnographic interviewing is a technique for obtaining information from the child and the child's family/caregiver and teachers. It avoids the use of leading questions and "why" questions and uses open-ended questions, restatement, and summarizing for clarification. The ethnographic technique is used to obtain information from the perspective of the child and other individuals in the child's environment and to validate other assessment findings.

5.8.5 Parent/teacher/child report measures include checklists or questionnaires completed by the family member(s)/caregiver, teacher, and/or child. These measures enable the clinician to obtain a comprehensive profile of language skills by comparing findings from multiple sources (e.g., family vs. teacher vs. self-report). For individuals who speak a language other than English at home, the clinician needs to gather detailed information about use of the primary language and English.

5.8.6 Curriculum-based assessment is a technique that uses probes, protocols, and direct assessment to determine the language demands of the curriculum and assess the student's ability to handle those demands.

5.9 Outcomes of assessment

- diagnosis of a spoken language disorder (receptive language disorder only, expressive language disorder only, or expressive-receptive mixed) with regard to:
  - type of impairment (primary, secondary)
  - impacted domains (form, content, use; comprehension, production)
  - severity (mild, moderate, severe, profound)
  - prognosis statement
- determination of a language delay in the absence of a language disorder (i.e., language delay due to environmental influences)
- description of the characteristics and severity of the disorder or delay
- determination of performance variability as a function of communicative situations/contexts
- identification of literacy problems
- identification of possible hearing problems
- recommendations for intervention and support
- referral to other professionals as needed
- develop a profile of individual's strengths and weaknesses in language, and identifies methods of improving language form, content, and use

Special considerations for the diagnosis of SLD are:

5.9.1 Early identification

Not all children with early language delay (late talkers) have significant language problems when they reach school age, making it difficult to diagnose a language disorder before the age of about 3 years. However,

given the risk that language disorders pose, children need to be assessed for language difficulties early and monitored periodically at critical educational stages (e.g., in preschool, kindergarten, second grade, and third grade, early middle school and high school) to track language development and identify any problems that might arise.

It is especially important to monitor and assess young children on a regular basis, if multiple risk factors are evident (e.g., family history of language problems, chronic otitis media, cognitive delay, social communication difficulties, and environmental risks.

5.9.2 Changing nature of SLD

Children with SLD demonstrate differing patterns of strengths and weaknesses across listening, speaking, reading and writing. The patterns of strengths and weaknesses may vary over time. In some cases, the language skills of children with SLD become seemingly similar to those of children without SLD.

However, as the complexity of the language demands increase, difficulty may resurface in one or more language domains. This phenomenon is referred to as illusory recovery. Although children may acquire new vocabulary or improve their use of grammatical forms following language intervention, they may not actually catch up to their peers. In fact, their rate of language growth may slow or level off when they reach early adolescence, resulting in language levels below those expected for their age groups. For this reason, it is important that practitioners use valid and reliable standardized assessments with normative data, in addition to other data sources (e.g., informal

measures, benchmarking, progress reports, etc.), when evaluating the language skills of children with SLD over time.

5.10 Bilingualism and some cultural and linguistic considerations

A communication difference/dialect is a variation of a symbol system, used by a group of individuals that reflects and is determined by shared regional, social, or cultural/ethnic factors. This variation should not be considered as a disorder of speech or language. In addition, children who demonstrate typical patterns of dual language learning, are learning English as a second language, or speak a non-standard dialect of English should not be considered as having a spoken language disorder, based only on those differences.

Clinicians face unique challenges when identifying SLD in children who speak a dialect of English, are bilingual, or are learning English as a second language. Distinguishing difference from disorder requires familiarity with the rules of the spoken dialect, awareness of typical dual language acquisition from birth, and understanding of the sequential process of second language acquisition. For children who speak a non-standard dialect of English, special consideration is given to the influence of the rules of that dialect on assessment measures, which are typically based on standard American English. The results are not valid if the sample of an assessment is not representative of the child being assessed.

Some linguistic characteristics of dual language learning (simultaneous bilingualism) and second language (L2) acquisition (sequential

bilingualism) may be the same as those of monolingual children with language impairment.

There is little research/information regarding bilingualism and the broader scope of spoken language disorders. However, a number of studies have identified potential areas of overlap between second language learners and monolingual children with SLI, one type of spoken language disorder:

- similar morphosyntactic profiles
- reduced processing efficiency
- superficial impairment in vocabulary development when combined vocabularies in both languages are not taken into account

Bilingualism is not a cause of language impairment. Typical processes of bilingualism, such as code-mixing, will be seen in bilingual children who have SLI. Language dominance may vary across the different domains of language, for example, dominance in L1 in receptive language and dominance in L2 expressively. This also may shift over time relative to environmental linguistic demands.

5.11 Let us sum up

To summarize, language problems of childhood have far reaching consequences. Language problems affect the child's social behavior and educational achievements. Language disorders that persist into adulthood can cause serious occupational difficulties too. Because of such serious consequences, assessment and treatment of language disorders at an early age is an important part of the duties of the speech and language pathologist. Appropriate language assessment tools

specific to age, gender and socio-cultural background are very essential for the differential diagnosis of various conditions associated with language disorders. Bi/multilingual aspects are other challenges the clinicians dealing with individuals with language disorders, especially in the pediatric population.

5.12 Unit end exercises

1. What are the objectives of assessment?
2. What are the outcomes of assessment?
3. What are the major tools used for assessment of language disorders?
4. Highlight the need for team approach in the assessment of language disorders?
5. What are the different parameters to be assessed in spoken language testing?
6. Mention some conditions associated with language disorders in children.
7. Write a brief note on screening assessment

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