# CHAPTER 2

# Biological Bases of Language Development

## Section 1: Learning Objectives

The following concepts are important in forming a foundation for understanding biological bases of language development and how aspects have been described and researched. Upon completion of Chapter Two, students will be prepared to discuss the following concepts:

1. The biological organism is unique to human beings in how it forms one of the bases of language creation and language development.

2. Language is a universal function common to all human beings.

3. The "functional architecture" of the human brain and how it relates to language acquisition relates to aspects of nueroanatomy, nuerolinguistics, and hemispheric function.

4. Viewpoints on whether language learning occurs during an age-related critical period or as a result of social, cultural, hereditary and similar conditions are presented.

5. Evidence is presented that human beings are uniquely capable of learning language.

6. Discussion of brain development as it is related to language development includes examination of specialization in the hemispheres.

7. Child language development is influenced by basic processes in neurological development.

8. How species other than human beings learn language and language-like behavior is presented in reports on recent research.

9. Results of research on teaching communication systems to other species are presented.

10. Research and reports on individuals who did not have access to language input, including individuals who are deaf and hard of hearing, demonstrates evidence of variables influencing language acquisition.

11. Theories regarding language as an evolutionary adaptation are discussed.

## 1. Section II: Student Review Questions

Before class, have your students select central concepts from this chapter and prepare an outline, schema, or short essay on the main points to be discussed in class. Students can be asked to select a partner and complete the following:

- Exchange notes;
- Review each other's views;
- Discuss similarities, differences and further questions;
- Present the results online before class or as an introduction to the lecture.

Examples for students:

1. What evidence of language as a human universal can be found in the discussion of how Pidgins and Creoles develop?
2. Discuss the relationship of the language bioprogram hypothesis to the common basis of language creation and language acquisition.
3. Explain how differences between human beings and other species' vocal tract influence views on the language and communication development process.
4. Explain the relationship of basic processes in neurological development such as neural plasticity to language development.
5. Describe how case studies of children who are deprived of access to language contribute to understanding the critical period hypothesis.

## Section III: Suggested Activities

1. **Goal:** To understand the theories, controversies and evidence regarding the uniqueness of language to humans.

Divide into groups of four to eight students and divide each group into teams of two to four students. Each group should select a controversial issue regarding language specificity in humans, the ability of primates to develop language, the evolution of language or another topic from the chapter. Have them research the arguments on both sides of this issue and hold a debate in class.

2. **Goal:** To appreciate issues regarding research and related assumptions on the biological bases of language development.

Divide into groups of three-to-five students and examine research presented in the discussion of hemispheric specialization, the critical period hypothesis and language and other species. Identify the conclusions of the research; describe strengths and weaknesses and present questions for further study.

3. **Goal:** To examine the effect of bilingual language research using the critical period hypothesis on education policy.

Divide the class into two groups and ask each group to prepare an argument, one in support of practices supporting the critical period hypothesis and the other against the hypothesis. Require each group to refer to concrete examples from research.

## World Wide Web References

- **Cornell University.** A comprehensive list of resources on language universals: http://kybele.psych.cornell.edu/LU/
- **Linguistic Society of America.** A website with rich discussions about language acquisition, language, and the human brain. http://www.lsadc.org/
- **National Science Foundation.** A discussion of language and species other than human beings. http://www.nsf.gov/sbe/nuggets/start.htm
- **The Salk Institute.** Web source for research on language modality, American Sign Language, and the brain: http://lcn.salk.edu/lm_index.html
- **The New York University Interdisciplinary Lab.** Website featuring studies of mental structures and neural bases of human language: http://www.psych.nyu.edu/pylkkanen/lab

## Section IV: Test Questions

1. One area of evidence for language as a universal human characteristic is the fact that: (WWW)
   A. young children learn language from their caretakers.
   B. adults use motherese with their offspring.
   C. some animal species acquire language.
   D. all human beings, barring impairment, are capable of language learning.

2. Pidgin is a:
   A. second language.
   B. language invented by people thrown together without a common language. It typically draws lexical items from one or more of the contact languages, but develops its own primitive syntax.
   C. language developed by children who were taken out of one environment and placed in another before their first language syntax was complete.
   D. language that develops in second generations from the simple language that two groups have developed to communicate in the absence of a common language.

3. Creole is a language that: (WWW)
   A. is acquired after Pidgin.

B. is invented by people thrown together without a common language. It typically draws lexical items from one or more of the contact languages but develops its own primitive syntax.
C. is learned by children born into a community in which a pidgin language is used as a common means of communication. The children add to the language and develop syntax complexities.
D. is developed by children who were taken from environment and placed in another before their first language syntax was complete.

4. Alternative views on the nature of Creoles include the idea that:
    A. Creoles are produced when one culture dominates a neighboring culture's use of their native language.
    B. Creoles develop when people import a language for the community to learn.
    C. Creoles result from the common uses to which all languages are put.
    D. shared features of independently arising Creoles indicate that human beings create only one kind of language system.

5. Alternative views on the origin of pidgins include the idea that:
    A. Pidgins develop from the common use of language rather than from properties of the human mind.
    B. Pidgins develop because one linguistic community dominates the other.
    C. Pidgins develop from the lack of mature adult models of the child's original language.
    D. Pidgins originate due to the invariance hypothesis.

6. Development of the Nicaraguan sign language provides an opportunity to examine: (WWW)
    A. how deaf children develop their own sign language in a new community.
    B. the universal development of a more-evolved form of sign language.
    C. sign language pidgins.
    D. the development of pidgins by comparing the complexities in aspects of sign language use in the early stages of the school existence to use in later stages.

7. One of the changes observed during the development of Nicaraguan sign language was that:
    A. children acquired differing spatial modulations of sign language at younger ages over time.
    B. comparisons between younger and older children showed that signs for objects became more complex for the older children.
    C. use of structure in the language changed from a structurally simpler language over time to a more complex structure of language.
    D. the location of where signs were placed for nouns became more complex over time.

8. The language bioprogram hypothesis developed to explain:
    A. how children acquire pidgins.

B. the underlying theory of language universals.
C. that humans are endowed with a "skeletal" or "core" grammar which is comprised of all or a portion of the human species-specific capacity for syntax.
D. aspects of developing internal knowledge of language.

9. Researchers agree on the view that creolization, language creation, and language acquisition:
    A. develop in the same way.
    B. demonstrate a number of nonlinguistic cognitive mechanisms that seek a solution to communicate.
    C. demonstrate how children analyze and adapt language input in their development of semantic, syntactic and morphological structures.
    D. provide evidence on how the language development process is an intrinsic part of human nature.

10. The human vocal tract is: (WWW)
    A. Better-adapted for producing speech and less well-adapted for other functions than the vocal tracts of other animals.
    B. less well-adapted for producing speech and better-adapted for other functions than the vocal tracts of other animals.
    C. equally well-adapted for speech and biological functions as the vocal tracts of other animals.
    D. equally well-adapted for biological functions, but better-adapted for speech than the vocal tracts of other animals.

11. The functional architecture of the brain is:
    A. the physical structure of the brain.
    B. the relationship of the cerebral cortex to the subcortical parts of the brain.
    C. how the brain is organized to do what it does.
    D. the brain connections between hemispheric functions.

12. The study of nueroanatomy is applied to:
    A. investigations of how the cerebral cortex and subcortical structures influence language development.
    B. research on whether language is a separate, isolated function or a factor of human beings' general cognitive development.
    C. explain the role of the corpus collosum in language delayed individuals.
    D. examine how contralateral connections determine language development milestones.

13. The cerebral cortex of the brain is:
    A. the outer layer of the brain that covers the subcortical structures.
    B. hidden by the corpus collosum.
    C. known to control primitive functions, such as eating and breathing.
    D. an undifferentiated mass that is studied as "the language organ."

14. Which of the following describes contralateral connections to the brain?:
    A. The right side of the body is controlled by the left side of the brain.
    B. The right side of the body is controlled by the right side of the brain.
    C. The two sides of the brain are equally important in controlling both sides of the body.
    D. None of these answers, as language is equally represented in both sides of the brain.

15. The lesion method, split brain studies, and brain imaging techniques are: (WWW)
    A. treatment techniques for aphasia.
    B. neurolingistic investigation.
    C. diagnostic techniques for aphasia.
    D. methods to examine different parts of the brain and how they relate to impaired functioning.

16. Dichotic listening tasks refer to: (WWW)
    A. the fact that contralateral connections from the ear to the brain are stronger than ipsilateral connections.
    B. experiments using two different stimuli, one after another, for listening tests.
    C. examining the effect of listening to two similar sounds at the same time.
    D. discriminating between loud and soft sounds occurring at the same time.

17. The ERP, or event-related brain potential, method of studying the brain is used:
    A. to examine lesions, or localized areas of damaged brain tissue.
    B. to provide a unique explanation of how each hemisphere of the brain functions.
    C. when placing electrodes on the scalp and monitoring the electrical potential of neurons.
    D. to wave more accurate results with infants or young children than with adults.

18. ERP research on adults provides:
    A. information that certain areas of the brain are associated with specific language processing functions.
    B. poor information about what is detected on the surface of the brain.
    C. a non-invasive way to study functional asymmetry.
    D. little information about how syntactic rules are applied to spoken language.

19. Aphasia is _____. (WWW)
    A. a total loss of ability to speak
    B. evidence of language learning capacity
    C. an impairment of language due to brain injury
    D. mild language loss due to bilateral connections

20. Research on split-brain patients:
    A. demonstrates that language is impaired when the corpus collosum is severed.

B. provides evidence on how individuals with impaired communication develop language skills.
C. provides information on how each side of the brain performs language functions.
D. indicates that language is primarily stored on the right side of the brain.

21. Dichotic listening experiments examined adults and found that there is:
    A. a right-ear advantage for speech stimuli.
    B. a right-ear advantage for adult users of language.
    C. a left-ear advantage for adult users of language.
    D. evidence of the invariance hypothesis.

22. Research on functions of the left hemisphere demonstrates that:
    A. analytical processing is primarily a function of the left hemisphere.
    B. musical processing engages the left hemisphere.
    C. the organization of the left hemisphere is especially suited for language processing.
    D. None of these answers are true.

23. Right-hemisphere lesion patients sometimes:
    A. have severe pathology in speech production.
    B. have increased capacity in the corpus callosum.
    C. have limited use of syntax, semantics and pragmatics.
    D. produce abnormal intonation contour when speaking, as well as have difficulties recognizing emotional tone.

24. Evidence for individual and sex-related differences indicates that:
    A. women tend to have stronger right hemisphere language functions than men.
    B. women show more bilateral participation in language than men.
    C. brain organization is related to sex-difference.
    D. people who are left-handed have stronger right hemisphere language functions.

25. Broca's area is in the: (WWW)
    A. front part of the left hemisphere near the part of the cortex that controls movement.
    B. rear part of the left hemisphere next to the primary auditory cortex.
    C. front part of the right hemisphere near the part of the cortex that controls movement.
    D. front part of the left hemisphere that displays localization of function.

26. Localizations of language functions are:
    A. evidenced in studies of the primary auditory cortex, or Wernicke's area.
    B. evidenced in clear studies of linguistic jobs and mapping of the brain.
    C. not clearly evidenced in studies of linguistic jobs and mapping of the brain.
    D. evidence of associated memory systems.

27. The equipotentiality hypothesis holds that:
    A. the left hemisphere is specialized for language at birth.
    B. the right hemisphere is specialized for language at birth.
    C. the right and left hemisphere have equal capacity for language at birth.
    D. language is equally well-processed by both hemispheres throughout childhood.

28. The invariance hypothesis refers to the view that:
    A. children and adults have the same potential for processing language in the left hemisphere.
    B. is opposite to the equipotentiality hypothesis.
    C. specialization for language is normally in the right hemisphere for children.
    D. children have the potential to process language only in the left hemisphere.

29. Using dichotic listening tasks, children have shown to have a right ear advantage for processing speech as young as _____.
    A. six months
    B. one and one half years
    C. two years
    D. three and one half years

30. Research on left-hemisphere functioning with infants suggests that
    A. specialization does not begin in infancy.
    B. infants utilize both the left and right hemisphere equally in the first months of life.
    C. specialization emerges earlier for infant girls.
    D. specialization is in the left hemisphere from birth.

31. Children suffering from childhood aphasia: (WWW)
    A. almost always have right-hemisphere injury and rarely followed left-hemisphere injury.
    B. almost always have left-hemisphere injury and rarely followed right-hemisphere injury.
    C. have equal potential for injury on either side of the brain.
    D. do not have related brain injury.

32. Current research on aphasia and brain injury prior to language indicates that:
    A. children store language in the same centers of the brain as adults.
    B. brain damage prior to language causes the same general delays for expressive language and language comprehension.
    C. children who suffer brain damage in infancy reflect a different relation of injury to site than do studies of adults.
    D. early left hemisphere damage impairs language acquisition more than later right hemisphere damage.

33. Neural plasticity means:
    A. parts of the brain are able to take over functions that they would normally not serve.

B. all parts of the brain are equally capable of performing all functions.
C. individual parts of the brain rejuvenate after injury.
D. the brain becomes more flexible with increasing age.

34. Brain plasticity in children is the result of:
A. the early development of neural redundancy which decreases after age two.
B. increasing redundancy of neural fibers with increasing age.
C. increases in functional asymmetry.
D. decreases in functional asymmetry.

35. The critical period hypothesis states that:
A. there is a critical length of time that is required for language to develop in children.
B. there is a critical age range during which chidlren are able to develop language.
C. it is critical that adults provide input to children in order for them to develop language.
D. children must be at least as old as the critical age before they can develop language.

36. The story of Genie suggests that:
A. by age eight, a left hemisphere that has never been used for language has lost that capacity.
B. humans do not lose their capacity to develop language.
C. by age 13, a left hemisphere that has never been used for language has lost that capacity.
D. after age 13, the right hemisphere will take over so that language will develop normally after that time.

37. Research on deaf children of deaf parents who have American Sign Language from birth is used to study:
A. how children develop differently when they communicate with signs.
B. how the brain processes language expressed in manual communication.
C. the critical period hypothesis by comparing the children to deaf children of hearing parents.
D. language comprehension.

38. Evidence from second language acquisition indicates:
A. the age at immigrating to the United States and the number of years of living in the United States determines language levels.
B. adult language learners have little plasticity in the brain.
C. adult language learners typically do not acquire proficient use of the second language for complex reasons.
D. adult language learners semantic competence due to lack of exposure at a young age.

39. Research on adults who learn English as a second language demonstrates that:
    A. the number of years in the new language community influences how much language the individual acquires.
    B. the age of arrival in the new community determines the accent of the immigrant.
    C. both number of years and age of arrival in the new community affect the immigrant's accent.
    D. None of these answers are true.

40. Principles of discontinuity suggest that if an individual arrives in the United States late in life, then it is expected that:
    A. the individual will not be proficient in the new language at certain ages.
    B. the individual will not have capacity to learn the new language.
    C. a window of opportunity exists during which the individual can learn the new language.
    D. puberty marks the age at which immigrants will stop being able to acquire the new language.

41. Non-biological influences on second language acquisition include:
    A. input conditions, which differ between children and adults.
    B. the age at which the learner is exposed to the new language.
    C. social and psychological variables.
    D. All of these answers are true.

42. Recent research on the genetic basis of language development suggests that:
    A. genetics are the major influence on language development abilities.
    B. environmental effects have a greater influence on grammatical development than on lexical development.
    C. environmental effects have a greater influence on lexical development than on grammatical development.
    D. environmental effects have the greatest influence on language development abilities.

43. The natural communication systems of language have been studied in other species:
    A. in order to prove the existence of language universals.
    B. as a means of defining which species relate to the human species.
    C. and has revealed that some species have complex communication systems, the study of which leads to defining the critical attributes of human language systems.
    D. to define the biological nature of human language acquisition.

44. Studies of the genetics of language impairment indicate that
    A. elements of language development are genetically determined.
    B. speech development is determined by a complex set of genetic and molecular biological features.
    C. the ease and speed of language development have a strong genetic foundation.
    D. All of these answers.

45. Efforts to teach chimpanzees to speak have yielded: (WWW)
    A. clear evidence of the generative nature of language.
    B. evidence of researchers' contamination of results of the studies.
    C. evidence of cognitive and linguistic differences in the language acquisition process.
    D. evidence that sign language acquisition relates to hemispheric specialization.

## Section V: Essay Questions

1. Discuss the arguments for and against the view that language is a human universal.

2. Describe the anatomy of the vocal tract and how it is related to language production.

3. Explain how the brain is structured and organizes language information. Include a discussion of such terms as Broca's area, auditory cortex, motor cortex and Wernicke's area. (WWW)

4. Newly emerging research suggests there is evidence of the brain's "plasticity". Discuss what this means and how it relates to what is known about brain development and language development.

5. The "critical period hypothesis" has much influence on the field of language acquisition. Explain what this term means and describe the various ways it is researched, applied and questioned.

6. Discuss the current issues in second language acquisition and how research has changed regarding adult second language learners. (WWW)

7. Discuss the range of studies that inform research on the degree of the genetic basis of language development. Include a review of the literature on twin studies, evidence of environmental effects, and on the genetics of language impairment.

8. Compare and contrast how species other than human beings learn language, to how human beings learn language. (WWW)

9. Compare and contrast literature on the biological bases of language development. Develop an argument for or against a genetic basis to a species-universal view of language development.

10. Define the term "evolutionary psychology." Review three researchers' studies in this field and describe the results of their research.

## Section VI: Answers to Multiple Choice Questions

1. D, page 40
2. B, page 40
3. D, page 41
4. C, page 42
5. A, page 42
6. D, page 42

7. C, page 42
8. C, page 43
9. D, page 43
10. A, page 44
11. C, page 44
12. B, page 45
13. A, page 46
14. C, page 47
15. D, page 47
16. A, page 47
17. C, page 48
18. A, page 48
19. A, page 49
20. C, page 50
21. C, page 51
22. A, page 52
23. C, page 52
24. D, page 53
25. B, page 53
26. A, page 53
27. C, page 56
28. D, page 56
29. D, page 56
30. D, page 57
31. B, page 57
32. C, page 59
33. A, page 59
34. A, page 60
35. B, page 61
36. C, page 62
37. C, page 64
38. C, page 64
39. D, page 65
40. C, page 66
41. D, page 67
42. B, page 67
43. C, page 69
44. D, page 71
45. B, page 76