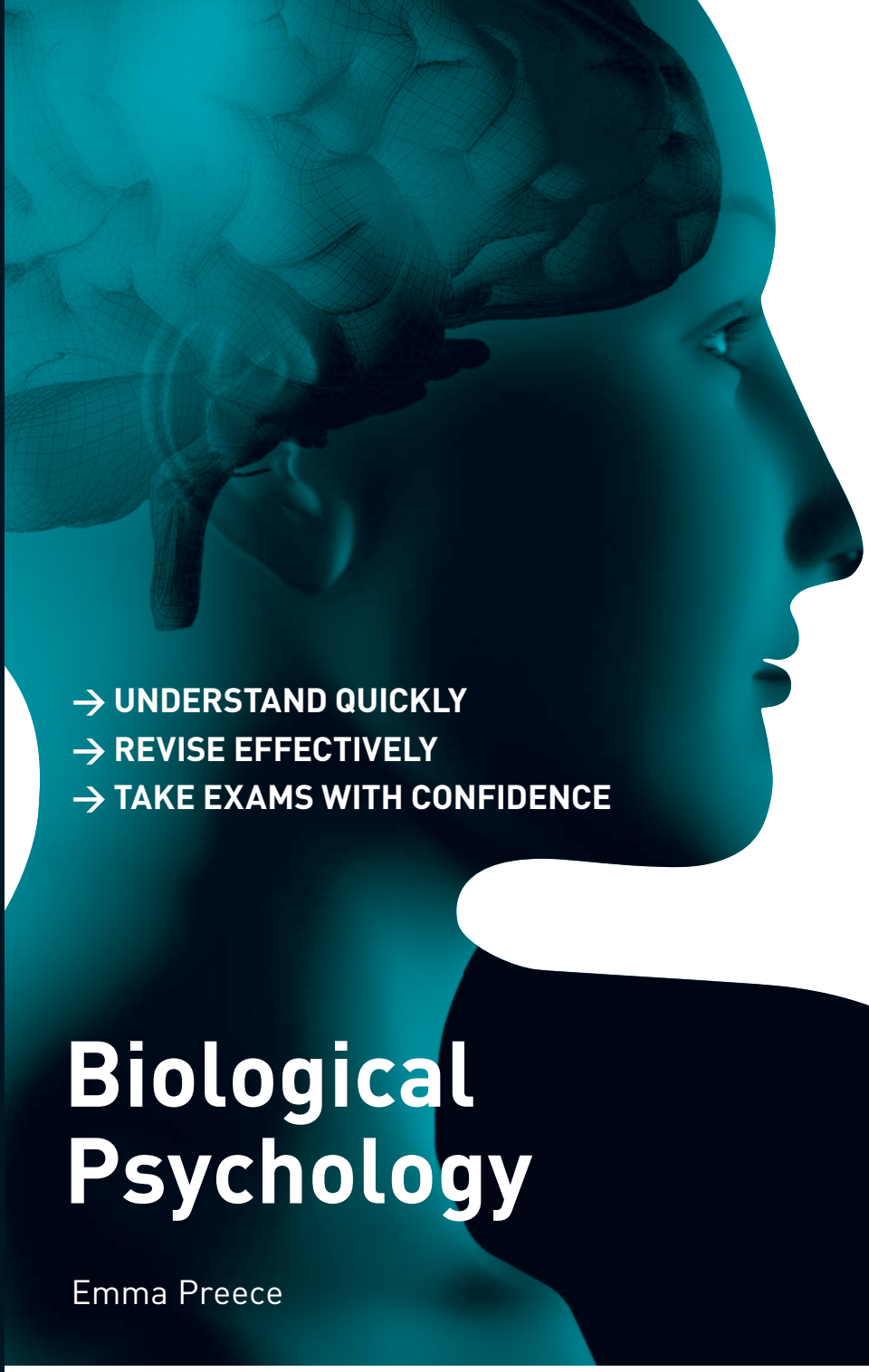

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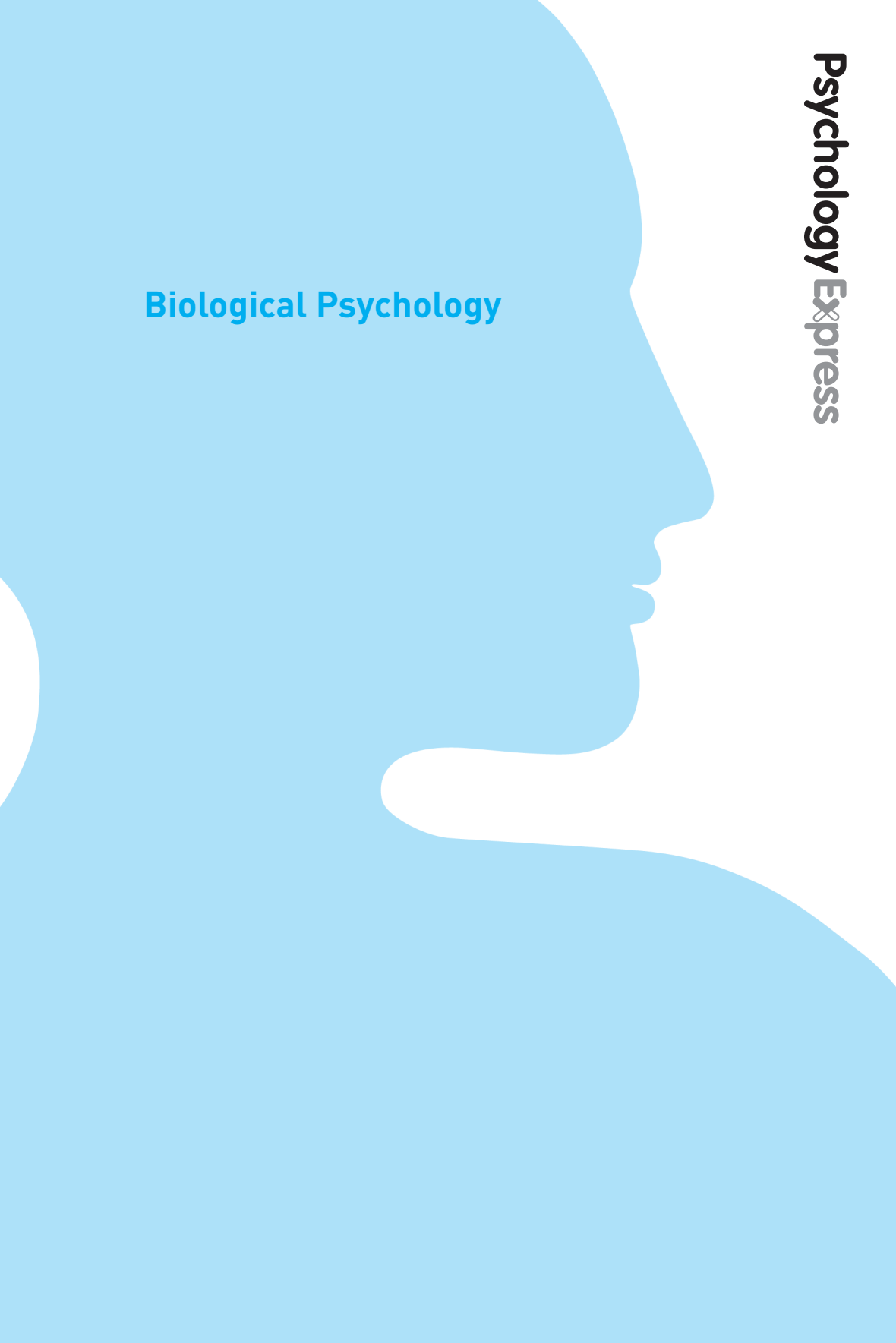

Test your knowledge

3.1 Which glands secrete their chemicals directly into the bloodstream?

3.2 What are the functions of the adrenal gland?

3.3 What are the functions of the pituitary gland?

3.4 What chemicals are produced by the pancreas?

Answers to these questions can be found on the companion website at: **www.pearsoned.co.uk/psychologyexpress**

Hormones

You may be aware that hormones are chemicals which arise naturally in the body and are associated with moods, behaviour and development (Carlson, 2004; Pinel, 2003). Hormones can be divided into three categories consisting of amino acid derivatives, peptides and proteins and finally steroids. A summary of these types of hormones is provided in Table 3.1 to help you refresh your memory.

Table 3.1 Types of hormone

Type of hormone	*Characteristics*
Amino acid derivatives	These substances are synthesised from epinephrine and are involved in the synthesis and transmission of peptides, proteins and neurotransmitters.
Peptides and proteins	These hormones are short and long chains of amino acids and facilitate physiological, biochemical and growth processes.
Steroids	These hormones are synthesised from cholesterol and play a large role in sexual development. Unlike other hormones they can bind to receptors and penetrate cell membranes allowing them to alter the manifestation of genetic characteristics. Effects are long-lasting. The sex steroids also include androgen, estrogen and progesterone which prepare the females for reproduction and parenting.

It is also important to remember that abuse of artificial substances which simulate the effects of steroids or natural imbalances of these substances can have serious consequences for health and wellbeing. For example, they can result in testicular atrophy, sterility, mood swings and gynecomastia (growth of breasts) in men. In women they can result in amenorrhea, sterility, mood swings, hirsutism (male pattern hair growth in women), abnormal male body shape, deepening of the voice, baldness, shrinking of the breast and growth of the clitoris. This demonstrates how hormones can significantly alter physical growth and impair health.

Sample question *Essay*

Critically discuss the belief that steroids significantly influence sexual development.

Sample question *Problem-based learning*

One of your colleagues would like to investigate whether the injection of testosterone and estrogen into human female and male foetuses will result in stereotypically male and female behaviour respectively. They have asked for your advice concerning the ethical and practical implications of this research. What advice and evidence would you provide?

Further reading Hormones

Topic	*Key reading*
Steroids and sexual behaviour	Mani, S. K., Allen, J. M. C., Clark, J. H., Blaustein, J. D., & O'Malley, B. W. (1994). Convergent pathways for steroid hormone- and neurotransmitter-induced rat sexual behavior. *Science*, *265*(5176), 1246–1249.

Test your knowledge

3.5 Which type of hormone is derived from cholesterol?

3.6 What are the main functions of steroids?

3.7 What are the main functions of amino acids?

3.8 What are the effects of steroid abuse?

Answers to these questions can be found on the companion website at: **www.pearsoned.co.uk/psychologyexpress**

Regulation of the endocrine system

Hypothalamus-releasing hormones play a large role in the regulation of the endocrine system which you should be aware of. Indeed, hormones tend to be topic which means that they stimulate or inhibit the release of other hormones (Carlson, 2004; Schommer, Hellhammer & Kirschbaum, 2003). For example, hormones from the hypothalamus trigger the release of thyrotropin-releasing hormones from the anterior pituitary which in turn stimulate the thyroid to release its hormones. Gonadotropin-releasing hormones also stimulate the release of follicle-stimulating hormone (FSH) and luteinising hormone (LH), which facilitate ovulation.

Key term

Topic: The term assigned to hormones which stimulate or inhibit the release of other hormones.

There are significant gender differences in the regulation of the endocrine system by the hypothalamus. For example, while the level of hormones in males remains relatively stable across time, female gonadal hormones are cyclical (Carlson, 2004; Kirschbaum, Kudielka, Gaab, Schommer & Hellhammer, 1999; Pinel, 2003). This cycle is on average 28 days and you will probably know that it stimulates the menstrual cycle including the development and release of an ovum and menstruation in the absence of conception. However, during pregnancy and for a brief time after birth there is a period of amenorrhoea in which menstruation is suspended, allowing time for the uterus to recover. The process can also be controlled with hormonal birth control which simulates the natural gonadal hormone progesterone. Regulation of the endocrine system can be also performed by the central nervous system, peripheral nervous system and other biological chemicals such as glucose, calcium and sodium.

Further reading Regulation of the endocrine system

Topic	*Key reading*
Hypothalamus–pituitary–adrenal axis	Kirschbaum, C., Kudielka, B. M., Gaab, J., Schommer, N. C., & Hellhammer, D. H. (1999). Impact of gender, menstrual cycle phase, and oral contraceptives on the activity of the hypothalamus–pituitary–adrenal axis. *Psychosomatic Medicine*, *61*, 154–162.
Dissociation of endocrine system	Schommer, N. C., Hellhammer, D. C., & Kirschbaum, C. (2003). Dissociation between reactivity of the hypothalamus–pituitary–adrenal axis and the sympathetic-adrenal-medullary system to repeated psychosocial stress. *Psychosomatic Medicine*, *65*, 450–460.

Test your knowledge

3.9 Which structures and substances are involved in the regulation of the endocrine system?

3.10 What characteristic of hormones means that they can be called topic?

3.11 What is the main difference between the levels of hormones in males and females?

3.12 How can the endocrine system be regulated by engineered substances?

Answers to these questions can be found on the companion website at: **www.pearsoned.co.uk/psychologyexpress**

Developmental aspects of the endocrine system

You have probably already realised that steroids such as androgen, estrogen, testosterone and progesterone play a large role in sexual development and behaviour (Escobar, Obregón & Rey, 2004; Handwerger & Freemark, 2000). Indeed, we have already identified that steroids are able to penetrate cell membranes and influence gene expression (how characteristics manifest). These chemicals are also involved with the production of sperm and ova by the male and female gonads respectively. This facilitates the production of a zygote at conception which will eventually grow into a foetus influenced by all of these hormones. In females, progesterone also prepares the uterus for carrying a baby and facilitates breast feeding.

? *Sample question* ***Essay***

Which hormones can result in sex differences?

Up to six weeks after conception, all foetuses have the same primordial gonads with the potential to develop ovaries or testes (Carlson, 2004; Pinel, 2003). However, at this point ovaries automatically develop and the male Y chromosome triggers the synthesis of the protein H-Y antigen which stimulates the development of testes. External genitalia develop from the second month of pregnancy although there are recursors from the glands, urethral folds, lateral bodies and labioscrotal swellings. You should also be aware that at six weeks after conception all foetuses have two sets of reproductive ducts. These are the male Wolffian system and the female Müllerian system. However, at the third month of foetal development the testes release testosterone and a Müllerian-inhibiting hormone which promote the development of the Wolffian system while inhibiting further development of the Müllerian system. The development of the precursors are all triggered by hormones and are listed below:

- **Glans:** Head of penis in males or the clitoris in females.
- **Urethral folds:** Fuse in males, enlarge and become the labia minora in females.
- **Lateral bodies:** The shaft of the penis in males or hood of the clitoris in females.
- **Labioscrotal swellings:** Scrotum in males or labia majora in females.

In addition to the sexual differences which arise due to hormones there are also differences in male and female brains. For example, you should know that the male brain is on average 15 per cent larger than the female brain and there are structural differences in the hypothalamus, corpus callosum, anterior commissure, thalamus and cerebral cortex. These changes are believed to arise due to hormones in the form of perinatal androgens occurring near the time of birth. However, it is important to remember that all sex steroids are derived from cholesterol and can be converted to other sex steroids via a process called

aromatisation. This process may be responsible for the differences observed between male and female brains.

Key term

Aromatisation: The process by which sex steroids derived from cholesterol are converted into other sex steroids.

After foetal development the next significant stage in physical sexual development occurs during puberty. The secondary sexual characteristics develop during this time and include hair growth, body shape, voice deepening in males and breast growth in females. This growth spurt is stimulated by the release of hormones from the anterior pituitary gland and results in an increase in gonadal hormones, the maturation of the sexual organs and development of secondary sexual characteristics.

Therefore, it is important that you remember that hormones and the endocrine system play a significant role during physical development (García-Aragón et al., 1992; Pinel, 2003; Reiter, 1991). However, you should also remember that many other factors influence the rate and nature of physical development. These can include:

- nutrition
- mother's wellbeing
- social norms and culture
- other health conditions of the child
- premature birth
- socioeconomic status.

? *Sample question* ***Essay***

To what extent is sexual development the product of the endocrine system?

Further reading Developmental aspects of the endocrine system

Topic	*Key reading*
Central nervous system development	Chan, S, & Kirby, M. D. (2000). Thyroid hormone and central nervous system development. *Journal of Endocrinology*, *165*(1), 1–8.
Thyroid hormones and foetal brain development	Escobar, G. M., Obregón, M. J., & Rey, F. E. (2004). Maternal thyroid hormones early in pregnancy and fetal brain development. *Clinical Endocrinology and Metabolism*, *18*(2), 225–248.
Foetal development	Handwerger, S., & Freemark, M. (2000). The roles of placental growth hormone and placental lactogen in the regulation of human fetal growth and development. *Journal of Pediatric Endocrinology and Metabolism*, *13*, 343–356.

Test your knowledge

3.13 How does the endocrine system influence the development of a foetus?
3.14 How does the endocrine system influence development in adolescence?
3.15 How would steroids influence gene expression?
3.16 What other factors may influence physical development?

Answers to these questions can be found on the companion website at:
www.pearsoned.co.uk/psychologyexpress

Hormones and sexual behaviour

The previous belief that sex steroids promote male and female stereotypical behaviour is not held in contemporary psychology due to a notable lack of evidence (Carlson, 2004; Orwoll & Klein, 1995; Pinel, 2003). Indeed, all of these substances are present in both males and females although the evolutionary role of the hormones may not be transparent. It is important to remember that early research linked the perinatal hormones to animal reproductive behaviour. For example, injections of testosterone near the time of birth were believed to masculinise and defeminise female copulation behaviour of the offspring. However, it is important to remember that this research makes the assumption that the behaviour would not have been masculine without testosterone injections and that the findings may not be generalised from laboratory animals to humans. Indeed, a significant degree of the research conducted with laboratory animals has investigated the effects of pheromones on the menstrual cycle and sexual behaviour. Pheromones are chemicals released by an animal which are perceived by another via smell or taste. Research has demonstrated that these chemicals can indicate when a female is likely to conceive. In females, pheromones can stimulate ovulation. However, it is important to remember that this research is not directly applicable to humans who do not rely on these substances. Table 3.2 will refresh your memory concerning some of the effects of pheromones observed in laboratory animals.

Key term

Pheromone: A chemical substance transmitted from one animal to another via smell or taste, usually to signal receptivity, availability, challenge or threat.