Biopsychology

INTRODUCTORY PSYCHOLOGY

This series of titles is aimed at psychology students in sixth forms and further education colleges and at those wishing to obtain an overview of psychology. The books are easy to use, with comprehensive notes written in coherent language; clear flagging of key concepts; relevant and interesting illustrations; well-defined objectives and further reading sections to each chapter, and self-assessment questions at regular intervals throughout the text.

Published

INDIVIDUAL DIFFERENCES

Ann Birch and Sheila Hayward

DEVELOPMENTAL PSYCHOLOGY

Ann Birch and Tony Malim

BIOPSYCHOLOGY

Sheila Hayward

COGNITIVE PROCESSES

Tony Malim

COMPARATIVE PSYCHOLOGY

Tony Malim, Ann Birch and Sheila Hayward

RESEARCH METHODS AND STATISTICS

Tony Malim and Ann Birch

SOCIAL PSYCHOLOGY

Tony Malim and Ann Birch

PERSPECTIVES IN PSYCHOLOGY

Tony Malim, Ann Birch and Alison Wadeley

Series Standing Order

If you would like to receive future titles in this series as they are published, you can make use of our standing order facility. To place a standing order please contact your bookseller or, in case of difficulty, write to us at the address below with your name and address and the name of the series. Please state with which title you wish to begin your standing order. (If you live outside the United Kingdom we may not have the rights for your area, in which case we will forward your order to the publisher concerned.)

Customer Services Department, Macmillan Distribution Ltd
Houndmills, Basingstoke, Hampshire RG21 6XS, England

BIOPSYCHOLOGY

Physiological Psychology

Sheila Hayward

© Sheila Hayward 1997

All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission.

No paragraph of this publication may be reproduced, copied or transmitted save with written permission or in accordance with the provisions of the Copyright, Designs and Patents Act 1988, or under the terms of any licence permitting limited copying issued by the Copyright Licensing Agency, 90 Tottenham Court Road, London W1P 9HE.

Any person who does any unauthorised act in relation to this publication may be liable to criminal prosecution and civil claims for damages.

First published 1997 by
MACMILLAN PRESS LTD
Houndmills, Basingstoke, Hampshire RG21 6XS
and London
Companies and representatives
throughout the world

ISBN 978-0-333-64613-7 ISBN 978-1-349-13885-2 (eBook)
DOI 10.1007/978-1-349-13885-2

A catalogue record for this book is available
from the British Library.

10	9	8	7	6	5	4	3	2	1
06	05	04	03	02	01	00	99	98	97

Editing and origination by
Aardvark Editorial, Mendham, Suffolk

Cartoons by Sally Artz

Contents

	List of Figures	vii
	Preface	ix
1	Introducing Biopsychology	1
	I What is biopsychology?	1
	II Methods of study in physiological psychology	3
	III Areas and approaches to psychology	9
	IV Models of the nervous system	13
2	Sensory Systems	17
	I The visual system	19
	II Visual pathways and perception	28
	III Auditory perception	30
	IV Other sensory inputs	37
3	The Nervous System and Behaviour	47
	I Cell structures and the communications network	49
	II The central nervous system	58
	III Neurochemicals	69
	IV How some psychoactive drugs act on the CNS	77
	V The autonomic nervous system	81

4	The Endocrine System	89
	I The pituitary gland	90
	II Other glands in the human endocrine system	91
	III Endocrine links with the nervous system	96
	IV Interactional effects with behaviour	96
5	Motivation and Emotion	103
	I Homeostatic motivation	104
	II Nonhomeostatic motivation	115
	III What is emotion?	120
	IV Theories and studies of emotion	125
	V Motivation, aggression and emotion	132
6	Stress and Anxiety	139
	I Stressors	141
	II Models of stress	148
	III Individual differences involved in stress	154
	IV Coping with stress	159
7	Altered States of Consciousness	165
	I Levels of consciousness	165
	II Body rhythms	173
	III The rhythms of sleep	176
	IV Why do we sleep?	184
	Epilogue	193
	Bibliography	195
	Index	203

List of Figures

- 1.1 CT scanner
- 1.2 An image from a CT scan
- 1.3 Electroencephalogram (EEG) recordings
- 1.4 Scanning techniques used in diagnosis

- 2.1 The Necker Cube
- 2.2 Diagram of the eye
- 2.3 Visual stimulus and retinal image
- 2.4 Diagrammatic representation of the structure of the retina, showing the difference between connections in the periphery and the fovea

- 2.5 Find your blindspot
- 2.6 Rods, cones and wavelengths of light
- 2.7 Visual pathways in the brain
- 2.8 The perceptual properties of sound
- 2.9 Diagram of the outer, middle and inner ear
- 2.10 Diagram of structures in the organ of Corti
- 2.11 Central pathways of the auditory system
- 2.12 Some commonly encountered noise levels
- 2.13 The olfactory system
- 2.14 Regions of the tongue involved in taste

- 3.1 Organisation of the nervous system
- 3.2 'See a friend and wave'
- 3.3 Diagrammatic representation of a neurone

viii *List of Figures*

- 3.4 The electrochemical process of nervous transmission
- 3.5 The synapse
- 3.6 A simple neural network model
- 3.7 Some areas of the cerebral cortex
- 3.8 Cross-section of the brain, showing some subcortical structures
- 3.9 A three-neurone reflex arc
- 3.10 The influence of dopamine pathways on movement
- 3.11 Norepinephrine is released
- 3.12 Summary table of the action of some psychoactive drugs
- 3.13 Actions of the ANS on organs of the body

- 4.1 Hormones of the pituitary gland
- 4.2 Some of the endocrine glands
- 4.3 Reactions of the nervous and endocrine systems to environmental stimuli
- 4.4 Relative amounts of sex hormones in the bloodstream throughout a 28-day menstrual cycle

- 5.1 Diagrammatic representation of homeostasis
- 5.2 Maslow's hierarchy of needs
- 5.3 Neural mechanisms for facial recognition
- 5.4 Diagrammatic representation of the physiological processes of emotion
- 5.5 The James–Lange theory of emotion
- 5.6 The Cannon–Bard theory of emotion

- 6.1 Stressors lead to stress responses
- 6.2 Social Readjustment Rating Scale
- 6.3 The general adaptation syndrome
- 6.4 The relationship between arousal and performance
- 6.5 The Transactional Model of Stress (Cox and Mackay)
- 6.6 Are you a Type A?

- 7.1 Summary diagram showing regions of the brain that have been reported to be involved in arousal or sleep
- 7.2 Normal sleep cycles of humans at different ages
- 7.3 Typical EEG traces for (NREM) stages of sleep and REM sleep

Preface

The aim of this book is to examine the relationships between the physiological mechanisms of the body, such as the sensory system, the nervous system and the endocrine system, and to see how these relate to mental processes such as those involved with perception, emotions, stress and biorhythms.

Chapter 1 discusses the reasons for studying physiology in conjunction with psychology, together with the methods of study used and the ethical basis for their usage. Information must first enter an organism before assimilation, learning or reactive behaviour can occur. This comes through one of the five senses: seeing, hearing, touch, taste, smell; therefore Chapter 2 looks at the human sensory systems. Chapters 3 and 4 examine the nervous and endocrine systems respectively, while Chapters 5–7 discuss the physiological and psychological interactions in areas such as emotion, motivation, stress and altered states of consciousness. Finally, readers are offered a glimpse into the future, as new methods of modelling the brain are outlined.

In line with other books in this series, the author has attempted to present material concisely, while giving as full an explanation as possible. It is hoped that the text may be used as an introduction to the area of physiological psychology, or as a revision text. Each chapter is prefaced by objectives to be met during that chapter, and each section within the chapter ends with some self-assessment questions, so that readers may test their own understanding of what has been read.

The independent student is advised to read through the text one section at a time and consider the questions at the end of each section. These may be reconsidered later, when the student has undertaken further reading. The aim of this book is to explain simply, one step at a time, so that nonbiologists will not feel disadvantaged.

While the books in this series are intended primarily for A level students, this particular volume is also likely to be useful to university undergraduates who are studying psychology, especially those without any science (biology/chemistry) background. In addition, students on nursing, BTec or social care courses may also find the book useful.

While 'introspection' is discouraged in many areas of psychology, the author here encourages readers to relate the phenomena described to their own personal physiological experiences, to try out demonstrations for themselves and to 'look and feel within their bodies', in order to become involved with the subject area under discussion.

To me, this is a fascinating area of study and one which I have always enjoyed teaching. I hope you will enjoy reading this book as much as I have enjoyed writing it.

Sheila Hayward

*This book is dedicated to my students, past, present and future,
especially my son, Robert, and my daughter, Emma.*

Acknowledgements

The author and publishers wish to thank the following for permission to use copyright material:

Tom Cox for material from T. Cox, *Stress*, 1978, Figure 1.10 (p. 19); *The New England Journal of Medicine* for material from Kales and Kales, *The New England Journal of Medicine*, **290**, 1974, Figure 1 (pp. 487–99); Oxford University Press for material from J.A. Horne, *Why We Sleep; The Functions of Sleep in Humans and Other Mammals*, 1988.

Every effort has been made to trace all the copyright holders, but if any have been inadvertently overlooked the publishers will be pleased to make the necessary arrangement at the first opportunity.

He's never met her, but he says she has the most beautiful brain scan and EEG's he's ever seen.