LANGUAGE PROCESSİNG AND THE HUMAN BRAİN

LEXICAL SELECTION

1.Word substitutions are seldom random; they show that in our attempt to express our thoughts, we may make an incorrect lexical selection based on partial similarity or relatedness of meanings. This is illustrated in the following examples:

Bring me a pen. → Bring me a pencil.
Please set the table. → Please set the chair.

2. Blends, in which we produce part of one word and part of another, illustrate how we may select two or more words to express our thoughts and instead of deciding between them, we produce them as **“portmanteaus.”Such blends are illustrated in the** following errors:

edited/annotated → editated
frown/scowl → frowl

These blend errors are typical in that the segments stay in the same position within the syllable as they were in the target words.

3. In production, speakers often make speech errors involving the substitution of a word that is phonologically related to the target but unrelated in meaning, as the following examples show:

The flood damage was so bad they had to evacuate the city. → The flood damage was so bad they had to evaporate the city.

APPLICATION AND MISAPPLICATION OF RULES

1. It is difficult to see this process in normal error-free speech, but when someone says *groupment* instead of *grouping*, *ambigual* instead of *ambiguous*, or *bloodent* instead of *bloody*, it shows that regular rules are applied to combine morphemes and form possible but nonexistent words.

2. Inflectional rules also surface.

We swimmed in the pool knows that the past tense of *swim* is *swam*, but he mistakenly applied the regular rule to an irregular form.

3. Consider the *a/an* alternation rule in English. Errors such as *a burly bird* for the intended *an early bird* show that when segmental misordering changes a word beginning with a vowel to a word beginning with a consonant, the indefinite article also changes to conform to the grammatical rule. Clearly, the rule applies, or perhaps reapplies, after the stage at which *early* has slipped to *burly*.

4. Similarly, an error such as *bin beg*, pronounced [**bɪñ bɛg] for the intended** *Big Ben* [**bɪg bɛñ**] shows that allophonic rules apply (or reapply) after phonemes are misordered. If the misordering occurred after the phonemes had undergone allophonic rules such as nasalization, the result would have been the phonetic utterance [**bɪn bɛg̃**].

PLANNING UNITS

- Although sounds within words and words within sentences are linearly ordered,speech errors or slips of the tongue show that the planning stages involve units larger than the single phonemic segment or even the word.
- Indeed , speech errors show that features ,segments , words and phrases maybe conceptualized well before they are uttered

Types of speech errors		
Type	Definition	Example
Addition	"Additions add linguistic material."	Target: We Error: We and I
Anticipation	"A later segment takes the place of an earlier segment."	Target: reading list Error: leading list
Blends	Blends are a subcategory of lexical selection errors.More than one item is being considered during speech production. Consequently, the two intended items fuse together.	Target: person/people Error: perple
Deletion	Deletions or omissions leave some linguistic	Target: unanimity of opinion

Metathesis	"Switching of two sounds, each taking the place of the other."	Target: pus pocket Error: pos pucket
Morpheme-exchange error	Morphemes change places.	Target: He has already packed two trunks. Error: He has already packs two trunked.

Shift	"One speech segment disappears from its appropriate location and appears somewhere else."	Target: She decides to hit it. Error: She decide to hits it.
Sound-exchange error	Two sounds switch places.	Target: Night life Error: Knife light
Spoonerism	A spoonerism is a kind of metathesis. Switching of initial sounds of two separate words.They are named after Reverend William Archibald Spooner, who probably invented most of his famous spoonerisms.	Target: I saw you light a fire. Error: I saw you fight a liar.

Segments	
Segment	Example
Distinctive or phonetic features	Target: clear blue sky Error: glear plue sky (voicing)
Phonemes or sounds	Target: ad hoc Error: odd hack
Sequences of sounds	Target:spoon feeding Error: foon speeding
Phrases	Target: The sun is shining./The sky is blue. Error: The sky is shining.

BRAİN AND LANGUAGE

The study of the biological and neural foundations of language is called neurolinguistics. Neurolinguistic research is often based on data from atypical or impaired language and uses such data to understand properties of human language in general.

- Neurolinguistics:
- A special branch of linguistics which studies physical structure of the brain as it relates to language production and comprehension.

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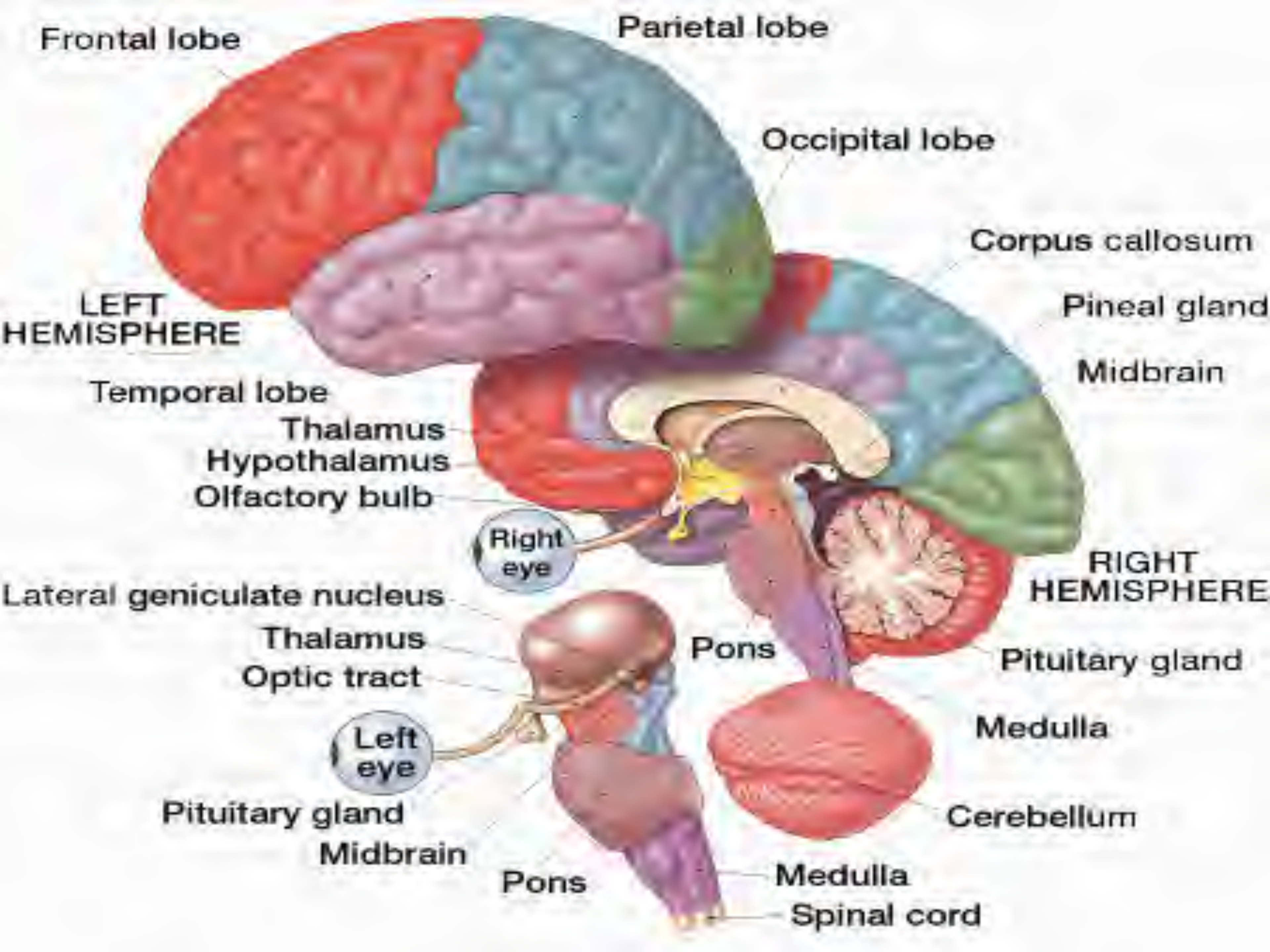
THE HUMAN BRAIN

- The brain is the most complex organ of the body. The surface of the brain is the **cortex, often called "gray matter," consisting** of billions of neurons (nerve cells) and glial cells (which support and protect the neurons). The cortex is the decision-making organ of the body. It receives messages from all of the sensory organs, initiates all voluntary and involuntary actions, and is the storehouse of our memories and the seat of our consciousness. It is the organ that most distinguishes humans from other animals. Somewhere in this gray matter resides the grammar that represents our knowledge of language.

- The brain is composed of a right and a left cerebral hemisphere, joined by the corpus callosum, a network of more than 200 million fibers .The corpus callosum allows the two hemispheres of the brain to communicate with each other. Without this system of connections,the hemispheres would operate independently. In general, the left hemisphere controls the right side of the body, and the right hemisphere controls the left side. This is referred to as contralateral brain function .

  E.g. If you point with your right hand, the left hemisphere is responsible for your action.


Frontal lobe
Parietal lobe
Occipital lobe
Corpus callosum
Pineal gland
Midbrain
LEFT HEMISPHERE
Temporal lobe
Thalamus
Hypothalamus
Olfactory bulb
Right eye
Lateral geniculate nucleus
Thalamus
Optic tract
Left eye
Pituitary gland
Midbrain
Pons
RIGHT HEMISPHERE
Pons
Pituitary gland
Medulla
Cerebellum
Medulla
Spinal cord

THE LOCALIZATION OF LANGUAGE IN THE BRAIN

- An issue of central concern has been to determine which parts of the brain are responsible for human linguistic abilities. In the early nineteenth century, Franz Joseph Gall proposed the theory of localization, which is the idea that different human cognitive abilities and behaviors are localized in specific parts of the brain. For example, he proposed that language is located in the frontal lobes of the brain because as a young man he had noticed that the most articulate and intelligent of his fellow students had protruding eyes,which he believed reflected overdeveloped brain material. He also put forth a pseudoscientific theory called "organology" that later came to be known as phrenology, which is the practice of determining personality traits, intellectual capacities, and other matters by examining the "bumps" on the skull.

Broca's and Wernicke's Area

- Broca's area is one of the main areas of the cerebral cortex responsible for producing language. This region of the brain was named for French neurosurgeon Paul Broca who discovered the function of this area while examining the brains of patients with language difficulties. Broca's area, located in the forebrain, controls motor functions involved with speech production. Persons with damage to Broca's area of the brain can understand language but cannot properly form words or speak fluently. Broca's area is connected to another brain region known as Wernicke's area. Wernicke's area is associated with processing and understanding language

Broca's Aphasia

- Patients have difficulty producing grammatical sentences and their speech is limited mainly to short utterances of less than four words. Producing the right sounds or finding the right words is often a laborious process. Some persons have more difficulty using verbs than using nouns.
- A person with Broca's aphasia may understand speech relatively well, particularly when the grammatical structure of the spoken language is simple. However they may have harder times understanding sentences with more complex grammatical construct.

Wernicke's aphasia

- Persons with Wernicke's aphasia can produce many words and they often speak using grammatically correct sentences with normal rate and prosody. However, often what they say doesn't make a lot of sense or they pepper their sentences with non-existent or irrelevant words.

Dyslexia & Acquired Dyslexia

Similar observations pertain to reading. The term dyslexia refers to reading disorders. Acquired dyslexics—people whose reading ability is impaired due to brain damage

Stimulus	response 1	response 2
example	*answer*	*sum*
heal	*pain*	*medicine*
south	*west*	*east*

- Most of us have experienced word-finding difficulties in speaking.
- This tip-of-the-tongue phenomenon is not uncommon. But aphasics who suffer from anomia have constant word-finding difficulties.

BRAİN IMAGİNG İN APHASİC PATİENTS

- Today we no longer need to rely on surgery or autopsy to locate brain lesions.Noninvasive neuroimaging technologies such as computer tomography (CT) scans and magnetic resonance imaging (MRI) can reveal lesions in the living brain shortly after the damage occurs.

SPLIT-BRAIN

- The result of an operation for epilepsy in which the corpus collosum is severed ,thus separating the brain into its two hemisphere in cognitive and language processing.
- CORPUS COLLOSUM: The nerve fibers connecting the right and left cerebral hemispheres.(The right and left halves of the brain,joined by the corpus collosum.)

DİCHOTİC LİSTENİNG

Dichotic listening is an experimental technique that uses auditory signals to observe the behavior of the individual hemispheres of the human brain. Subjects hear two different sound signals simultaneously through earphones. They may hear *curl* in one ear and *girl* in the other, or a cough in one ear and a laugh in the other. When asked to state what they heard in each ear, subjects are more frequently correct in reporting linguistic stimuli (words, nonsense syllables, and so on) delivered directly to the right ear, but are more frequently correct in reporting nonverbal stimuli (musical chords, environmental sounds, and so on) delivered to the left ear.

These experiments also show that the left hemisphere is not superior for processing all sounds, but only for sounds that are linguistic.

Event-Related Potentials

Event-related potentials (ERPs) are the electrical signals emitted from the brain in **response to different stimuli. Researchers can investigate the brain's ERP** responses by taping electrodes to different areas of the skull and measuring the responses to different kinds of perceptual and cognitive information. This technique, based upon EEG (electroencephalogram) readings, exploits the fact that the brain is electrically active and that this electrical activity can be measured both for its strength and for its pattern over time.

For example, ERP differences result when the subject hears speech versus non-speech sounds, with a greater response from the left hemisphere to speech. ERP experiments also show variations in timing, pattern, amplitude, and hemisphere of response when subjects hear sentences that are meaningless, such as

The man admired Don's headache of the landscape.

as opposed to meaningful sentences such as

The man admired Don's sketch of the landscape.

NEURAL EVİDENCE OF GRAMMATİCAL PHENOMENA

Many technological advances that provide non-invasive methods for studying linguistic and other cognitive functions in the brain. These techniques reveal how the healthy brain reacts to particular linguistic stimuli. For example, researchers observe how the normal brain responds in deciding whether two or more sounds are the same or different, whether a sequence of sounds constitutes a real or possible word, or whether a sequence of words forms a grammatical or ungrammatical sentence.

NEUROLİNGUİSTİC STUDİES OF SPEECH SOUNDS

Several studies using ERPs and MEGs (magnetoencephalography—the measuring of the magnetic field of the brain) have shown a neural reflex of categorical perception: The brain reacts differently to sounds that are phonemically different (e.g., [t] and [k]) than to sounds that are acoustically distinct (e.g., [p] and [ph]) but non-phonemic. The overall patterns of response differ in intensity, speed, and location in the brain. Another ERP experiment involving the sound system has demonstrated a neurological reflex of the notion *phonotactically permitted* (e.g., *blick versus bnick).*

Neurolinguistic Studies of Sentence Structure

Many studies consistently find that the brain reacts similarly to grammatically well-formed sentences regardless of whether they are anomalous or meaningful. Such findings provide neurological evidence for the separation between syntax and semantics posited by linguists. Subjects hear sentences in which the underlying subject or object has been moved to the beginning of the phrase.

- For example: *Which bagel . . . did Seymour slice __?*
- *the basic word order*
- *—between the moved element and the position from which it moves.*

LANGUAGE AND BRAİN DEVELOPMENT

- Numerous *neurolinguistic* studies have found that the way the brain is organized for language and grammar in the adult is already reflected in the brains of newborns and young infants—even before they have entered the period during which language actively develops. Lateralization of language to the left hemisphere is a process that begins very early in life. For example, Wernicke's area is visibly distinctive in the left hemisphere of the fetus by the twenty-sixth gestational week. Moreover, infants show evidence of many of the neural correlates of linguistic categories that we observe in adults.

- Lateralization:

- Functional specialization of the brain, with some skills, as language, occurring primarily in the left hemisphere and others, as the perception of visual and spatial relationships, occurring primarily in the right hemisphere.

It is a small part of the brain that helps us to understand language. It's usually, though not always, found on the back portion of the left temporal lobe. It's found on the left side of the temporal lobe in right-handed people about 90% of the time and in left-handed people about 70% of the time. This same area is found in the brain of deaf people who use sign language as well. This last finding hints that Wernicke's area may not be used just for spoken language.

LEFT HEMISPHERE LATERALIZATION FOR LANGUAGE İN YOUNG CHİLDREN

- In a very intriguing study researchers videotaped smiling babies and babbling babies (producing syllabic sequences like *mamama or gugugu)* *between* the ages of five and twelve months. The videotapes showed that when they **were smiling the babies' mouths were** opened wider on the left side (the side controlled by the right hemisphere) whereas when they babbled the *right side* of the mouth (controlled by the left hemisphere) was opened wider, indicating greater left hemisphere involvement for language even during the babbling period.

As a summary of this subject

- At birth, a baby is ready for some form of communication. For example, your baby will initiate conversation by looking into your eyes and will terminate the conversation by looking away. Your newborn baby can hear a wide variety of sounds and they prefer the sounds of voices and other complex sounds. Newborns prefer happy sounding speech as opposed to speech with negative or neutral emotions. When your baby hears you talk, the language areas of the brain are stimulated.

BRAIN PLASTICITY

Brain Plasticity is the brain's ability to adapt to change across the lifespan and to rewire itself after damage. With every new experience, the brain changes in some way. As we experience an event or learn a new skill, new connections are formed between neurons, and connections that aren't needed anymore are eliminated. This reorganization of the pathways in our brain takes place at an astounding rate when we are young and rapidly acquiring new information, but the brains of adults are also "plastic" to a degree. There is evidence that, in patients with brain damage, healthy brain areas can take over for injured areas and adopt new functions.

- While the left hemisphere is innately predisposed to specialize for language,there is also evidence of considerable *plasticity (i.e., flexibility) in the system* during the early stages of language development. This means that under certain circumstances, the right hemisphere can take over many of the language functions that would normally reside in the left hemisphere. An impressive illustration of plasticity is provided by children who have undergone a procedure known, as hemispherectomy in which one hemisphere of the brain is surgically removed. This procedure is used to treat otherwise intractable cases of epilepsy. In cases of left hemispherectomy after language acquisition has begun, children experience an initial period of aphasia. However,in certain cases, depending on the underlying disease that led to the epilepsy, the child may reacquire a linguistic system that is virtually indistinguishable from that of normal children. They also show many of the developmental patterns of normal language acquisition .

THE CRITICAL-AGE HYPOTHESIS

- The critical period hypothesis says that there is a period of growth in which full native competence is possible when acquiring a language. This period is from early childhood to adolescence. The critical period hypothesis has implications for teachers and learning programmes, but it is not universally accepted. Acquisition theories say that adults do not acquire languages as well as children because of external and internal factors, not because of a lack of ability.
- Example
  Older learners rarely achieve a near-native accent. Many people suggest this is due to them being beyond the critical period.
- In the classroom
  A problem arising from the differences between younger learners and adults is that adults believe that they cannot learn languages well. Teachers can help learners with this belief in various ways, for example, by talking about the learning process and learning styles, helping set realistic goals, choosing suitable methodologies, and addressing the emotional needs of the adult learner.

THE MODULAR MIND: DISSOCIATIONS OF LANGUAGE AND COGNITION

- The modular view of cognition is also supported by various case studies of extraordinary individuals who show deficits in certain cognitive domains alongside normal or superior abilities in other areas. The individuals we discuss below show *dissociations* between their linguistic abilities and other nonlinguistic cognitive abilities. In some cases, their language abilities far outpace the other areas, and in other cases, the reverse is true.

LINGUISTIC SAVANTS

- There are numerous cases of intellectually handicapped individuals who, despite their disabilities in certain spheres, show remarkable talents in others. There are superb musicians and artists who lack the simple abilities required to take care of themselves. Such people are referred to as savants. Some of the most famous savants are human calculators, who can perform arithmetic computations at phenomenal speed, or calendrical calculators, who can tell you without pause on which day of the week any date in the last or next century falls.

SPECİFİC LANGUAGE IMPAİRMENT

Specific language impairment is diagnosed when a child has delayed or disordered language development for no apparent reason.
Children with SLI have do not have brain lesions, but they nevertheless have difficulties acquiring language or are much slower than the average child. They show no other cognitive deficits, they are not autistic or retarded, and they have no perceptual problems. Only their linguistic ability is affected, and often only specific aspects of grammar are impaired.Children with SLI have problems with the use of function words such as articles, prepositions, and auxiliary verbs. They also have difficulties with inflectional suffixes on nouns and verbs such as markers of plurality or tense. The following examples from a four-year-old boy with SLI illustrate this:

Meowmeow chase mice.

GENETIC BASIS OF LANGUAGE

- Studies of genetic disorders also reveal that one cognitive domain can develop normally along with abnormal development in other domains, and they also underscore the strong biological basis of language. Children with Turner syndrome (a chromosomal anomaly) have normal language and advanced reading skills along with serious nonlinguistic (visual and spatial) cognitive deficits.Similarly, studies of the language of children and adolescents with Williams syndrome reveal a unique behavioral profile in which certain linguistic functions seem to be relatively preserved in the face of visual and spatial cognitive deficits and moderate retardation. In addition, developmental dyslexia and SLI also appear to have a genetic basis. And recent studies of Klinefelter syndrome (another chromosomal anomaly) show quite selective syntactic and semantic deficits alongside intact intelligence.

- The impaired members of this family have a very specific grammatical problem: They do not reliably use verb inflections or “irregular” verbs correctly. They routinely produce sentences such as the following:

- *She remembered when she hurts herself the other day.*
- *He did it then he fall.*

specific language impairment (SLI):

Difficulty in acquiring language faced by certain children with no other cognitive deficits.

SUMMARY

- Psycholinguistics is concerned with linguistic performance or processing,which is the use of linguistic knowledge (competence) in speech production and comprehension. The attempt to understand what makes the acquisition and use of language possible has led to research on the brain-mind-language relationship. Neurolinguistics is the study of the brain mechanisms and anatomical structures that underlie linguistic competence and performance.The brain is the most complex organ of the body, controlling motor and sensory activities and thought processes. Research conducted for more than a century has shown that different parts of the brain control different body functions. The nerve cells that form the surface of the brain are called thecortex, which serves as the intellectual decision maker, receiving messages from the sensory organs and initiating all voluntary actions. The brain of all higher animals is divided into two cerebral hemispheres, which are connected by the corpus callosum, a network that permits the left and right hemispheres to communicate. Each hemisphere exhibits contralateral control of functions. Lateralization is the term used to refer to the localization of function to one hemisphere of the brain.

- Language is lateralized to the left hemisphere, and the left hemisphere appears to be the language hemisphere from infancy on. Much of the early evidence for language lateralization comes from the study of aphasia, which is the neurological term for any language disorder that results from acquired brain damage caused by disease or trauma. For example, lesions in the part of the left hemisphere called **Broca's** area may suffer from **Broca's** aphasia, which results in impaired syntax and agrammatism. Damage to **Wernicke's** area, also in the left hemisphere, may result in **Wernicke's** aphasia, in which fluent speakers produce semantically anomalous utterances. Damage to yet different areas can produce anomia, a form of aphasia in which the patient has word-finding difficulties. Evidence for language lateralization as well as the contralateral control of function is also provided by dichotic listening experiments, split-brain patients, and neurolinguistic studies of grammatical phenomena. While the left hemisphere is innately predisposed to specialize for language,there is also evidence of considerable plasticity in the system during the early stages of language development. Children who undergo a left hemispherectomy experience an initial period of aphasia, but in certain cases,may reacquire a linguistic system like that of normal children.

- The critical-age hypothesis states that there is a window of opportunity between birth and middle childhood for learning a first language. Evidence for modularity is found in the selective impairment of language in aphasia, in children with specific language impairment (SLI), in linguistic savants, and in children who learn language past the critical period. The genetic basis for an independent language module is supported by studies of SLI in families and twins and by studies of genetic anomalies associated with language disorders.

QUESTIONS

1.) In the division of labour between the two hemispheres of the brain, which of the following fits into the right hemisphere ?

- A)Holistic processing
- B)Thinking and reasoning
- C)Listening
- D)Speaking
- E)Calculating

- **ANSWER: A**
- Left brain is responsible for linguistic skills,mathematical concepts and logical organizations whereas right hemisphere is responsible for creativity,artistic abilities relations and spatial organizations.
- So, the answer is A.

2.)The branch of linguistics concerned with the brain mechanisms that underlie the acquisition and use of human language; the study of the neurobiology of language.

- Which of the following can best explain of this statement ?
- A) sociolinguistic
- B)psycholinguistics
- C)Syntax
- D)Discourse analysis
- E)Neurolinguistics

- ANSWER IS "E"

3.) The fact that the left hemisphere controls movement on right side of body,and the right hemisphere controls movement on left side of body can be best explain by_______

- A)modularity
- B)contralaterality
- C)corpus collosum
- D)motor association cortex
- E)Wernicke’s area

- ANSWER IS "B"

4.) The fact that under circumstances, the right hemisphere can take over many of the language functions that would normally reside in the left hemisphere during the early stages of language development is because of ____

- A) Jargon aphasia
- B)Wernicke’s aphasia
- C)plasticity
- D)the autonomy of language
- E)Broca’s aphasia

- ANSWER IS "C"

5.) The left and right halves of the brain, joined by the_________?

- Which of the following can best explain of this statement ?

A)cerebral hemispheres

B) Corpus callosum

C) Lateralization

D) Cortex

E) Contralateral

- ANSWER IS "B"

- 6.) Which of the following is the basic premise of Critical Age Hypothesis?
- A)It is hard to learn a large vocabulary after the critical period.
- B)After the crritical period,language is lateralized to the left hemisphere.
- C)Acquisition of grammatical abilities is intact after the critical period.
- D)Children cannot fully acquire language unless they are exposed to it within the critical period.
- E)Being a good nonverbal communicator is not possible after the critical period.

- ANSWER IS “D”

- 7.) Which of the following is not true about Broca’s aphasia?

- A)It is a disorder that affects the ability to form sentences with the rules of syntax.
- B)Broca’s aphasics frequently lack function words.
- C)Broca’s aphasics omit inflections.
- D)Broca’s aphasics have difficulty mainly with semantics.
- E)Broca’s aphasics produce often agrammatic language.

- ANSWER IS "D"

- 8.) A right-handed split-brain patient is first asked to name an object placed into her right hand without looking at it. She then is asked to name a different object placed into her left hand without looking at it. What probably will happen?

- A.) She will not be able to name either object.
B.) She will be able to name both objects.
C.) She will be able to name the object placed into her left hand but not be able to name the object placed into her right hand.
D.) She will be able to name the object placed into her right hand hand but not be able to name the object placed into her left hand

- ANSWER IS "B"

- 9.) (……………..) also known as reading disorder,is characterized by trouble by reading unrelated to problems with overall intelligence. The cause of (…………) is believed to involve both genetic and environmental factors

- A)Split brain
- B)Agrammatism
- C)Dyslexia
- D)Aphasia

- ANSWER IS "C"

- 10.) Which of the following sentences would a person with Broca's aphasia find easiest to understand?
- A)The red sports car was hit by the cement truck, which was speeding across a narrow bridge.
  B)The speeding cement truck hit the red sports car on a narrow bridge.
  C) The red sports car was hit by the speeding cement truck on a narrow bridge.
  D) A person with Broca's aphasia would find all of these equally easy to understand.

- ANSWER IS "B"

11.) In production, speakers often make speech errors involving the substitution of a word that is phonologically related to the target but unrelated in meaning.

- Which of the following can best explain of this statement ?
- A) Lexial Selection
- B) Aphasia
- C) Plasticity
- D) Split Brain

- ANSWER IS "A"

- 12.) ___________is the term used to refer to the localization of function to one hemisphere of the brain.

Which of the following can best explain of this blank ?

A) Lateralization
B) Neurolinguistic
C) Anomia
D) Hemispherectomy

- ANSWER IS "A"

- 13.) Evidence for language lateralization as well as the contralateral control of function is also provided by ________experiments.

Which of the following can best explain of this blank ?

A) Linguistic Savants

B) Modular

C) specific language impairment

D) dichotic listening

- ANSWER IS "D"

14.) The process involved in any language acquisition which takes place after the age of puberty will be qualitatively different from those involved in first language acquisition.

- Which of the following theories supports this claim ?
- A) Natural Order Hypothesis
- B) Universal Grammar Hypothesis
- C) Acqusition vs. Learning Hypothesis
- D) Critical Period Hypothesis
- E) Input Hypothesis

- ANSWER IS "D"

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