

Chapter 2

Epigenesis and the Brain: The Fundamentals of Behavioral Development

Outline

I. The Nature-Nurture Illusion

II. Epigenesis and Coaction

Conception and Early Growth

Defining epigenesis and coaction

The cell as the scene of the action

Gene regulation: The heart of coaction

More about genes

III. Atypical Development

The influence of defective gene alleles

The influence of chromosomal abnormalities

Teratogenic influences

Nutritional influences

IV. The Developing Brain

Early prenatal brain development

Box 2.1 - The Major Structures of the Brain

Structure and function of neurons

Later prenatal brain development

Postnatal brain development

V. The Developing Stress and Adaptation System

Classic and contemporary views of stress and adaptation

The architecture of the stress response

VI. Applications

Box 2.2 - Do Numbers Matter? The Relationship Between Early

Stress and Later Adversity

Healthy baby guidelines

Helping the most vulnerable: Preterm and LBW babies

The healing touch

What is massage therapy?

Beyond massage therapy

VII. Summary

VIII. Case study

IX. Journal questions

X. Key terms

Chapter 2

Multiple Choice Questions

- Complete the following analogy: genotype is to phenotype as
 - gene is to chromosome
 - DNA is to RNA
 - code is to expression
 - night is to day
- Brown eye-color alleles are dominant over blue eye-color alleles, which are recessive. Jenna has brown eyes. Her husband, Bill, has blue eyes. Jenna and Bill are the biological parents of James, who has blue eyes. What eye-color gene alleles must Jenna have?
 - Bb (one brown and one blue allele)
 - BB (two brown alleles)
 - bb (two blue alleles)
 - BBB (three brown alleles)
- Brown eye-color alleles are dominant over blue eye-color alleles, which are recessive. Jenna has brown eyes. Her husband, Bill, has blue eyes. Jenna and Bill are the biological parents of James, who has blue eyes. Jenna would be described as _____ of the allele for blue eyes.
 - having the phenotype
 - being a regulator
 - having the genotype
 - being a carrier
- Recessive, defective gene alleles can cause hereditary disorders. It is estimated that most people carry _____ recessive, defective alleles in their genotypes.
 - zero
 - three to five
 - hundreds of
 - thousands of
- The epigenome is the full set of factors, from the cell to the outside world, that controls the expression of
 - hereditary material.
 - recessive genes.
 - the zygote.
 - histones.
- One epigenetic change that can affect the expression of a gene is methylation, which is

- a. the subtraction of an organic molecule from DNA
 - b. the addition of an organic molecule to DNA
 - c. the addition of RNA to DNA
 - d. the effect of hormones on DNA
7. In one animal study of the influence of genes on behavior, offspring of rats with genes for low stress reactivity were reared by unrelated mother rats with genes for high stress reactivity. This is an example of
- a. a survey study.
 - b. a cross-fostering study.
 - c. a longitudinal study.
 - d. a comparative study.
8. In one study, young rats exposed to stress vocalized their anxiety. Their mothers, alerted to this distress, responded with diligent caregiving behavior that altered the development of the hippocampus. Which of the following processes or principles does this example demonstrate?
- a. Dominant-recessive gene relationships.
 - b. Active gene effects.
 - c. The role of regulator genes in behavior genetics.
 - d. Epigenesis.
9. Based on your knowledge of prenatal development, which of the following sequences would you expect to be correct?
- a. The heart begins to form before the hands.
 - b. The hands begin to form before the heart.
 - c. The legs begin to form before the head.
 - d. The feet begin to form before the lungs.
10. Which of the following statements is true about the effects of teratogens on the developing fetus?
- a. Any given teratogen usually has the same effect regardless of when in prenatal development exposure occurs.
 - b. The kind of damage done depends on the stage of development during exposure.
 - c. A teratogen will usually have the same effect regardless of how much exposure the fetus has to that teratogen.
 - d. Ancient Greeks believed in teratogens, but modern science has been unable to identify any.
11. When she was pregnant with Joey, Joey's mother had a poor diet because food was in short supply in her war-torn country. The war ended after Joey was born, and his middle-class mother was able to provide him with adequate, nutritious food throughout his childhood. Which of the following outcomes is the most likely for Joey?

- a. Joey may show few, if any, long term negative effects from his prenatal deprivation.
 - b. Joey will probably experience serious long-term cognitive deficits.
 - c. Joey will probably experience serious long-term emotional deficits, but not cognitive problems.
 - d. Joey is at greater risk of serious ongoing health problems than youngsters who have adequate prenatal nutrition.
12. The available data indicate that chronic maternal stress during pregnancy has which of the following effects on the fetus?
- a. No effects
 - b. Arouses the fetus's own stress response temporarily, but has no lasting effects
 - c. Is related to newborn hyperactivity and irritability
 - d. Causes long term psychopathology
13. The hypothalamic-pituitary-adrenal axis (HPA axis) plays a significant role in
- a. the human response to stress.
 - b. X-linked recessive diseases.
 - c. determining the sex of a fetus.
 - d. determining eye color.
14. Which of the following is an accurate description of the long-term effects of chronic stress on the body?
- a. The ability of the immune system to fight infection and ward off disease is compromised.
 - b. There are no effects on the immune system, and only short term effects on the cardiovascular system.
 - c. There are no effects on the cardiovascular system, but long term effects on the skeletal muscles.
 - d. There are no lasting effects on the body – when the stress ends all physical systems return to normal.
15. Ms. Dawson recently gave birth to twins, a girl and a boy. Which of the following statements about them must be true?
- a. They share 100 per cent of their genes.
 - b. They are monozygotic.
 - c. They are dizygotic.
 - d. They originated from a single zygote.
16. There are 46 of these in the nuclei of human cells, they are composed of deoxyribonucleic acid.
- a. Teratogens
 - b. Zygotes
 - c. Chromosomes
 - d. Genes

17. Which of the following is the best example of neuroplasticity?
- Cells from the hippocampus are instrumental in encoding memories.
 - The 3-year-old's brain is approximately three-fourths of its adult size.
 - Fetal brains grow quickly, increasing in weight over the course of pregnancy.
 - Neurons that are transplanted from the auditory cortex to the visual cortex begin to perceive light.
18. Neurons communicate with each other
- by means of chemicals that are present in the spaces between them.
 - by means of dendrites touching other dendrites.
 - by means of electrical impulses that radiate out of the myelin sheath.
 - by means of connections with glial cells.
19. Fetal brains are built by neurons
- that are generated by the cortex.
 - that migrate from the top of the brain down to the lower brain.
 - that migrate from the bottom of the brain up to the higher areas.
 - that migrate from the glial cells to the outside surface of the cortex.
20. Myelination is the process which involves
- neurons migrating to the temporal lobes.
 - separating the left and right hemispheres of the cortex.
 - coating the axon with a fatty sheath that improves conduction of electrical impulses.
 - development of the nuclei of the brain.
21. The brain is commonly classified into three main parts. They are
- midbrain, pons, and cerebellum.
 - forebrain, midbrain and hindbrain.
 - midbrain, forebrain and cerebral cortex.
 - cerebellum, medulla and limbic system
22. The process of myelination is not completed until
- well into adulthood.
 - middle childhood.
 - the end of infancy.
 - around age 5 or 6.
23. Which of the following is true with respect to the impact of nurture on the fetus' developing brain?
- Fetal brain development is almost totally dependent upon the fetus' genetic inheritance because it has no environmental experience in the

- womb.
 - b. The development of the lower, primitive areas of the brain depend upon nature but the higher levels depend upon nurture.
 - c. Mothers can advance the fetus' intelligence significantly by speaking out loud in foreign languages during pregnancy.
 - d. The establishment of some synaptic connections in the fetal brain depends upon environmental input, like sound.
24. Most postnatal brain growth depends upon the proliferation of
- a. synapses.
 - b. myelination.
 - c. neurotransmitters.
 - d. glial cells.
25. If you look at the karyotypes of person A and person B and discover that they look alike, what can you infer is the same about these two people?
- a. Their parents.
 - b. Their sex.
 - c. Their height.
 - d. Their blood type.
26. Sally, age 28, recently married John, age 45. They would like to have a child, but they are concerned that they may be at high risk to have a child with a chromosomal abnormality, like Down's syndrome, because of John's age. What is their genetic counselor likely to tell them?
- a. They are at higher than average risk for some chromosomal disorders because of John's age, but not for Down's syndrome.
 - b. They are at higher than average risk for chromosomal disorders of all sorts because of John's age.
 - c. There is no relationship between parents' age and chromosomal disorders in their offspring.
 - d. The risk of *any* chromosomal disorder in a child is only related to the mother's age, not to the father's age.
27. For most mental illnesses and behavioral disorders, like alcoholism and clinical depression, the genetic contribution can best be described as
- a. the result of a pair of recessive, defective genes.
 - b. the result of a dominant, defective gene.
 - c. the result of a single gene mutation.
 - d. polygenic.
28. Symptoms of fetal alcohol syndrome (FAS) include
- a. addiction to alcohol.
 - b. blindness and shortened limbs.
 - c. flipper arms.
 - d. widely spaced eyes and flattened nose.

29. Children who suffer severe protein and calorie shortages at any age may experience stunted growth, a protuberant belly, and extreme apathy. This severe starvation syndrome is called
- lowest observable effect.
 - kwashiorkor.
 - Huntington's disease.
 - proximo-distal development.
30. Of the following, which is the most accurate example of coaction?
- Genes that are related to a specific disorder may be expressed phenotypically only in a certain kind of environment.
 - Genes for a disorder that are on the X-chromosome will only be expressed in females.
 - The environment and the genes have an equal influence on a disorder.
 - Genes will have a greater influence on the development of a disorder when the genes are dominant.
31. Robert and Nadine both have been laid off. The couple has inadequate access to food or health care. When they realize that Nadine is pregnant, they feel desperate, and they talk to a social worker at a local clinic about their situation. The social worker is able to provide them with referrals to a food outlet, but she is unable to find a prenatal care clinic that provides free services in their neighborhood. Considering the effects of multiple risk factors, what is the most likely potential value of the social worker's efforts?
- The fewer risk factors the better, so their unborn child is likely to be better off even with the limited help the social worker provided.
 - Their unborn child is not likely to be benefited by eliminating only one risk factor.
 - The unborn child might have been benefited if prenatal care were found, but improving prenatal nutrition is not important.
 - The health care and stress factors will only be important after the child is born.
32. Massage therapy for infants has been very successful in promoting weight gain and social interaction, and in decreasing distress in low birth weight infants. Based upon developmental research, what is the best explanation for this?
- Infants' bodies take in more nutrients when they are touched as they nurse.
 - Touch is the best developed sense at birth and therefore the most effective avenue for soothing and regulating the newborn.
 - When the infant is massaged, its attachment to the caregiver is strengthened.
 - Crying and other distress is reduced because the infant is paying attention to the person giving the massage.

Chapter 2 Essay Questions

(See answer key for potential essay answers)

33. Genes have their effects on the proteins and enzymes produced by the cell. Yet, there appear to be genetic influences on behavior. Take some example of a behavior or a behavioral disorder, and explain how genes operating at a cellular level could have any effect at the behavioral level.
34. Explain why it is important for a helping professional to be aware of the coaction of genes and environment. Be sure to include a definition of coaction, with examples.
35. There are several principles that govern the effects of teratogens on the developing fetus. Describe these principles, giving examples.
36. What advice could you provide a pregnant teenager in order to help her assure the health of her baby?