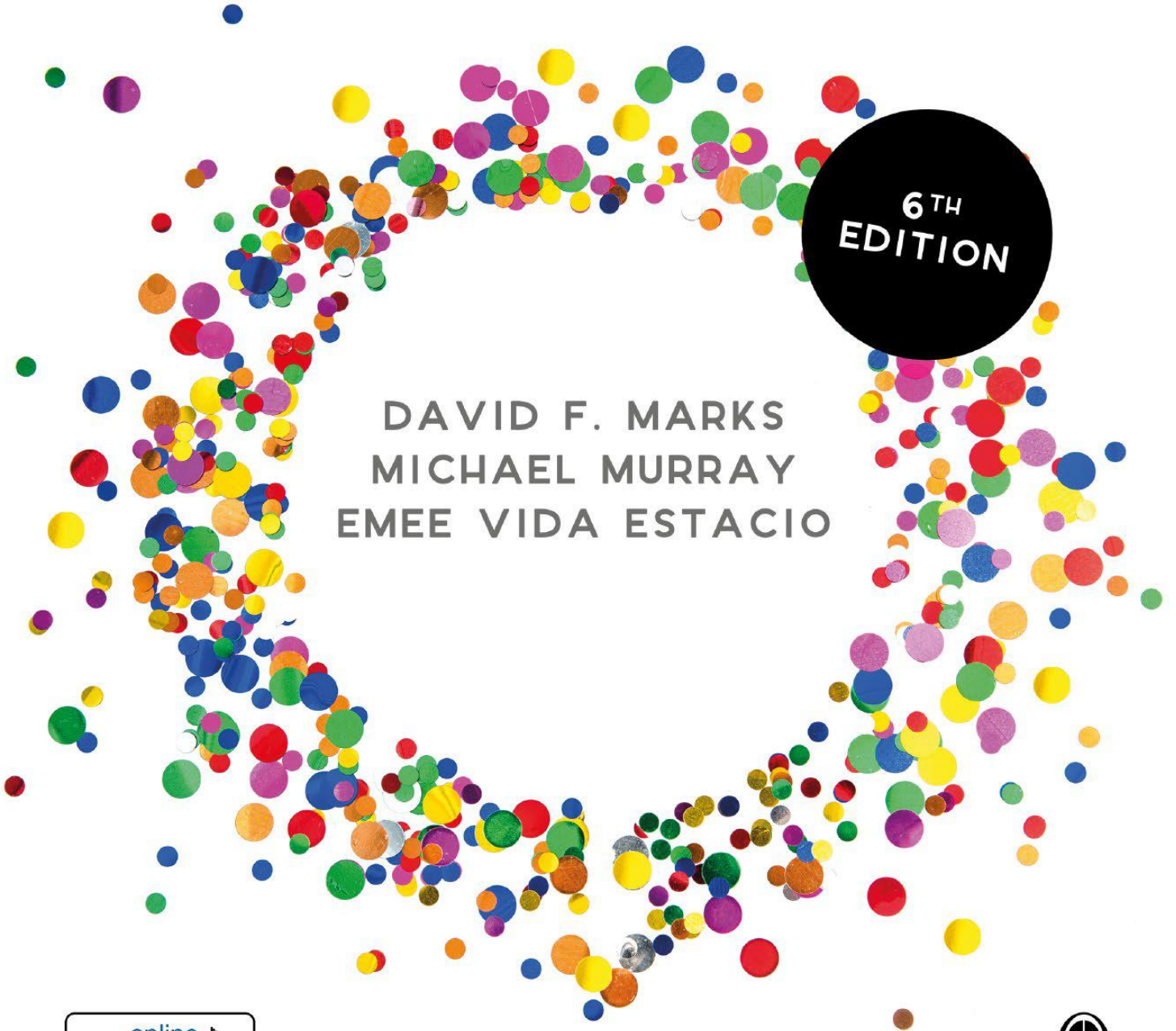
HEALTH PSYCHOLOGY

THEORY, RESEARCH AND PRACTICE



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First edition published 1999; reprinted 2002, 2003.
Second edition published 2005; reprinted 2008, 2009, 2010.
Third edition published 2010; reprinted 2011, 2013, 2014.
Fourth edition published 2015; reprinted 2016, 2017.
Fifth edition, published 2018; reprinted 2018 (twice), 2019 (three times). This, sixth edition, published 2021.

Editor: Donna Goddard
Editorial assistant: Marc Barnard
Assistant editor, digital: Sunita Patel
Production editor: Imogen Roome
Marketing manager: Camille Richmond
Proofreader: Leigh C. Smithson
Cover design: Wendy Scott
Typeset by: C&M Digitals (P) Ltd, Chennai, India
Printed in the UK

Library of Congress Control Number: 2020935695

British Library Cataloguing in Publication data

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

ISBN 978-1-5297-2308-3
ISBN 978-1-5297-2307-6 (pbk)

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David served as Chair of the British Psychological Society's Health Psychology Section and Special Group in Health Psychology and as Convenor of the European Task Force on Health Psychology when he was instrumental in establishing the first postgraduate health psychology training programmes at Master's and Doctoral levels in the UK. With Michael Murray, David is a founding member of the International Society of Critical Health Psychology. He is the founder and Editor of the *Journal of Health Psychology* and founder of *Health Psychology Open*. David is a specialist in theories, methods and psychometrics.

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EMEE VIDA ESTACIO is a chartered psychologist, author, speaker, and life transformation and health promotion specialist. Originally from the Philippines, she completed her Bachelor's degree in Psychology (magna cum laude) from the University of the Philippines, Diliman and her MSc and PhD in Health Psychology at City University London. She previously held positions at the University of East London and Keele University. Emee specialises in health promotion and community development and has facilitated action research projects in some of the most deprived areas in the UK and in the Philippines. As a scholar activist, she became actively involved in supporting activities for Oxfam, the Association for International Cancer Research, CRIBS Philippines and Save the Children UK. In addition to previous editions of this book, Emee is also the author of the 'Psychology in Your Life' Book Series (2019), including titles such as *The Imposter Syndrome Remedy*, *Change Your Life for Good* and *Fear is Not My Enemy*. She also sits on the editorial board of the *Journal of Health Psychology*, *Health Psychology Open* and *Community*, *Work and Family*.

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The Institute of Futures Studies for Figure 1.5, 'A framework for the determinants of health' Dahlgren, G., Whitehead, M. (1991). *Policies and Strategies to Promote Social Equity in Health*. Stockholm, Sweden: Institute for Futures Studies.

CHAPTER 2

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Springer Nature for Figure 2.10, Gamble, K.L., Berry, R., Frank, S.J. and Young, M.E. (2014). Circadian clock control of endocrine factors. *Nature Reviews Endocrinology*, 10 (8): 466–75.

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CHAPTER 3

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CHAPTER 15

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PREFACE

Welcome to *Health Psychology: Theory, Research and Practice (Sixth Edition)*. This textbook provides an in-depth introduction to the field of health psychology. It is designed for all readers wishing to update their knowledge about psychology and health, especially undergraduates and postgraduates taking courses in health psychology, medicine, nursing, public health, and other subjects allied to medicine and health care. The authors strive to present a balanced view of the field and its theories, research and applications. We aim to present the mainstream ideas, theories and studies within health psychology and to examine the underlying theoretical assumptions and critically analyse methods, evidence and conclusions. This edition updates all content from previous editions and adds significant, core topics from the biological and clinical domains.

All mainstream domains and topics relevant to health psychology are included. A key feature of this textbook is the equal priority given to the three aspects of the biopsychosocial (BPS) approach: biological, social and psychological determinants of health, illness and health care. The authors argue that both social embeddedness and psychological influences are as important to health and illness as genes and 'germs'. In this book we attempt to locate health psychology within its global, social and political contexts. We attempt to provide a snapshot of the 'bigger picture' using a wide-angle lens, as well as giving detailed, critical analyses of the 'nitty-gritty' of theory, research and practice.

This textbook introduces readers to the field of health psychology, the major foundations and theoretical approaches, contemporary research on core topics, and how this theory and evidence is being applied in practice. This more streamlined sixth edition includes a new chapter on stress as well as brand new online case studies. The outbreak of the coronavirus pandemic (**COVID-19**) occurred as this book was being prepared for production in the first months of 2020. As we were checking the proofs, in May 2020, almost 6 million people had been infected with COVID-19, 2.5 million people had recovered, but, sadly, 350,000 people had died. Around 4 billion people are estimated to have been living under some form of restriction of movement. Unfortunately these numbers will continue to rise (for an interactive dashboard, see Johns Hopkins University, 2020). Unless a vaccine is developed, or we discover medicines to treat the virus, our means of controlling the spread of infection depend entirely upon behavioural changes. Unfortunately,it was impossible here to include an in-depth discussion of the COVID-19 pandemic. However, the COVID-19 pandemic will be a major new topic within the next (7th) edition.

Health psychology is still relatively young, having developed as a sub-discipline in the 1970s and 1980s. The primary mainstream focus has been theories and models about social-cognitive processes concerned with health beliefs and behaviours. This approach has yielded thousands

of research publications of a mainly empirical nature to study issues, test theories and models about the causes of health behaviour change, and investigate interventions. The growth of interest in this subject has been truly amazing. Similar to psychology more generally, the primary focus of health psychology has been the behaviour, beliefs and experiences of individuals.

The book introduces alternative, critical approaches to health psychology which are not yet part of the mainstream. We advance the case that psychological issues are embedded in human social structures in which economics and social justice play crucial roles. The mainstream socio-cognitive framework appears to us to be of limited relevance in a world where issues of poverty, social injustice and conflict exist for millions of people, and psychological processes are conditioned by basic limitations of capability, freedom and power (Marks, 1996, 2002a, 2004; Murray and Campbell, 2003; Murray, 2014a, 2014b). We evaluate and critique contemporary psychological theories and models in that context.

In our view, to make a contribution to society, theory, research and practice in health psychology must engage with the real economy, develop approaches for industrial-scale behaviour change, and work with communities and the struggles of the dispossessed. An agenda for health psychology needs to include 'actionable understandings of the complex individual–society dialectic underlying social inequalities' (Murray and Campbell, 2003: 236). Preliminary thoughts on 'actionable understandings' and of the 'individual–society dialectic' are presented in this book. By having access to mainstream and alternative perspectives in a single volume, lecturers and students can reach an assessment of the field and how it could make more progress in the future.

We explain the significance of the biological and social contexts, and review theory and methods (Part 1), analyse the complexity and diversity of health behaviour (Part 2), discuss health promotion and disease prevention (Part 3), and explicate the significance of clinical health psychology for some of the major afflictions of the age (Part 4).

Table P1 A multi-level framework or 'Onion Model' for health psychology

Level	Description	Where covered
Core	Age, sex and hereditary factors	Part 1
Level 1	Individual lifestyle	Part 2
Level 2	Social and community influences	Whole book
Level 3	Living and working conditions; health care system	Parts 3 and 4
Level 4	General socio-economic, cultural and environmental conditions	Part 1

Source: Adapted from Dahlgren and Whitehead (1991: 23)

The book uses a multi-level framework that takes into account both the biological determinants and the social context of health-related experience and behaviour. This multi-level framework, the 'Onion Model', assumes different levels of influence and mechanisms for bringing about change (see Table P1 and Chapter 1 for details).

Health psychology is a potentially rich field, but, if it is to become more than a 'tinker', it is necessary to master an appreciation of the cultural, socio-political and economic roots of human behaviour. In this book, we aim to apply an international, cultural and interdisciplinary perspective. We wish to demonstrate the great significance of social, economic and political changes. As the gaps between the 'haves' and the 'have-nots' widen, and the world population

grows larger, the impacts of learned helplessness, poverty and social isolation are increasingly salient features of contemporary living.

Those concerned with health promotion and disease prevention require in-depth understanding of the lived experience of health, illness and health care. By integrating research using quantitative, qualitative and action-oriented approaches, we take a step in that direction.

THE BIOPSYCHOSOCIAL MODEL

The dominance of the biomedical system has been challenged by figures in the scientific establishment and by certain patient groups. These challenges are reflected in a call for more attention to the psychological and social aspects of health and, in particular, in the so-called '**biopsychosocial model' (BPSM)** proposed by Engel (1977, 1980). According to Engel (1980) all natural phenomena can be organized into a hierarchy of systems ranging from the biosphere at one end of the hierarchy, to society and the individual level of experience and behaviour towards the middle, and then to the cellular and subatomic levels at the other end of the hierarchy. These different levels need to be considered if we are to fully understand health and illness. The BPSM has become the conceptual status quo of contemporary psychiatry (Ghaemi, 2009) and a banner for health psychology. Yet it is far from being established as a paradigm in medicine and health care where the biomedical model remains resiliently in force.

Long before Engel, William Osler (1849–1919) had stated: 'The good physician treats the disease; the great physician treats the patient who has the disease.' He also stated: 'Listen to your patient, he is telling you the diagnosis.' The traditional biomedical model remains the core of medical education, although there may have been a slight shift in the thinking of doctors in primary care and in liaison psychiatry towards a more holistic, BPS view of the patient (see Chapter 1). The BPSM remains a fertile idea for a transformed biomedical model by including the psychological and social aspects of illness along with the biological aspects. The BPSM has been influential, for example, in providing an account of the influence of racism on health outcomes (Clark et al., 1999) and in understanding adolescent conduct problems (Dodge and Pettit, 2003).

However, the BPSM has not been free of controversy – for example, when it has been extended as a cognitive behavioural theory of illness such as myalgic encephalomyelitis (ME) or chronic fatigue syndrome (CFS) by asserting that cognitions and behaviours perpetuate the fatigue and impairment in individuals suffering from the condition(s) (Wessely et al., 1991; Chapter 23). In psychiatry Engel's BPSM became associated with a particular socio-cognitive model for illness experience. We argue that the socio-cognitive formulation has tended to constrain theorizing within health psychology (Chapter 8) and narrowed thinking about clinical conditions and stigma to the presumption of incorrect beliefs and attitudes (Chapter 22). It is important to distance Engel's generic BPSM as a schematic approach to health care from specific formulations of the socio-cognitive model. In truth, there is a multitude of biopsychosocial theories and models that should not be lumped together under a single umbrella, because the devil is in the detail. The adoption of the BPSM by general practitioners can meet with resistance or even hostility by patients, either because they feel more comfortable with the traditional 'doctor knows best' model of biomedicine or because they deem the BPSM is not a good fit for their illness (e.g., myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS)).

Seventy years ago the World Health Organization (WHO) proposed a definition of health as: 'a state of complete physical, mental and social well-being, not the mere absence of disease

or infirmity'. This definition widened the scope of health care to consider well-being more holistically. The WHO definition has not been revised since its original publication in 1948. In Chapter 1 we suggest a wider definition, encompassing the economic, political and spiritual domains of daily living for these are also contributing conditions of well-being. Currently, some areas of health care are shifting from a concern with purely bodily processes to an awareness of broader concepts of quality of life and subjective well-being.

Another recent trend has been an ideological emphasis on patient choice and individual responsibility for health. Crawford (1980: 365) argued that 'in an increasingly "healthist" culture, healthy behaviour has become a moral duty and illness an individual moral failing'.

HUMAN RIGHTS AND THE RESPONSIBILITY TO 'DO NO HARM'

The universal human rights of freedom of speech, thought and action within the law are an essential principle in health care. Health care is at the interface between policy and practice and as such must have a strong foundation in the rights of patients and populations as human beings. In recent years there has been a political shift wherein hate speech and divisive rhetoric by key political leaders have served to 'unleash the dark side of human nature'. This political shift has been the subject of a report by Amnesty International (2017), which has brought to stark attention the 'dark forces' which are changing the geo-political environment … wherein more and more politicians call themselves anti-establishment and wield a politics of demonization that hounds, scapegoats and dehumanizes entire groups of people to win the support of voters.

> This rhetoric will have an increasingly dangerous impact on actual policy. In 2016, governments turned a blind eye to war crimes, pushed through deals that undermine the right to claim asylum, passed laws that violate free expression, incited murder of people simply because they use drugs, legitimized mass surveillance, and extended draconian police powers. (Amnesty International, 2017: https://www.amnesty.org/en/latest/research/2017/02/amnesty-international-annual-report-201617/)

The report also refers to the fact that some countries have implemented intrusive security measures, such as prolonged emergency powers in France and unprecedented surveillance laws in the UK. Another feature of 'strongman' politics has been the rise of anti-feminist and anti-LGBTI rhetoric, such as efforts to roll back women's rights in Poland (Amnesty International, 2017).

Changes to the geo-political framework towards an openly political agenda that supports division, inequality, discrimination, scapegoating and stigma are likely to ripple across into health and social care. All who work in health care face everyday difficult decisions that profoundly impact upon people's lives. The embedding of such decisions in a human rights-based ethical foundation of 'do no harm' becomes ever more relevant if the current climate continues.

MAKING THE BEST USE OF THIS BOOK

This sixth edition has been streamlined in order to focus on the core issues pertinent to students. A new chapter on stress has also been added. Lecturers may recommend the chapters in any

order, according to the requirements of any particular course and their personal interests and preferences. Chapters are written as free-standing documents. No prior reading of other chapters is assumed.

Each chapter begins with an **Outline** and ends with a detailed **Summary** of key ideas and suggestions for **Future Research**. Each chapter contains tables, figures and boxes, and recent examples of key studies to guide student understanding. International studies present works by key people living in different parts of the world, showing how context, culture and the environment affect health and behaviour.

Key terms are identified by **bold** and defined in the **Glossary** at the end of the book.

A useful companion reader to this textbook is *The Health Psychology Reader* (Marks, 2002a), which reprints and discusses 25 key articles, accompanied by introductions to the main themes. Readers can also refer to the 85 key articles in *New Directions in Health Psychology* (Murray and Chamberlain, 2015).

ONLINE RESOURCES

The following online resources in support of *Health Psychology* can be found at **https://study.sagepub.com/Marks6e**

STUDENT RESOURCES

- **Learning objectives** for each chapter to help structure your learning and summarise key points.
- Useful **multiple choice questions** to test your understanding of important information.
- Extra **case studies** to see how health psychology is applied in real world contexts.
- **Video links** that offer a fresh perspective on the concepts covered in the book.
- **eFlashcards** to aid your revision of key terms and ideas.

LECTURER RESOURCES

- A **testbank** of questions which can be used to help student progress and understanding.
- Downloadable and customisable **PowerPoint** slides for use in class.

ACKNOWLEDGEMENTS

DFM: Over 20 years, many talented people have created this textbook and I wish to acknowledge their contributions. To Michael and Emee, my co-authors, for friendship and collaboration; specifically, to MM for his unstinting support and lively humour; to EVE for cake, songs and smiles. To Brian Evans, co-author of four previous editions, for walks and talks over heath and by river. To Ziyad Marar for his enthusiastic skills of persuasion that drew me into the SAGE fold more than two decades ago. To colleagues at SAGE: Michael Carmichael, the original commissioning editor, Luke Block, Amy Jarrold, Donna Goddard and Katie Rabot and the complete editorial team for editing this sixth edition. To Alice Vallat, for a happy home in Arles, Provence. Thank you all warmly – this book couldn't and wouldn't have happened without you.

MM: Thanks to David for initiating and sustaining this project over the years and to the various other co-authors (Brian, Carla, Catherine, Cailine and Emée) who have added so much to it. Thanks, as well, to my wonderful and loving wife (Anne) and sons (Matthew and Daniel) for their continuing support, kindness and inspiration.

EVE: To my parents for life, to my Andy for love, to my mentor, DFM, for guidance, and to my son, Vas, for purpose – thanks!

PART 1

This book provides an in-depth, critical overview of the field of health psychology. In Part 1 we are concerned with the biological and psychosocial context of the health and illness experience. This part covers the most relevant aspects of the biological and social sciences that contribute to an in-depth knowledge of health psychology.

In Chapter 1 we review the meaning of the concept of 'health' and the development of health psychology as a field of inquiry. Health and health psychology are defined and issues of measurement and the scaling of subjective well-being are presented. Frameworks, theories and models are discussed and a framework we call the 'Health Onion' is introduced.

In Chapter 2 we introduce the role of the nervous, endocrine and immune systems and the important principle of homeostasis in human health and well-being. These are the key biological systems for the preservation of equilibrium in mind, body and spirit.

In Chapter 3 we focus on the influence of genetics, epigenetics and development across the lifespan. Development is life-long and multi-dimensional with biological, cognitive, psychosocial, economic and spiritual aspects.

In Chapter 4 we discuss the contextual factors of the macro-social environment: the demographic, economic and societal factors which operate globally to structure the

health experience of populations, communities and individuals. The chapter uses a wide-angle lens to explore the bigger picture of the global context for human health and suffering.

In Chapter 5 we examine the associations of social inequalities and social injustice with health outcomes. Measures to tackle social injustice are required at political and policy levels and health psychologists can play a role as agents and facilitators of change.

In Chapter 6 we examine the ways in which health and illness have been construed across time and place. Western biomedicine often tends to be accepted as 'scientific' and 'evidence based', while the medical systems of other cultures and indigenous populations, including 'complementary' therapies, are often written off as 'unscientific mumbo-jumbo', 'supernatural' or 'magical'. These alternative systems at least deserve to be fairly evaluated in the light of studies conducted with participants from different cultures and ethnic groups.

In Chapter 7 we present an A–Z of relevant research issues and methods for carrying out research in health psychology. Three categories of methods are quantitative, qualitative and action research methods. These types of method all have potential in assessing, understanding and improving health, illness and health care outcomes.

HEALTH PSYCHOLOGY: AN INTRODUCTION

1

'Cell, organ, person, family each indicate a level of complex integrated organization about the existence of which a high degree of consensus holds. ... In no way can the methods and rules appropriate for the study and understanding of the cell as cell be applied to the study of the person as person or the family as family.'

George Engel (1980)

OUTLINE

In this chapter, we introduce health psychology as a field of inquiry. At the beginning, we introduce the concept of 'health' from a historical perspective. We define health psychology and review theories of need-satisfaction and subjective well-being. We present a new Theory of Well-Being that includes the constructs of attachment, life satisfaction, subjective well-being, affect and consumption. Problems with measurement are examined. Finally, a framework we call the 'Health Onion' is described.

WHAT DO WE MEAN BY 'HEALTH'?

It seems logical – although few textbooks do it – to discuss what is meant by the term '**health**' in a book about health psychology. Otherwise, how do we understand the subject? It seems slightly bizarre that few textbooks ever consider it. We must never take the meaning of 'health' for granted.

Ancient links exist between the concepts of 'health', 'wholeness', 'holiness', 'hygiene', 'cleanliness', 'goodness', 'godliness', 'sanitary', 'sanity' and 'saintliness', as in: 'Wash you, make you clean; put away the evil of your doings from before mine eyes; cease to do evil' (Isaiah, 1:16, King James Bible) and: 'O you who believe! when you rise up to prayer, wash your faces and your hands' (Quran). The concept of health as wholeness existed in ancient China and classical Greece where health was seen as a state of 'harmony', 'balance', 'order' or 'equilibrium' with nature. Related ideas are found in many healing systems today. On the other hand, there are traditional associations between concepts of 'disease', 'disorder', 'disintegration', 'illness', 'crankiness' (or 'krankheit' in German), 'uncleanness', 'insanity', 'chaos' and 'evil'.

Galen (CE 129–200), the early Roman physician, followed the Hippocratic tradition with *hygieia* (health) or *euexia* (soundness) as a balance between the four bodily humours of black bile, yellow bile, phlegm and blood. Galen believed that the body's 'constitution', 'temperament' or 'state' could be put out of equilibrium by excessive heat, cold, dryness or wetness. Such imbalances might be caused by fatigue, insomnia, distress, anxiety, or by food residues resulting from eating the wrong quantity or quality of food. Human moods were viewed as a consequence of imbalances in one of the four bodily fluids. Imbalances of humour corresponded to particular temperaments (blood–sanguine, black bile–melancholic, yellow bile–choleric, and phlegm–phlegmatic). The theory was also related to the four elements: earth, fire, water and air (Table 1.1).

In the winter, when it is chilly and wet, people might worry about catching a cold, caused by a build-up of phlegm. In summer, when a person is hot and sweaty, they may worry about not drinking enough water or they could otherwise become 'tetchy' or 'hot and bothered' (bad tempered). It is remarkable that some common beliefs today are descendants of early Greek and Roman theories of medicine from 2,000-plus years ago. It is significant that the concept of balance/equilibrium and the idea that a basic bodily process exists to restore balance (homeostasis) are as much core issues in Science today as in Classical times.

Table 1.1 Galen's theory of humours

Humour	Season	Element	Organ	Qualities	Personality type	Characteristics
Blood	spring	air	liver	warm and moist	sanguine	amorous, courageous, hopeful
Yellow bile	summer	fire	gall bladder	warm and dry	choleric	easily angered, bad tempered
Black bile	autumn	earth	spleen	cold and dry	melancholic	despondent, sleepless, irritable
Phlegm	winter	water	brain/lungs	cold and moist	phlegmatic	calm, unemotional

Universal interest in health is fuelled by a continuous torrent of content in the media about health and medicine, especially concerning the 'dread' diseases. In 1946 the **World Health Organization (WHO)** defined health as: 'the state of complete physical, social and spiritual well-being, not simply the absence of illness'. It is highly doubtful whether 'complete physical, social and spiritual well-being' can ever be reached by anyone. Apart from this

idealism, the WHO definition overlooks the *psychological*, *cultural* and *economic* aspects of health. Psychological processes, the main subject of this book, are a key factor in health and are embedded in a social context. For this reason, the term 'psychosocial' is often used to describe human behaviour and experience as an influence on well-being. Social inequalities and poverty are also strongly associated with health outcomes and warrant explicit inclusion in any definition of health. With these thoughts in mind, we define health in the light of five key elements (Box 1.1).

BOX 1.1

Definition of health

Health is a state of well-being with satisfaction of physical, cultural, psychosocial, economic and spiritual needs, not simply the absence of illness.

NEED SATISFACTION, HAPPINESS AND SUBJECTIVE WELL-BEING

To be useful, the above definition of health needs to be unpacked. Philosophers, psychologists, poets, songsters and others have had much to say about what makes a person feel well. A key concept is that of **need satisfaction**. In Maslow's (1943) more academic **hierarchy of needs** (Figure 1.1), a person is healthy if all of their needs are satisfied, starting with the most basic needs for air, food, water, sex, sleep, homeostasis and excretion. Then as need satisfaction moves towards the top of the pyramid, the epitome of need satisfaction, a person becomes more and more 'satisfied', and thus physically and mentally healthy to the point of 'self-actualization'.

Maslow's hierarchy framework has been influential. It puts the concept of '**self-actualization**' at the top of the pyramid, a state in which the person feels they have achieved a so-called 'peak experience' of meaningful and purposeful existence. Maslow's needs hierarchy emphasizes the great importance of safety, love and belonging, and self-esteem. For every good principle in psychology, there are always exceptions, and human needs do not always fall into any fixed hierarchy. For example, an extreme sports enthusiast who is into mountain climbing may put 'esteem' and 'self-actualization' ahead of 'safety'. We read about it in the news the next morning. Few would disagree about the existence of the five levels of need within the pyramid. However, there are also key elements of human fulfilment that are not explicitly mentioned in Maslow's hierarchy, for example, **agency** and **autonomy** – the freedom to choose – and the often-neglected **spirituality** – the subjective intuition that lacks any hard empirical proof that not all that is significant is of the physical world.

Homeostasis is a core concept within Physiology, a regulating property of the organism wherein the stability of the internal environment is actively maintained. The function of cells, tissues and organs are organized into negative feedback systems. Homeostasis operates at cellular, organismic and ecosystems levels. At organismic level, homeostasis regulates core body temperature and the levels of pH, sodium, potassium and calcium, glucose, water, carbon dioxide and oxygen in the body.

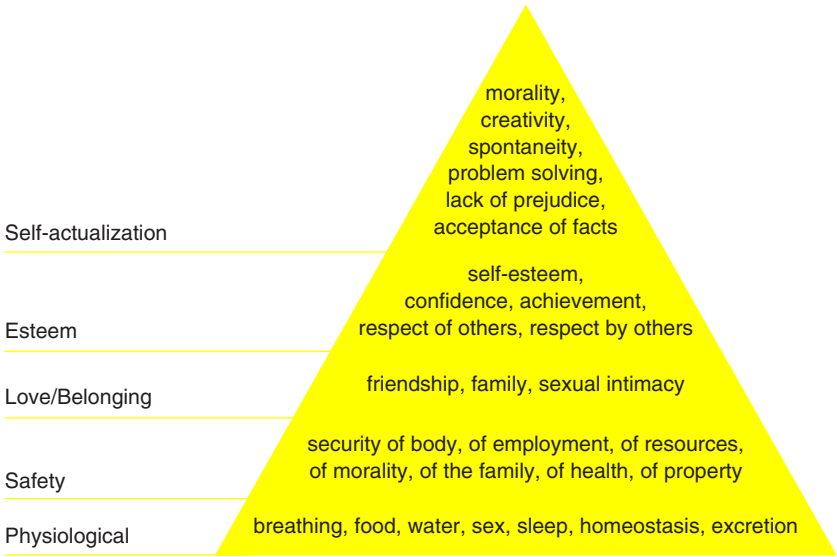


Figure 1.1 Maslow's hierarchy of human needs

In Chapter 2 we present a Homeostasis Theory of Behaviour which can be applied across all areas of health psychology. If homeostasis breaks down, a person can suffer a variety of life-threatening conditions, including diabetes, obesity, starvation, chronic thirst and insomnia (Marks, 2015, 2016a, 2016b). Homeostasis is not actually a 'need' as suggested by Maslow's pyramid; it is the process that works towards the restoration of equilibrium, as we shall see in Chapter 2. A broad spectrum of evidence from many scientific fields suggests that homeostasis is an organizing principle of considerable generality, not simply at the level of physiological need, but throughout the psychological universe of regulation of thought, feeling and action (Marks, 2018).

Throughout history, philosophers have discussed the nature of a *good and happy life* or what, in health care, is termed '**quality of life**' **(QoL)**. For Aristotle, happiness was viewed as 'the meaning and the purpose of life, the whole aim and end of human existence'. For utilitarians such as Jeremy Bentham, happiness was pleasure without pain. To individuals suffering from cancer or other conditions with pain, unpleasant physical symptoms and treatment options, and an uncertain prognosis, QoL has special relevance.

QoL has been defined by WHO as (take a deep breath):

> An individual's perception of their position in life, in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns. It is a broad ranging concept, affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and their relationship to salient features of their environment. (WHOQoL Group, 1995: 1404)

A sixth domain, concerning spirituality, religiousness and personal beliefs, was later added by the WHOQoL Group (1995). The Collins dictionary defines QoL more simply as: 'The general well-being of a person or society, defined in terms of health and happiness, rather than wealth.' The QoL concept overlaps with that of **subjective well-being (SWB)**, which has been defined

by a leader in the field, Ed Diener ('Dr Happiness'), as: 'An umbrella term for different valuations that people make regarding their lives, the events happening to them, their bodies and minds, and the circumstances in which they live' (Diener, 2006: 400). The evidence linking SWB with health and longevity is strong and plentiful.

With a global population of more than seven billion unique individuals of diverse cultures, religions and social circumstances, one wonders whether QoL can ever be assessed using a single yardstick. A few courageous individuals and organizations have given it a try and, since the 1970s, many scales and measures have been constructed. A few examples are listed in Table 1.2.

By far, the most utilized scale to date has been the SF-36, which accounts for around 50% of all clinical studies (Marks, 2013). These 'happiness scales' are diverse and consist of items about what makes a 'good life'. For example, Diener et al.'s (1985) brief *Satisfaction with Life Scale* (SWLS) uses a seven-point Likert scale with five items:

> In most ways my life is close to my ideal.
>
> The conditions of my life are excellent.
>
> I am satisfied with my life.
>
> So far I have gotten the important things I want in life.
>
> If I could live my life over, I would change almost nothing.

Table 1.2 Examples of QoL, subjective well-being and happiness scales

Authors	Year	Title	Domains	Samples
Andrews and Withey	1976	Social indicators of well-being	Job satisfaction	Adults
Flanagan	1978	The QoL scale (QoLS)	Material and physical well-being Relationships Social, community and civic activities Personal development and fulfilment Recreation	Healthy adults and patients with chronic illnesses
Kammann	1979	Affectometer 1	Happiness/subjective well-being	Adults
Kammann and Flett	1983	Affectometer 2		
Diener et al.	1985	Satisfaction with Life Scale (SWLS)	Satisfaction with life	Adults
European Organization for Research and Treatment of Cancer (EORTC)	1986	QLQ-C30	Physical Role Cognitive Emotional Social Global QoL	Patient samples

(Continued)

Table 1.2 (Continued)

Authors	Year	Title	Domains	Samples
Ware and Sherbourne	1992	Short-Form Health Survey (SF-36)	Vitality Physical functioning Bodily pain General health perceptions Physical role functioning Emotional role functioning Social role functioning Mental health	Healthy adults and patients with chronic illnesses
WHOQoL group	1995	WHOQoL	Physical Psychological Level of independence Social relationships Environment Spirituality	Healthy adults and patient groups
International Wellbeing Group	2013	Personal Wellbeing Index Percentage Scale Maximum	Allows results from different scales to be compared,	Healthy adults and patient groups

Using the 1–7 scale below, testees indicate their agreement with each item by placing the appropriate number on the line preceding that item. They are asked to 'be open and honest' in their responding.

7 Strongly agree

6 Agree

5 Slightly agree

4 Neither agree nor disagree

3 Slightly disagree

2 Disagree

1 Strongly disagree

For the vast majority of people, SWB is relatively stable over the long term. Using longitudinal data, Headey and Wearing (1989) reported that when the level of SWB changed following a major event, it tended to return to its previous level over time. To account for this, the authors proposed that each person has an 'equilibrium level' of SWB, and that 'personality' restores equilibrium after change by making certain kinds of events more likely. Restoration of equilibrium is nothing to do with personality; it's a fundamental stabilizing process across all living systems, called 'homeostasis'.

Diener and Chan (2011) review evidence that *having high SWB adds four to ten years to life*. The evidence for an association between SWB and all-cause mortality is mounting. As always, there could be a mysterious third variable influencing both SWB and mortality (e.g., foetal nutrition, social support, lifestyle) and, if the relationship between SWB and mortality did prove to be causal, the possible mediating processes would be a matter for speculation and further research. For the time being, it seems safe to assume that happy people live longer.

SUBJECTIVE WELL-BEING HOMEOSTASIS

The most basic property of SWB is that it is normally positive. On a rating scale from 'feeling very bad' to 'feeling very good', only a few people lie below the scale mid-point. General population data from over 60,000 people gathered over 13 years by the Australian Unity Wellbeing Index surveys (Cummins, 2013) found that only 4% of scores lie below 50 percentage points. Feeling good about yourself is the norm.

While it has been generally agreed that SWB consists of both affect and cognition, it is thought that SWB mainly comprises mood (Cummins, 2016). Russell (2003) coined the term 'Core Affect' to describe a neurophysiological state experienced as a feeling, a deep form of affect or mood. Russell considered it analogous to felt body temperature in that it is always present, can be accessed when attended to, existing without words to describe it.

Robert A. Cummins introduced the idea that homeostasis is operating on SWB, as it does in biological systems of the body: 'It is proposed that life satisfaction is a variable under homeostatic control and with a homeostatic set-point ensuring that populations have, on average, a positive view of their lives' (Cummins, 1998: 330). Cummins suggested the concept of 'Homeostatically Protected Mood' (HPMood) as the most basic feeling state of SWB (Cummins, 2010). The concept of 'HPMood' places the regulation of mood in the same framework as physiological homoeostasis, which controls body temperature, blood pressure, and a thousand and one other bodily systems (Cannon, 1932). Cummins' describes HPMood as follows:

1. It is neurophysiologically generated consisting of the simplest, constant, non-reflective feeling, the tonic state of affect that provides the underlying activation energy, or motivation, for routine behavior.
2. It is not modifiable by conscious experience, yet it is a ubiquitous, background component of conscious experience. It is experienced as a general feeling of contentment, but also comprises aspects of related affects, including happy and alert.
3. When SWB is measured using either the Satisfaction with Life Scale (Diener et al., 1985) or the Personal Wellbeing Index (International Wellbeing Group, 2013), HPMood accounts for over 60% of the variance.
4. Under normal conditions of rest, the average level of HPMood for each person represents their 'set-point', a genetically determined, individual value. Within the general population, these set-points are normally distributed between 70% and 90% along the 0–100-point scale.
5. For each person's set-point there is a 'set-point-range', the limits within which homeostatic processes normally maintain HPMood for each individual.
6. HPMood 'perfuses all cognitive processes to some degree, but most strongly the rather abstract notions of self (e.g., I am a lucky person). Because of this, these self-referent

perceptions are normally held at a level that approximates each set-point range' (Cummins, 2016: 63).

7. Under resting conditions, SWB is a proxy for HPMood. However, SWB can vary outside the set-point-range for HPMood when a strong emotion is generated by momentary experience. 'When this occurs, homeostatic forces are activated, which attempt to return experienced affect to set-point-range. Thus, daily affective experience normally oscillates around its set-point' (Cummins, 2016: 64).

One of the principal goals of health psychology is to understand the links between subjective well-being and health. The application of the concept of homeostasis from Physiology in the discipline of Psychology holds significant potential. A general homeostasis theory of well-being, physical health and life satisfaction is summarized in Box 1.2.

BOX 1.2

Homeostasis Theory of Well-Being

The Homeostasis Theory of Well-Being (HTWB) shows causal links between some significant determinants of physical and mental well-being (see Figure 1.2). In addition to emotion, and the role of income, restraint and consumption, the HTWB places emphasis on the developmentally important construct of attachment (Bowlby, 1969, 1973, 1980). The manner in which a baby attaches to its mother, father and/or other caregiver is assumed to create a template for life based on the infant's need to maintain proximity to an anchor person who provides a 'secure base' for exploring the environment. The availability and responsivity of the anchor person to attachment are internalized as mental models that are generalized to relationships throughout life until the individual's death (Ainsworth et al., 1978). The different ways of attaching to anchor figures is termed 'attachment style'.

Of relevance to the GTWB is the basic construct SWB. The hedonic conception of SWB of Diener and Chan (2011) can be contrasted with the **eudaimonic** approach, which focuses on meaning and self-realization and defines well-being in terms of the degree to which a person is fully functioning (Ryan and Deci, 2001). Waterman (1993) has argued that eudaimonic well-being occurs when people are living in accordance with their 'daimon', or authentic self. Eudaimonia is thought to occur when people's life activities mesh with deeply held values and are fully engaged in authentic personal expression.

An important aspect of life satisfaction is the search for eudaimonic meaning. Empirical studies suggest that there exists a strong and stable relationship between meaning in life and subjective well-being (Zika and Chamberlain, 1992). People who believe that they have meaningful lives tend to be more optimistic and self-actualized (Compton et al., 1996), and experience more self-esteem (Steger et al., 2006) and positive affect (e.g., King et al., 2006), as well as less depression and anxiety (Steger et al., 2006) and less suicidal ideation (Harlow, 1986). The 'Salutogenic Theory' of Antonovsky (1979) also emphasized the relationship between meaning and purpose in life, assessed by the Sense of Coherence scale, and positive health outcomes (Eriksson and Lindström, 2006).

THE NATURE OF HEALTH PSYCHOLOGY

The importance of psychosocial processes in health and illness is an established part of health care. The evidence on the role of behaviour and emotion in morbidity and mortality has been steadily accumulating over the last century. By the end of the First World War, the British Army had dealt with 80,000 cases of shell shock, including those of poets Siegfried Sassoon and Wilfred Owen. Millions of men and women suffered psychological trauma as a result of their war experiences. Since that time, and the experiences of many other wars, much research has been conducted to investigate the possible role of trauma, stress and psychological characteristics on the onset, course and management of physical illnesses. Health psychology has grown rapidly, and psychologists are increasingly in demand in health care and medical settings. Psychologists have become essential members of multidisciplinary teams in rehabilitation, cardiology, paediatrics, oncology, anaesthesiology, family practice, dentistry, and other fields, including defence, intelligence, policing and justice.

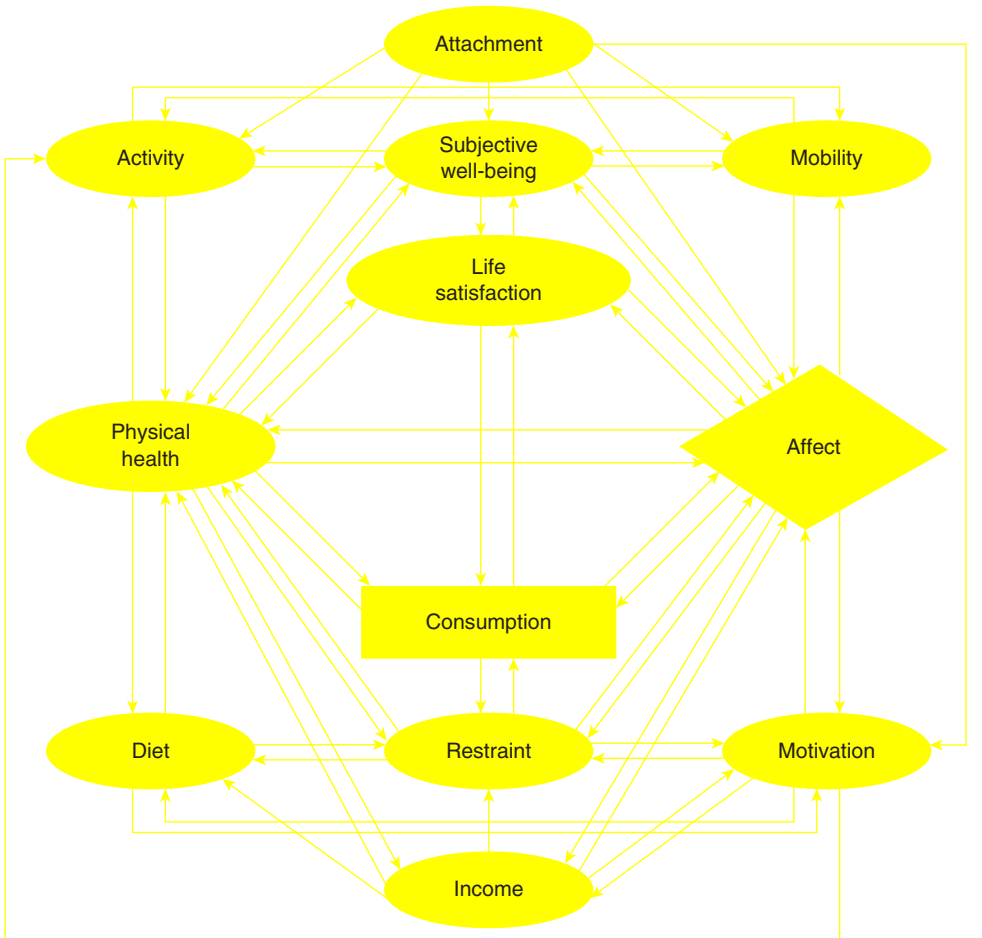


Figure 1.2 General Theory of Well-Being (GTWB)

Source: Marks (2015)

Increasing interest is being directed towards disease prevention, especially with reference to sexual health, nutrition, smoking, alcohol, inactivity and stress. A current ideology is '**individualism**', in which individual 'agents' are deemed responsible for their own health. From this neoliberalist viewpoint, a person who smokes 40 a day and develops lung cancer is responsible for causing their own costly, disabling and terminal illness. Traditional health education has consisted of campaigns providing a mixture of exhortation, information and advice to persuade people to change their unhealthy habits. By telling people to 'Just say no', policy makers expect people to make the 'right' choices and change 'unhealthy' choices into 'healthy' ones. There has been notable success in tobacco control, which provides a benchmark for what may be achieved through health education, and policy in other clinical areas, such as coronary artery disease, obesity, diabetes and metabolic syndrome.

Against the 'healthist' view that keeping ourselves healthy means making responsible choices, there is little convincing evidence, beyond the example of smoking, that people who change their lifestyle actually *do* live longer or have a greater quality of life than people who 'live and let live' and make no real attempt to live healthily. Consider an example: a prospective study suggests that vegetarians live longer than meat eaters. But vegetarians may differ from the meat-eaters in many ways other than their choice of diet (e.g., religious beliefs, use of alcohol, social support). A statistical association between two variables, such as a vegetarian diet and longevity, does not prove causality or allow a prediction about any particular individual case. A vegetarian can still die of stomach cancer and becoming vegetarian does not necessarily lengthen the life of any specific individual. Epidemiology is a statistical science. It provides a statistical statement to which there will always be inconvenient exceptions, such as 90-year-old smokers.

The healthist assumption that a person must 'live well to be well' is prevalent today in industrialised countries and it can lead to victim blaming. If people become ill, it is seen as possibly being 'their own fault' because they smoke, drink, eat poorly, fail to exercise or use screening services, do not jog or join a gym, and so on. Health policy is run through with blaming and shaming individuals for their own poor health. The 'smoking evil' has been replaced by the 'obesity evil'. More recently we have seen cases of blaming and shaming of people, including government advisors, for not following social distancing rules in the COVID-19 emergency.

Health campaigns are often based on the idea that by informing people they can make responsible choices. People are presumed to be free agents with self-determination. Yet human behaviour is influenced by so many factors in the social and economic environment, and especially by role models among family and friends or in the mass media. The herd instinct is as strong in humans as it is in bees, birds or sheep. Christakis and Fowler (2007) reported evidence that behaviour changes such as quitting smoking or putting on weight are associated with similar changes in networks of friends. Imitation is an important influence in human behaviour and one significant change approach, social cognitive theory, is based on this principle (Bandura, 1995).

The built environment, the sum total of objects placed in the natural world by human beings, is another influence on behaviour. Included within this are the images and messages from advertisers in mass media, and the digital environment. A 'toxic environment' has been engineered to draw people towards unhealthy products, habits and behaviours (Brownell, 1994). The **obesogenic** environment contains affordable but nasty, fatty, salty and sugary foods that readily cause weight gain and obesity on an industrial scale. Items for sale include foods such as 'hot dogs' containing 'mechanically recovered meat' and 0% real meat, and 'chicken nuggets' with 0% chicken. The proliferation of such low-priced items in supermarkets and 24/7 stores

offer low-income consumers an unhealthy selection of options. A reliance on meat-eating and careless practices in markets has contributed to the spreading of dangerous viruses such as Ebola and COVID-19, with devastating impact.

In this book, arguments are presented on different sides of the 'freedom and choice' debate. It is accepted that our present understanding of health behaviour is far from definitive. However, we also need to adopt a critical position towards the discipline. Health psychology is still relatively young as a sub-discipline and there are many issues to be addressed. For the most part, health psychology has been formulated within an individualistic ideological formulation which is part of neoliberalist mass culture. The evidence presented in this book suggests that socio-cognitive approaches to behaviour change that target internalized processes in the form of hypothetical 'social cognitions' are ineffectual, inefficient and too small in scale (Marks, 1996, 2002a, 2002b). Apart from their theoretical shortcomings, mass dissemination of individualized therapeutic approaches through the health care system is unsustainable and unaffordable. Like it or not, in spite of the many critiques, the biomedical model remains the foundation stone of clinical health care.

Health psychologists work at different levels of the health care system: carrying out research; systematically reviewing research; designing, implementing and evaluating health interventions; training and teaching; doing consultancy; providing and improving health services; carrying out health promotion; designing policy to improve services; giving scientific advice to government; and advocating social justice for people and communities to act on their own terms. In this book we give examples of all these activities, and suggest opportunities to make further progress.

A community perspective on health work offers an alternative prospect for intervention. Community approaches are less popular within mainstream health psychology and have been the mainstay of community psychology. There could be valuable synergies between health and community psychology working outside the health care system. In working towards social justice and reducing inequalities, people's rights to health and freedom from illness are, quite literally, a life and death matter; it is the responsibility of planners, policy makers and leaders of people wherever they may be to fight for a fairer, more equitable system of health care (Marks, 2004; Murray, 2014a).

Our definition of health psychology is given in Box 1.3. In discussing this definition, we can say that the objective of health psychology is the promotion and maintenance of well-being in individuals, communities and populations.

BOX 1.3

Definition of health psychology

Health psychology is an interdisciplinary field concerned with the application of psychological knowledge and techniques to health, illness and health care.

Although there are diverse points of view, health psychologists generally hold a holistic perspective on individual well-being, that all aspects of human nature are interconnected. While the primary focus of health psychology is *physical* rather than *mental* health, the latter being the province of clinical psychology, it is acknowledged that mental and physical health are

actually 'two sides of one coin'. When a person has a physical illness for a period of time, then it is not surprising if they also experience worry (= anxiety) and/or sadness (= depression). If serious enough, 'negative affect' (sadness and/or worry) may become classified as 'mental illness' (severe depression and/or anxiety), and be detrimental to subjective well-being and to aspects of physical health. Each side of the 'well-being coin' is bound to the other. The distinction between 'health psychology' and 'clinical psychology' is an unfortunate historical accident that is difficult to explain to non-psychologists (or even to psychologists themselves). There is also significant overlap between health and clinical psychology and 'positive psychology' as an integrative new field (Seligman and Csikszentmihalyi, 2000; Seligman et al., 2005), although not without critiques of exaggerated claims and poor methodology (e.g., Coyne and Tennen, 2010).

RATIONALE AND ROLE FOR HEALTH PSYCHOLOGY

There is a strong rationale and role for the discipline of health psychology. First, the behavioural basis for illness and mortality requires effective methods of behaviour change. Second, a holistic system of health care requires expert knowledge of the psychosocial needs of people.

In relation to point 1, *all* the leading causes of illness and death are *behavioural*. This means that many deaths are preventable if effective methods of changing behaviour and/or the environment can be found.

BOX 1.4

KEY STUDY: The Global Burden of Disease study

An important epidemiological perspective comes from measures of 'disability' or 'disablement'. The Global Burden of Disease (GBD) study projected mortality and disablement over 25 years. The trends from the GBD study suggest that disablement is determined mainly by ageing, the spread of HIV, the increase in tobacco-related mortality and disablement, psychiatric and neurological conditions, and the decline in mortality from communicable, maternal, perinatal and nutritional disorders (Murray and Lopez, 1997).

The GBD study was repeated in 2010 and figures were prepared by age, sex and region for changes that had occurred between 1990 and 2010. Global figures for life expectancy show increases for all age groups (Figure 1.3).

The GBD uses the disability-adjusted life year (DALY) as a quantitative indicator of the burden of disease. It reflects the total amount of healthy life lost that is attributed to all causes, whether from premature mortality or from some degree of disablement during a period of time. The DALY is the sum of years of life lost from premature mortality plus years of life with disablement, adjusted for the severity of disablement from all causes, both physical and mental (Murray and Lopez, 1997).

The data in Table 1.3 indicate that nearly 30% of the total global burden of disease is attributable to five risk factors. The largest risk factor (underweight) is associated with poverty (see Chapters 4 and 5). The remaining four risk factors are discussed in Part 2 of this book (see Chapters 8–13).

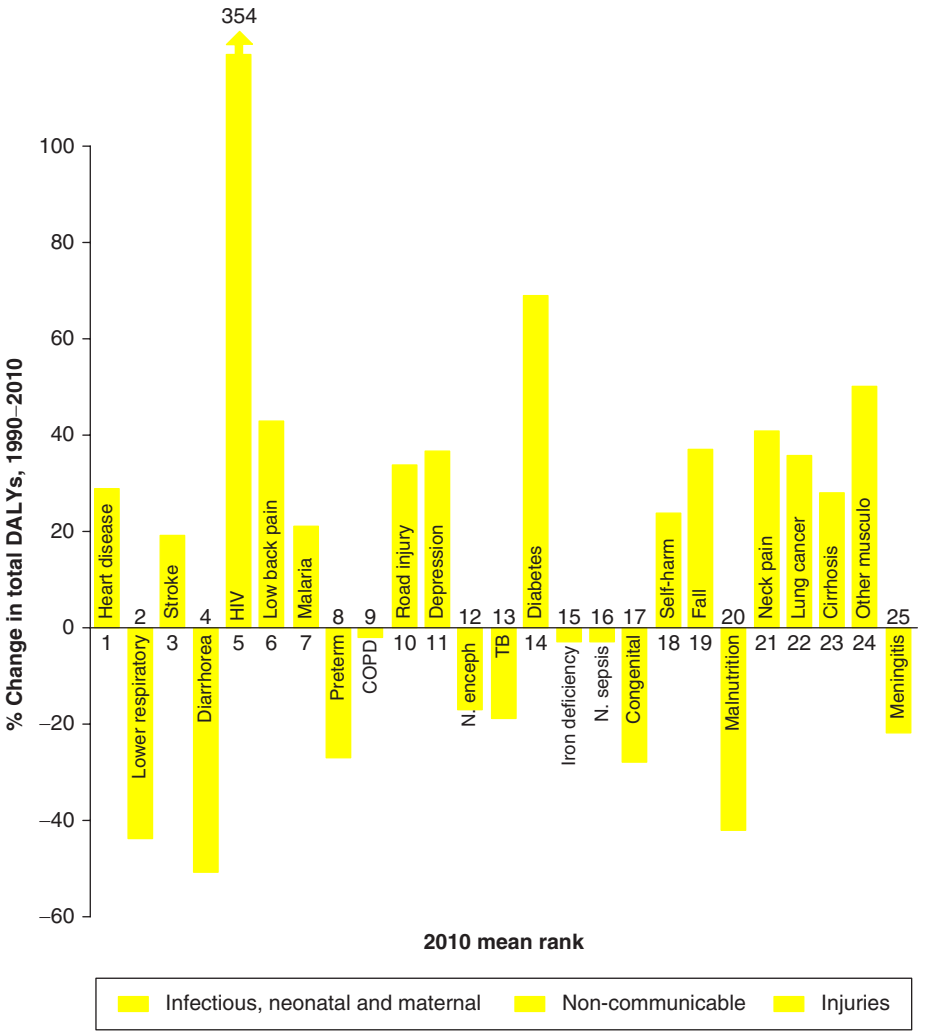


Figure 1.3 Percent change in total DALYs, 1990–2010

Source: Institute for Health Metrics and Evaluation (2014), www.healthdata.org/infographic/percent-change-total-dalys-1990-2010

There were changes in the total DALYs attributable to different causes between 1990 and 2010, as shown in Figure 1.3. Good progress is evident in DALYs for the lower respiratory tract and diarrhoea, but a huge increase of 354% occurred in DALYs for HIV patients. Moderate but significant increases in DALYs occurred for heart disease, stroke, low back pain, depression and diabetes.

The statistics on death and disablement indicate the significant involvement of behaviour and therefore provide a strong rationale for the discipline of health psychology in all three of its key elements: theory, research and practice. If the major risk factors are to be addressed, there is a pressing need for effective programmes of environmental and behavioural change. This requires a sea change in policy. The dominant ideology that makes individuals responsible for

their own health may not be the most helpful approach. The environment is a hugely important factor. In our opinion, a psychological approach in the absence of environmental change is like whistling in the wind.

Table 1.3 The five leading risk factors for global disease burden computed in DALYs

Risk factor	Number of DALYs (millions)	Percentage of DALYs
Childhood and maternal underweight	138	9.5
Unprotected sex	92	6.3
High blood pressure	64	4.4
Tobacco	59	4.1
Alcohol	58	4.0
Totals	411	28.3

Health psychologists are at the 'sharp end' of the quest to produce health behaviour change on an industrial scale. The fact that people are highly constrained by their environment and socio-economic circumstances militates against such change. In a sense, without adaptations of the environment, this effort is disabled. There are strong constraints on the ability of health care systems to influence health outcomes at a population level because of the significant social and economic determinants that structure the health of individuals and communities. The environment must change, and by that route there can be behaviour change on a societal scale. Attempting to change behaviour without first attending to the environment is akin to 'the tail wagging the dog', mission impossible.

A second rationale for health psychology is growing recognition that a purely medical approach to health care is failing to meet the psychosocial needs of many patients. This has led to a search for an alternative perspective that values holistic care of patients and attempts to improve services through higher quality psychosocial care. In spite of their very high costs, health care systems are often perceived to be inefficient, ineffective and unfit for purpose. This is especially the case in the USA, where the largest per capita expenditure is producing some unimpressive outcomes.

The **biomedical model** has been criticized since the 1970s (Illich, 1976). While medical experts want to give modern medicine the credit for the decline of disease in the twentieth century, critics have suggested that health improvements are due mainly to better hygiene, education and reduced poverty (McKeown, 1979). In addition, there has been a growing awareness of psychological and social influences in health and illness which has been formulated as the **biopsychosocial model** (BPSM) (Engel, 1977). Following in the footsteps of Weiss and von Bertalanffy, Engel observed that nature is a 'hierarchically arranged continuum with its more complex, larger units superordinate on the less complex smaller units' (Engel, 1980: 536). He represented the hierarchy either as a vertical stack or as a nest of squares, with the simplest at the centre and the most complex on the outside (Figure 1.4). At the very beginning of this chapter, we print a quotation from Engel (1980), part of which states: 'In no way can the methods and rules appropriate for the study and understanding of the cell as cell be applied to the study of the person as person or the family as family.'

Our review of the core construct of homeostasis in the next chapter will prove this part of Engel's statement to be 100% false. Homeostasis is a unifying principle across the continuum of natural systems from the molecule at one end to the biosphere at the other.

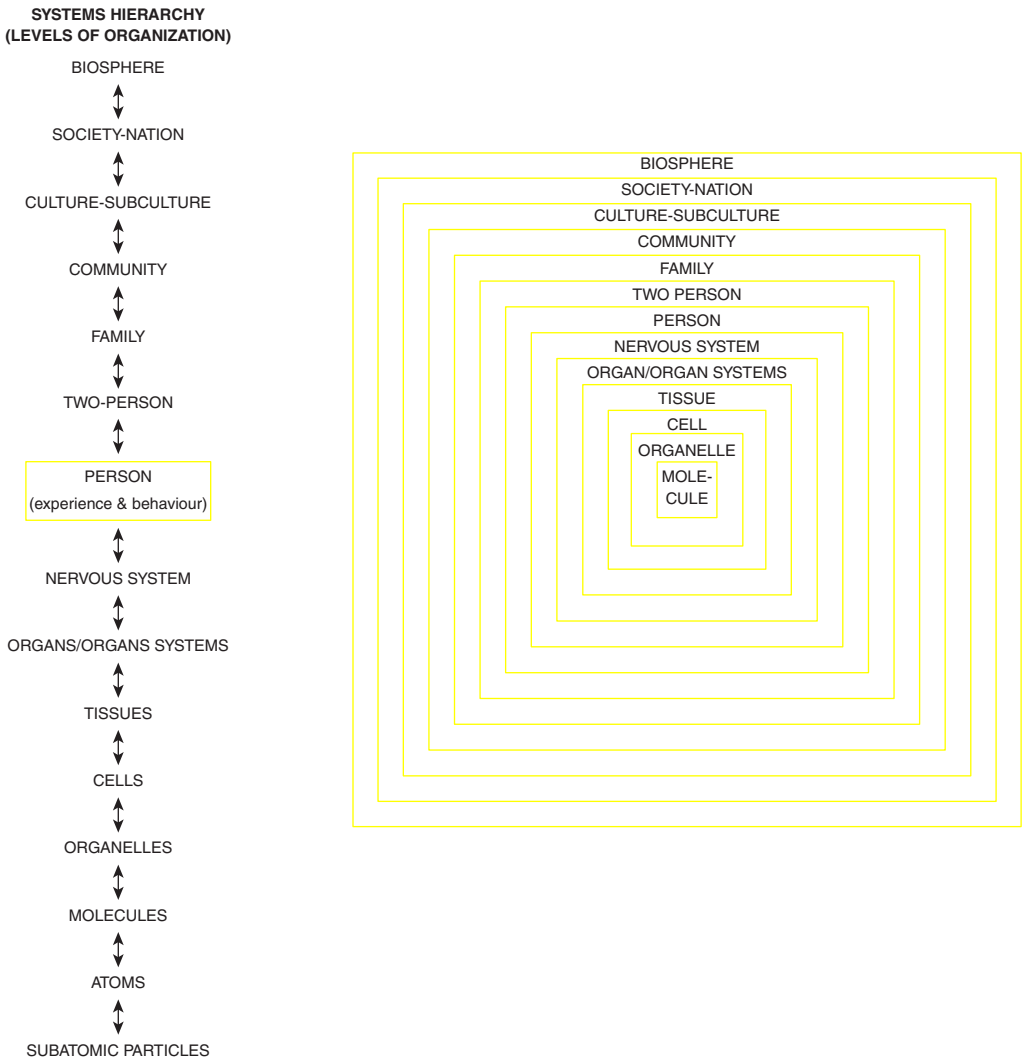


Figure 1.4 Continuum of nature from the simplest unit to the most complex

Adapted from Engel (1980)

The vertical stack was sub-divided into two stacks, the first starting with subatomic particles and ending with the individual person, the second starting with the person and finishing with the biosphere. The first is an organismic hierarchy, the second a social hierarchy. The constructs of a biological/organismic and a social universe are both integral to the study of health psychology. There has been a lot of discussion in health psychology about the adoption of the BPSM. However, the evidence of this adoption in medical education is meagre.

A majority of US physicians reported not receiving effective training regarding the role of the BPSM, and thus have feelings of low self-efficacy in addressing and managing biopsychosocial issues (Moser and Stagnaro-Green, 2009). Some reference to the BPSM occurs in the nursing research literature on patient-centred care, but the specific influence of the BPSM on nursing is not significant (e.g., Mead and Bower, 2002; Kitson et al., 2013). The paradigm shift that Engel proposed for health care is yet to happen.

One crucial tool in the development of the BPSM and of health psychology as a discipline is the need for measurement of psychological variables.

MEASUREMENT

In the natural sciences, attributes of the physical world, such as space, time, temperature, velocity and acceleration, are all measured quantitatively. Psychologists, concerned with behaviour and experience, are unable to measure many of the most interesting psychological attributes in the same objective manner and have struggled to justify the discipline as a science.

Psychology's early years as an infant science were spent developing psychophysics and ability testing. Despite some apparent successes in these two areas, the measurement problem in psychology had not been satisfactorily resolved. In the 1950s the influential *Handbook of Experimental Psychology* was published by a professor at Harvard, Stanley Smith Stevens (1951). Stevens proposed a solution, or so he hoped, to the measurement problem by invoking the principle of **operationism**. Since that time, psychologists have assumed that measurement is simply what Stevens said it was: the assignment of numbers to attributes according to rules. Unfortunately, Stevens' solution is purely illusory.

It is apparent that numbers can be readily allocated to attributes using a non-random rule (the operational definition of measurement) that would generate 'measurements' that are not quantitatively meaningful. For example, numerals can be allocated to colours: red = 1, blue = 2, green = 3, etc. The rule used to allocate the numbers is clearly not random, and the allocation therefore counts as measurement, according to Stevens. However, it would be patent nonsense to assert that 'green is 3 × red' or that 'blue is 2 × red', or that 'green – blue = red'. Intervals and ratios cannot be inferred from a simple ordering of scores along a scale. Yet this is how psychological measurement is usually carried out. Despite its obvious flaws, Stevens' approach circumvented the requirement for quantitative measurement that only quantitative attributes can be measured (Michell, 1999). This is because psychological constructs, such as the quality of life, are nothing at all like physical variables that are quantitative in nature. However, psychologists have routinely treated psychological constructs *as if they are quantitative in nature and as amenable to measurement as physical characteristics*. For more than 60 years, psychology has been living in a make-believe world where making rules for applying numbers to attributes has been treated as if it were proper measurement. This fundamental issue cuts off at its very roots the claim that psychology is a quantitative science on a par with the natural sciences.

However, this would be a very short textbook if we were to give up at this point! We must soldier on as if we have solid ground to walk upon rather than boggy sand.

Measurement can be defined as the estimation of the magnitude of a quantitative attribute relative to a unit (Michell, 2003). Before quantification can happen, it is first necessary to obtain evidence that the relevant attribute is quantitative in structure. This has rarely, if ever, been carried out in psychology. Unfortunately, it is arguably the case that the definition of measurement within psychology since Stevens' (1951) operationism is incorrect and psychologists' claims

about being able to measure psychological attributes can be questioned (Michell, 1999, 2002). Contrary to common beliefs within the discipline, psychological attributes may not actually be quantitative at all, and hence not amenable to coherent numerical measurement and statistical analyses that make unwarranted assumptions about the numbers collected as data.

The situation is akin to the 'Emperor has no clothes' story. Psychometricians are forced to pretend/make the inference that the ordering of scores is a reflection of an underlying quantity and therefore that psychological attributes are measurable on interval scales. Otherwise there would be no basis for quantitative measurement in psychology. Michell (2012: 255) argued that: 'the most plausible hypothesis is that the kinds of attributes psychometricians aspire to measure are merely ordinal attributes with impure differences of degree, a feature logically incompatible with quantitative structure. If so, psychometrics is built upon a myth.' This view is supported by Sijtsma (2012), who argued that the real measurement problem in psychology is the absence of well-developed theories about psychological attributes and a lack of any evidence to support the assumption that psychological attributes are continuous and quantitative in nature. This fundamental measurement problem exists as much within health psychology as it does within psychology as a whole.

BOX 1.5

Measuring a psychological attribute – what the majority of textbooks don't tell you and about which you are not supposed to ask

A typical study requires participants to complete a set of ratings on questionnaire scales that are designed to measure a psychological attribute. The essential issue is whether the total score obtained from the numbers (ratings) provided by an individual is in any way a measure of an attribute along a quantitative scale, like the readings from a tape measure, which reflect the quantity of distance. Distance has an absolute zero and different objects can be placed at equal distances from each other or in fixed ratios. Now let's consider the example of Diener's *Satisfaction with Life Scale* (SWLS) (Table 1.2). The total scores on the SWLS are obtained by summing the seven-point ratings of each of five items. Thus, a maximum score is 35 and the minimum score is 5. The scoring scheme is given here:

31–35	Extremely satisfied
26–30	Satisfied
21–25	Slightly satisfied
20	Neutral
15–19	Slightly dissatisfied
10–14	Dissatisfied
5–9	Extremely dissatisfied

(Continued)

Is there any basis for assuming the total scores on the SWLS are measures of a quantitative attribute 'Life Satisfaction' such that there is an absolute zero (as there would be in any ratio scale) and a person with a score of 20 has exactly double the life satisfaction of a person who has a score of 10 and/or that two people with scores of 30 and 25 have a life satisfaction that is the same 'distance' apart (5 points) as in the case of two people with scores of 20 and 15? If the 5-point differences were shown to be the same, then the SWLS would be an interval scale. However, *neither of the hypotheses is plausible*. We can only infer a person's life satisfaction from their answers to items on the SWLS. *This is because we have no independent definition of life satisfaction, and no evidence that life satisfaction is a quantitative attribute, apart from the SWLS scores themselves.*

The total scores on the SWLS really only allow respondents to be placed along an ordinal scale, yet it is common practice to treat the scores as if they were interval scale data that can be added together, subtracted, averaged and compared between groups using standard deviations and variance scores in statistical analyses.

This measurement problem cuts through the entire discipline of psychology. We infer or, in truth, are forced to act on the unproven assumption (i.e., prejudice) that a person's score on a questionnaire is a measure on a continuous quantitative interval scale. That assumption has never been tested and psychometrics, therefore, has been challenged as a form of 'pathological science' (Michell, 2008).

[Nobody promised you a rose garden! We said at the outset that we would adopt a critical stance, and the measurement problem we have described here, which, for obvious reasons, is not normally talked about, is a good start. The situation is not completely hopeless, however, so please do read on.]

Fortunately, for a practical domain like health psychology, it is possible to 'get by' without any proper solution to the measurement problem. Yes, it's a fudge, but a necessary fudge, because otherwise psychological science would be no more advanced today than it was in 1900. One of the main goals of health psychologists is to design interventions that are effective solutions to health problems. Normally we can find ways to objectively compare different interventions to see what works and what doesn't work. The associations between interventions and outcomes can be observed and measured in quantitative terms. Additionally, a patient seeking treatment for an unpleasant condition can express their thoughts, feelings and motives using plain words by answering questions or items on a questionnaire. In the vast majority of cases, either psychological measures are assumed, for the sake of convenience, to lie along an interval scale or the data are purely categorical.

Health psychologists are concerned with patient–practitioner interactions, public health promotion, or working in communities where actions are carried out, all with observable inputs and outputs. Outcomes in these various scenarios are all objectively observable and measurable, even if the measurements themselves are not shown to have an underlying quantitative attribute. In addition, it is the experiences of the actors that are important, and these are amenable to qualitative methods where the presumption of quantitative attributes and the associated measurement problem do not apply.

A FRAMEWORK FOR HEALTH PSYCHOLOGY

Theoretical thinking in any scientific discipline consists of four broad types that vary according to their level of generality: paradigms, **frameworks**, **theories** and **models**. Paradigms explicitly state assumptions, laws and methods in a complete system of thinking about a field of inquiry (Kuhn, 1970). Frameworks have some of the characteristics of paradigms, but are smaller-scale and much looser, although they are a way of organizing information about a field. Figure 1.5 shows a framework about the main influences on the health of individual human beings that we find quite helpful. It has been adapted from the work of Dahlgren and Whitehead (1991) and we call this the 'Health Onion'.

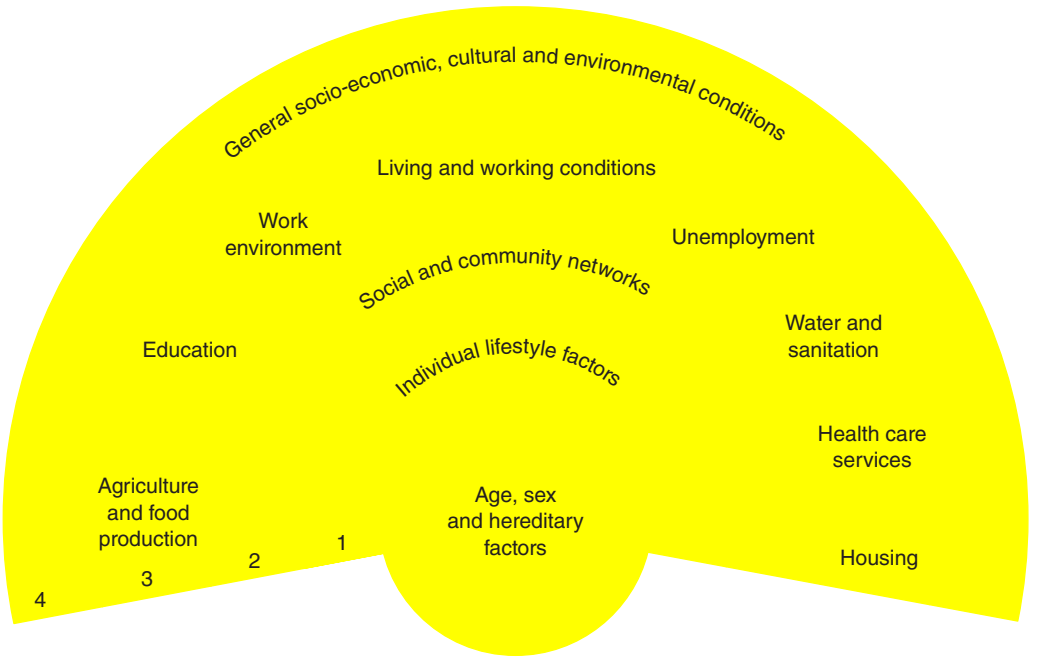


Figure 1.5 The 'Health Onion': a framework for health psychology

Source: Dahlgren and Whitehead (1991)

The 'Health Onion' has a multi-layered structure of 'rings', with the individual person at its core, surrounded by four layers of influence,'systems' or 'rings'

Core: age, sex and hereditary factors (Part 1 of this book).

Level 1: individual lifestyle (Part 2 of this book).

Level 2: social and community influences (Part 1 of this book).

Level 3: living and working conditions, and health care services (Parts 3 and 4 of this book).

Level 4: general socio-economic, cultural and environmental conditions (Part 1 of this book).

The Health Onion is a systems framework with seven characteristics:

1. It is holistic – all aspects of human nature are interconnected.
2. It is concerned with all health determinants, not simply with events during the treatment of illness.
3. The individual is at the core with health determinants acting through the community, living and working conditions, and the socio-economic, cultural and physical environment.
4. It places each layer in the context of its neighbours, including possible structural constraints upon change.
5. It has an interdisciplinary flavour that goes beyond a medical or quasi-medical approach.
6. It makes no claim that any one level is more important than others.
7. It acknowledges the complex nature of health determinants.

Different theories and models are needed for each setting and context. However, there is also a need for a general paradigm for individual health within which specific theories and models can be nested. Such a paradigm should attempt to represent in an explicit, detailed and meaningful way the constraints upon and links between individual well-being, the surrounding community and the health care system (Marks, 1996). No such general paradigm exists. We are waiting for a Hippocrates, Darwin or Einstein.

BOX 1.6

Filtering of evidence in evidence-based practice

Some methodological purists believe we have a paradigm for all of health care in the form of evidence-based medicine or **evidence-based practice (EBP)**. In EBP, randomized controlled trials are used to produce conclusions about the effectiveness of different methods and treatments. In theory, the approach sounds wonderful. In practice, it is far from perfect. Evidence on effectiveness in EBP is assumed to have an objective, inviolable status that reflects 'reality'. It is given an iconic status. In some undefined ways, this evidence about 'reality' not only aids decision-making, but also determines it. In truth, evidence is never absolutely certain. It rests on subjective elements consisting of negotiable, value-laden and contextually dependent beliefs that are given the status of 'facts' when all they really are items of information. Until the Magellan–Elcano circumnavigation of 1519–22 the Earth was assumed by everybody to be completely flat. The flat-Earth was a belief masquerading as fact. Flat-earthers still exist, but their numbers are dwindling.

The nature of evidence, and the methods by which evidence is gained, are contentious issues in the history of science. In health care, evidence (= new knowledge) for a technique or treatment is not an accident, but the product of a series of 'gates' or 'filters' that must be passed before the technique is deemed to be useful.

Consider the sequence of processes through which evidence must pass if it is to be considered admissible in EBP. The filtering is so selective that, typically, systematic reviewers will be able to find only a dozen or fewer primary studies that fulfil the inclusion criteria from a field of several thousand. It's not unlike making a pot of filter coffee – the stronger the filtering, the less fresh and flavourful the coffee or using a tea-bag to make a cup of tea.There are no guarantees the end product will be fit for purpose. The final product is almost certainly inferior to the genuine article. The filtering process in EBP consists of seven levels: current knowledge, theory and paradigms taught in universities and schools; funding priorities of government, industry and charities; hypotheses considered important by the funders; methodology approved by funders; journal publication; systematic reviews; translated into EBP.

To be judged 'sound', evidence must pass through these seven filters, which are biased towards the preservation of existing practices, knowledge and myths. In confirming the 'sound' status of the techniques that have passed through the filters, the 'unsoundness' of the unfiltered techniques occurs by default. Undeniably, evidence filtering is systematic and biased towards the status quo. Evidence is considered 'sound' or 'unsound' according to established criteria.

However, EBP is contentious on a number of grounds. First, it is wasteful that so much evidence is 'thrown away'. Many unfiltered techniques are quite possibly as effective as techniques that have been filtered. Second, the filtering process gives a high weighting to techniques that conform to beliefs and values of the knowledge establishment. For example, pharmacotherapy will be established ahead of psychological therapies (pharmaceutical industry sponsorship at filters 1–4), quantitative techniques will be preferred to qualitative techniques (filters 5–6), and patient treatment care will be about outputs and outcomes, rather than feeling they have been cared for as human beings (filters 7). Third, innovation may have difficulty breaking through.

In this book, we review the results of many studies using the approach of EBP, but many studies that have *not* been based on EBP are also reviewed. Many such studies have been in settings where EBP would be unethical, impractical or impossible. We also include qualitative studies because the findings illuminate the lived experience of health and illness.

Source: Marks (2005, 2009)

FUTURE RESEARCH

1. Psychology requires a solution to the measurement problem (if there is one): there is no evidence that psychological attributes are continuous quantitative variables of the kind studied in the natural and physical sciences.
2. Trans-cultural studies of health, illness and health care are needed to facilitate communication and understanding of systems of healing among different cultural, ethnic and religious groups.
3. Evidence needs to be gathered to confirm that lifestyle changes cause positive changes to life expectancy and quality of life.
4. The limits of evidence-based practice require innovative evaluation methods of interventions.

SUMMARY

1. Health is a state of well-being with physical, cultural, psychosocial, economic and spiritual attributes, not simply the absence of illness.
2. The fundamental sociality of individual behaviour demands a social orientation to health psychology, which must be studied in the context of society and culture.
3. To be healthy in body and mind a person's needs to interconnect and to act autonomously as an agent must both be satisfied as well as his/her biological needs.
4. Subjective well-being is normally positive for the majority of individuals. It fluctuates around a set-point inside a range and is regulated by homeostasis.
5. Behavioural and environmental changes need to be given equal priority in interventions.
6. Health psychology has grown rapidly, with increasing evidence that much illness and mortality is caused by behaviour, and there is a growing awareness of the psychosocial aspects of health and illness.
7. The 'Health Onion' is a useful framework for the investigation of health and illness. The core of the onion is an individual's current health status, including age, sex, genetic and epigenetic factors. Four layers of analysis surrounding this core are: (1) individual lifestyle, (2) social and community influences, (3) living and working conditions, and (4) general socio-economic, cultural and environmental conditions.
8. Concepts about health and disease are embedded in culturally diverse ways, with significant differences in experience and behaviour between cultures and places.
9. The organization of knowledge in health psychology is structured within frameworks, theories and models. It is helpful to notice the difference between these three types of structure and to treat them differently.
10. The nature of evidence and the methods by which evidence is gained are contentious issues in science. In health care, new knowledge about a theory, technique or intervention is the product of a series of evidence 'gates' or 'filters' that must be passed before it is deemed to be useful.

2

THE NERVOUS, ENDOCRINE AND IMMUNE SYSTEMS AND THE PRINCIPLE OF HOMEOSTASIS

'... almost all aspects of behaviour can be fully understood in terms of the concept of homeostasis.'

Curt Richter (1967)

OUTLINE

In this chapter, we outline three interacting biological systems with a primary role in the regulation of health and illness: the nervous system, endocrine system and immune system. These three systems together control and coordinate the body's responses to changes in the internal and external environment. We outline each system in turn and examine interactions between the nervous system, endocrine system and immune system with examples of recent research on psychoneuroimmunology. We conclude with a description of two kinds of homeostasis, both physiological and psychological.

BIOLOGICAL SYSTEMS

Three biological systems of relevance to health psychology are the nervous system (NS), the endocrine system (ES) and the immune system (IS). These three systems communicate within the body using electrical and chemical signals. They activate and de-activate tissues, organs and muscles to control and regulate the body, the emotions and the mind. The principal objective

of the three systems is to preserve homeostasis. The three systems and their relationships to the brain and behaviour are illustrated in Figure 2.1.

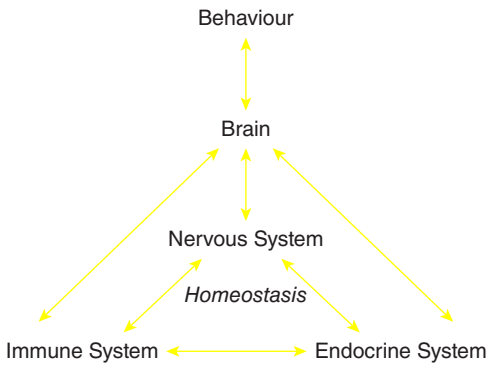


Figure 2.1 The nervous system (NS), endocrine system (ES) and immune system (IS) and their relationships to brain and behaviour

Constant reciprocated interaction between the three systems – the brain, organs and gut – is required to enable the control and coordination of behaviour. Endocrine substances directly affect the nervous and immune systems. The NS innervates every organ and tissue of the IS with reciprocal connections. The continuous interactions among the nervous, endocrine and immune systems was named 'neuroimmunomodulation' by Spector and Korneva (1981). Other related terms for these interactions include 'psychoimmunology', '**psychoneuroimmunology**' (Kiecolt-Glaser and Glaser, 1992), 'immunoendocrinology', 'behavioural immunology' and 'mind and immunology'. We review research on psychoneuroimmunology later in the chapter.

The three biological systems provide an essential foundation for the understanding of health and illness. Interest in the NS, however, is more than an academic one; it is also economic. The burden on health care and the economy from neurological disease is massive and rapidly increasing. For example, in the USA nearly 100 million people are ill with neurological disease. The combined annual costs of Alzheimer's and other dementias, low back pain, stroke, traumatic brain injury, migraine, epilepsy, multiple sclerosis, spinal cord injury and Parkinson's disease totals nearly $800 billion, and this figure is rapidly rising due to the ageing population (Gooch et al., 2017). This huge sum suggests a pressing need to expand knowledge and training in neuroscience. One necessary step is to begin with a basic grounding in the nature and function of the NS, a foundation stone for everything that follows.

THE NERVOUS SYSTEM

Neurones and microglial cells

It has been estimated that the human body consists of 37.2 trillion cells plus or minus around 0.81 trillion (Bianconi et al., 2013) and there are hundreds of different cell types (Mescher, 2016). The cells in one body have identical DNA but carry out a coordinated myriad functions to enable the maintenance of a near-stable internal environment. Only by communicating with one another can the necessary high level of coordination be possible. The two primary

organizations for cell–cell communication are the NS, using **neurotransmitters** such as acetylcholine, and the ES, which transports **neuromodulators** and **hormones** (e.g., cortisol) around the entire body. Most cell–cell communication occurs using intracellular enzymes, molecules that speed up chemical reactions (Michael et al., 2017). We outline here the basic structure and functions of the NS.

There are two main cell types in the NS, **neurones** and **glial cells**. Both cell types are absolutely necessary for neurological health. Glial cells provide support and nutrition, maintain local homeostasis, produce myelin and participate in signal transmission. The total number of glial cells roughly equals the number of neurons. Of particular importance are **microglial cells**, a type of glial cell accounting for 10–15% of all cells found within the brain. Microglial cells are highly plastic and act as **macrophage** ('big eater') cells, the main form of active immune defence in the central nervous system (CNS).

As both unique immune cells and unique brain cells that constantly change shape and have numerous different functions, microglial cells could stake a claim to being the 'smart' cells of the body. Microglia travel independently, unattached to any structure, circling a territory with extended arms seeking suboptimal functioning. This constant system of microglial surveillance protects the brain against any microbe invaders, demyelination, trauma and cancerous or defective cells (Lieff, 2013). When glial cells go wrong, all sorts of chaos can break loose, including brain inflammation and neurodegeneration, which can cause chronic pain (McMahon et al., 2005), Alzheimer's disease (Paresce et al., 1996), Parkinson's disease (Kim and Joh, 2006) and, according to some research, myalgic encephalomyelitis/chronic fatigue syndrome (**ME/CFS**) (Morris and Maes, 2014). It can be seen already that intimate connections exist between the immune and nervous systems, and so far we have only mentioned the 'foot soldiers' of the NS and not the command structures.

Neurones provide the main 'wiring' of the NS; they are communication devices that connect with other neurones, tissues, organs and muscles. How the neuronal communication works can best be explained by looking at the structure of the neurone (Figure 2.2).

The brain contains around 86 billion neurones, 20% in the cerebral cortex and 80% in the **cerebellum** (Lent et al., 2012). Each neurone can connect with up to 1–10,000 other neurons so there may be as many as *860 trillion* **synaptic connections** in total. Each neurone consists of a cell body or 'soma', dendrites and an axon. Dendrites are thin structures that arise from the cell body. They may be hundreds of micrometres in length and branch multiple times to produce a complex 'dendritic tree'. An axon, or 'nerve fibre' when myelinated, arises from the soma at the axon hillock and travels for a distance which can be as far as one metre in humans (connecting the toe to the spinal column).

Most excitatory synapses are formed between the axon of one neuron and a dendritic spine on another. When two neurons on either side of a synapse are active simultaneously, that synapse becomes stronger, a form of memory. The dendritic spine also becomes larger to accommodate the extra molecular machinery needed to support a stronger synapse.

Myelin is a fatty white substance that surrounds the axon of some neurones, providing electrical insulation. Multiple sclerosis (MS) occurs when an abnormal IS response produces chronic inflammation, which damages or destroys myelin.

Synapses and neurotransmission

One major form of communication in the NS uses neurotransmitters which are 'squirted' across an inter-cell channel called a 'synapse' or 'synaptic cleft'. This feature is illustrated in Figure 2.3.

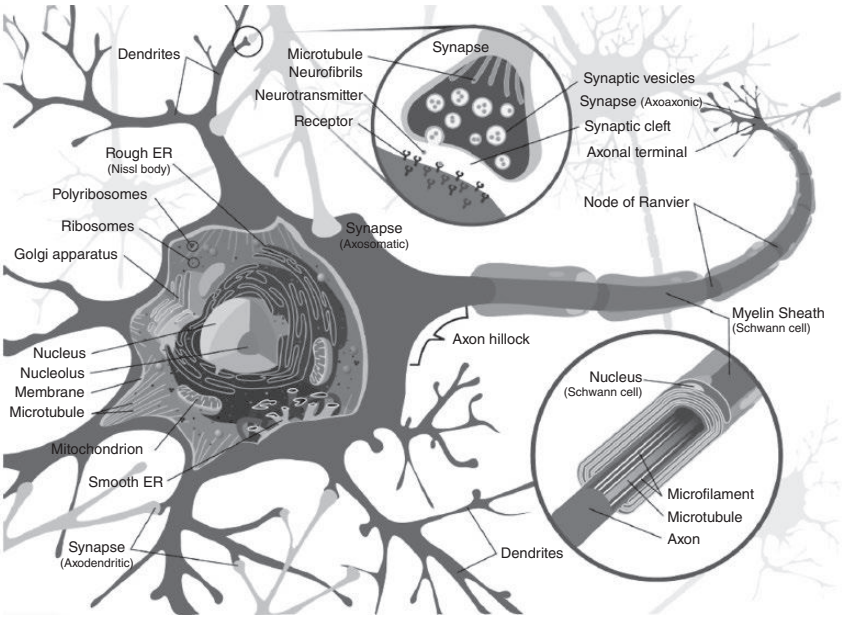


Figure 2.2 A schematic neurone and synapse

Source: Yurana's portfolio, IMG ID:214981837, acquired via Shutterstock

A wave of electrochemical excitation called an action potential travels along the membrane of the presynaptic cell, until it reaches the synapse. Channels that are permeable to calcium ions then open and calcium ions flow through the presynaptic membrane, increasing the calcium concentration in the interior. The increased calcium concentration activates a set of calcium-sensitive proteins attached to vesicles which contain a neurotransmitter. These proteins change shape, causing the membranes of some 'docked' vesicles to fuse with the membrane of the presynaptic cell, thereby opening the vesicles and dumping their neurotransmitter molecules into the synaptic cleft, the narrow space between the membranes of the pre- and postsynaptic cells.

To use an analogy, think of a couple of crazy kids having some fun in the school cafeteria when the teacher is nowhere to be seen. In a mêlée of hundreds of children all waiting for lunch, one kid picks up a bottle of ketchup and squirts it at the other kid's face. If the ketchup squirt hits the target, and lands squarely in the other kid's mouth, we have a successful 'transmission'. If he misses, he'll have to have another go, or another kid from the crowd will need to have a squirt to achieve a successful transmission. This is the kind of thing that goes on in neurotransmission across the synapse. The first kid with the ketchup bottle is the neurone, the bottle is the synaptic vesicle, the ketchup is the neurotransmitter, the first kid's squeezy hand is the neurotransmitter transporter, and the second kid with ketchup all over his face is the receptor. The more ketchup on the face, the better the communication. Once the ketchup has done its job, it magically returns to the bottle. Job done! Unless, of course, that tomato ketchup is the 'wrong' kind of neurotransmitter and the receptor kid demands a certain flavour of ice-cream instead! These 'ketchup kid fights' are going on trillions of times every day in each and everyone of us.

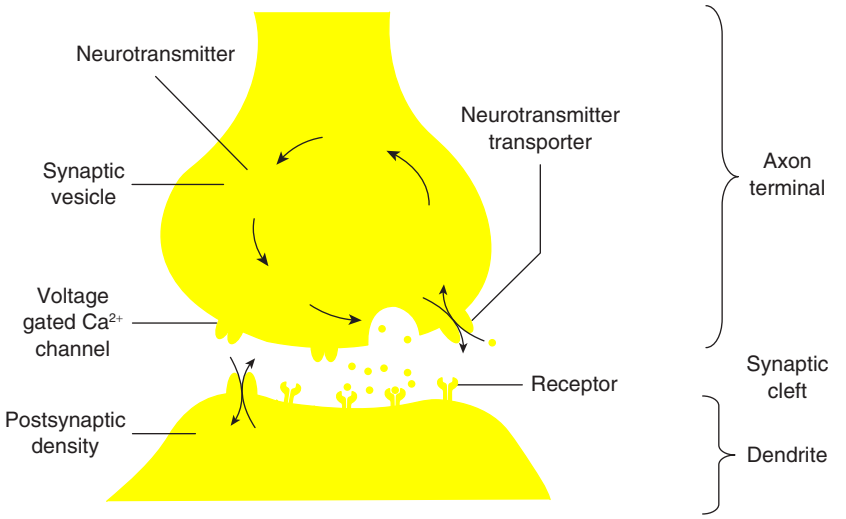


Figure 2.3 The synapse, axon terminal, dendrites and associated processes

Source: Thomas Splettstoesser, Wikimedia Commons, CC 4.0 International license

There are at least 60 different kinds of ketchup – sorry, I mean neurotransmitter – to choose from. To be a neurotransmitter, a molecule must: (1) be red, sticky and taste like ketchup [*no cancel that, just checking whether you're concentrating*], be produced inside a neurone, be found in the neurone's terminal button, and be released into the synaptic gap upon the arrival of an action potential; (2) produce an effect on the postsynaptic neurone; (3) be deactivated rapidly, after it has transmitted its signal to this neurone; (4) have the same effect on the postsynaptic neurone when applied experimentally as it does when secreted by a presynaptic neurone. The best-known neurotransmitters are:

- acetylcholine
- serotonin
- catecholamines, including epinephrine, norepinephrine and dopamine
- excitatory amino acids, such as aspartate and glutamate (half of the synapses in the CNS are glutamatergic)
- inhibitory amino acids, such as glycine and gamma-aminobutyric acid (GABA; one-quarter to one-third of the synapses in the CNS are GABAergic)
- histamine
- adenosine
- adenosine triphosphate (ATP).

Peptides form another large family of neurotransmitters, with over 50 known members, including: substance P, beta endorphin, enkephalin, somatostatin, vasopressin, prolactin, angiotensin II, oxytocin, gastrin, cholecystokinin, thyrotropin, neuropeptide Y, **insulin**,

glucagon, calcitonin, neurotensin and bradykinin. However, many peptides act more as neuromodulators than as neurotransmitters. Neuromodulators do not propagate nerve impulses, but instead affect the synthesis, breakdown or reabsorption (reuptake) of neurotransmitters (more on this later). Curiously, certain soluble gases can also act as neurotransmitters, for example nitrogen monoxide (NO, 'laughing gas'). These neurotransmitters have their own distinctive mechanism: they exit the transmitting neurone's cell membrane by simple diffusion and penetrate the receiving neurone's membrane in the same way.

Organization of the nervous system

Having outlined aspects of the 'wiring' of small clusters of cells in the NS, we need to consider how the 86 or so billion cells of the NS are organized into functional subsystems (Figure 2.4). This diagram divides the highly complex system into a framework of functional domains.

The command and control centre at the 'top' of the NS is the central nervous system (CNS), consisting of the brain and spinal cord. Decisions made in the CNS are communicated via the peripheral NS, the cranial and spinal nerves, to the motor (effector) division of the NS. Communication back to the CNS is conducted by the sensory (afferent) division. There are two branches of the efferent division, the autonomic nervous system (ANS), which deals with cardiac muscles, smooth muscles and glands, and the somatic nervous system, which deals with skeletal muscular actions (speech and behaviour).

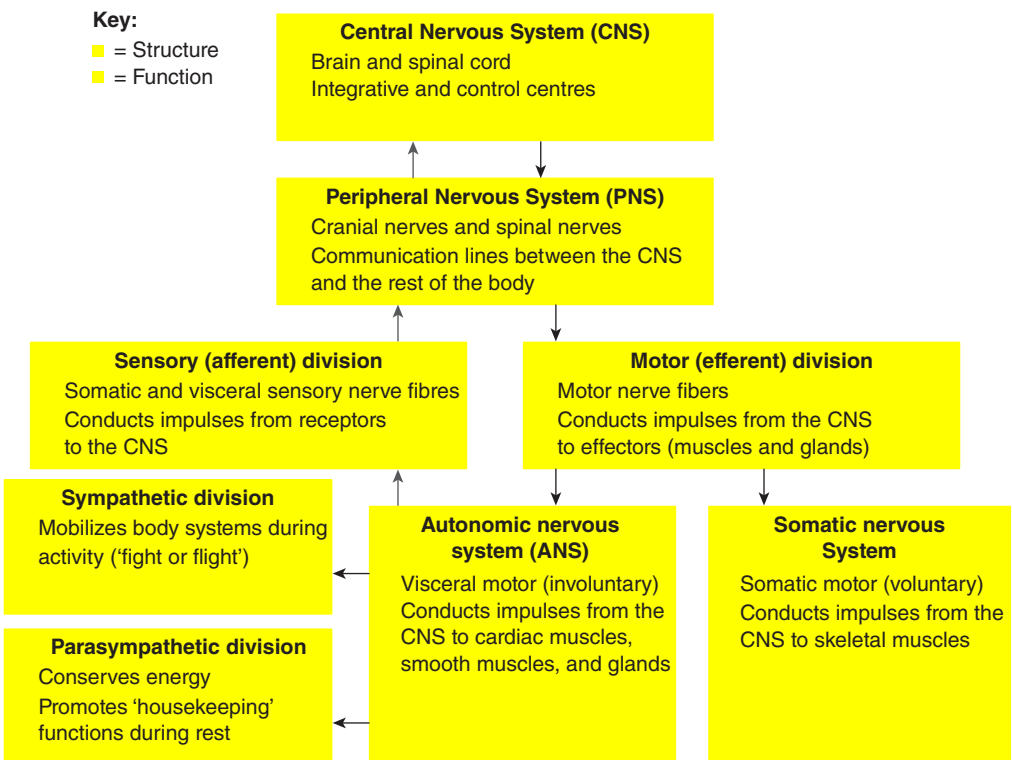


Figure 2.4 Organizational framework of the nervous system

The brain[1]

The brain and associated structures are shown in Figure 2.5. The cortex controls information input, synthesis and comparison, and output and action. Information input comes through receptors that are sensitive either to variations in the outside world or to variations within the body, such as changes in body position. Before the nerve fibres emerging from a sensory organ reach the primary cortex, where inputs are processed, almost all make at least one connection in subcortical centres such as the thalamic nuclei.

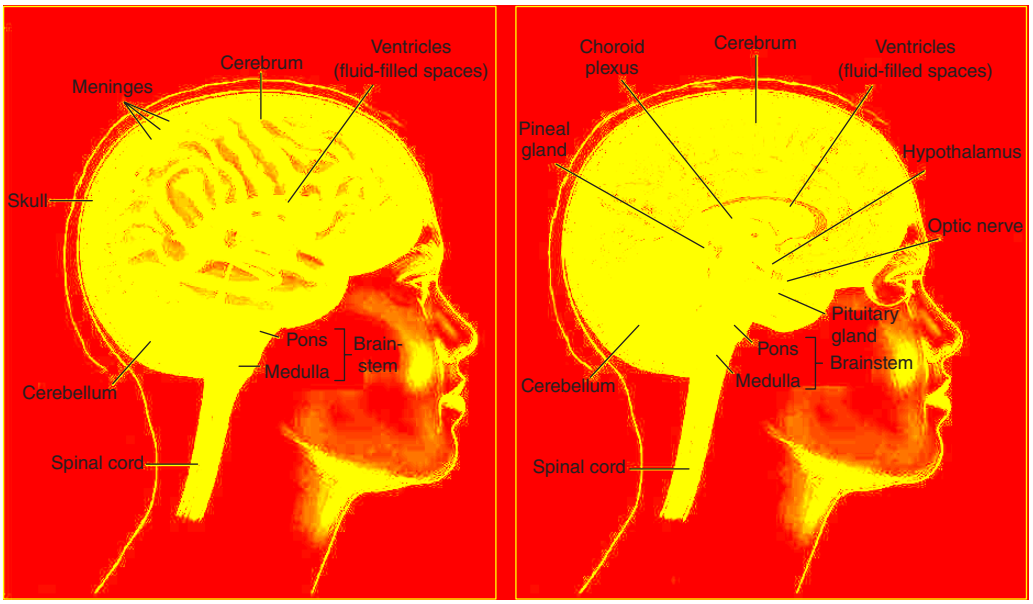


Figure 2.5 The brain, brainstem, medulla, pons and other important brain structures

Source: © 2010 Terese Winslow, U.S. Govt.

Another cortical input consists of fibres from the cortex itself, from either the same hemisphere or the opposite one. Once sensory signals arrive in their primary cortical area, they diverge into various local circuits responsible for information processing. These cortical microcircuits comprise the same types of cell distributed in the same six layers of the cortex. The results of 'computations' performed by these microcircuits ultimately converge at pyramidal neurons whose axons are the only output pathways from the cortex. A high proportion of axons that leave the cortex return to it, on the same or the opposite side. Other axons emerging from the cortex terminate in subcortical centres such as the thalamic nuclei, where they come into contact with the sensory fibres that send their axons to the cortex.

'Feedback looping' is a fundamental characteristic of information processing by the brain. At every stage, some of the fibres and connections loop back to the preceding stage to provide feedback that helps to control it. For instance, feedback loops enable the brain's motor control centres to correct and adjust their signals to the muscles, right up to the moment these signals are sent. Feedback

[1]Some illustrations and content are from 'The Brain from Top to Bottom', available at: http://thebrain.mcgill.ca/

loops like these let us keep our balance while walking against sudden gusts of wind. Feedback loops are also found in bodily reflexes, such as the leg withdrawal reflex. A complex task, such as playing a piano, involves highly complex connections because it requires the pianist to contract and relax many different muscles simultaneously, which is controlled by the cerebellum.

Neuromodulation

Neuromodulation occurs when a neurone uses a chemical to regulate diverse populations of neurones. Neuromodulators are secreted by a small group of neurons and diffused through large areas of the NS, instead of into a synaptic gap, affecting multiple neurones at the same time. Just one of these neurones can influence over 100,000 others through the neuromodulators that it secretes into the brain's extracellular space.

Neuromodulators spend significant amounts of time in the cerebrospinal fluid (CSF), 'modulating' the activity of several other neurones. Some of the same chemicals that act as neurotransmitters are also neuromodulators, specifically serotonin, acetylcholine, dopamine and norepiniphrene. The neurons of the 'hormonal brain' differ from those of the 'wired brain' in several ways. The hormonal neurones are concentrated mainly in the brainstem and the central region of the brain. They form small masses of thousands of cells, but these cells project their axons into large areas of the forebrain and the midbrain. Many drugs and medications, including those prescribed for affective disorders and schizophrenia, act on the neuromodulators of the diffuse projection neurons in the brainstem. For this reason, the function and distribution of the projections of these neurons have been the subject of much research using tracing techniques, because the axons of these neurons are not myelinated and do not form readily identifiable bundles. The results have confirmed how widely diffused these projections are. For example, a single axon from one of these neurons may subdivide and innervate both the cortex and the cerebellum.

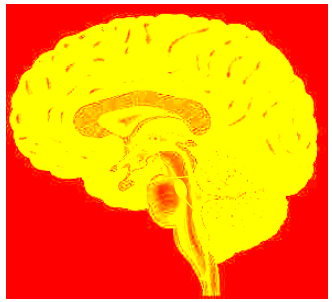
The four main neuromodulators are norepinephrine (diffused by the locus coereleus), serotinin (diffused by the Raphe nuclei), acetylcholine (diffused by the basal nucleus of Meynert, pedunculopontine and pontine nuclei) and dopamine (diffused by the substantia nigra and ventral tegmental area). Each of these groups of neurones projects axons into large areas of the CNS and thus modulates numerous behaviours. The diffusion of the four main neuromodulators is illustrated in Figure 2.6.

THE SOMATIC AND AUTONOMIC NERVOUS SYSTEMS

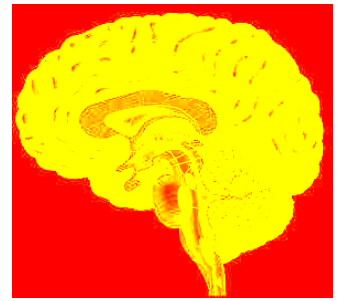
The **somatic nervous system** is the organism's apparatus for responding to the external environment. It sends information to the brain from the body's various sensory detectors. The somatic nerves enable us to respond to these stimuli by moving through our environment, taking voluntary action, reacting and speaking. One of the principal roles of the somatic NS is maintaining homeostasis in the external environment, as discussed later in this chapter.

The **autonomic nervous system** (ANS) maintains homeostasis in the internal environment by regulating vital organs, such as those involved in digestion, respiration, blood circulation, excretion, and the secretion of hormones. The ANS is divided into two subsystems, the sympathetic and parasympathetic systems. The two branches of the ANS generally work in opposite directions, enabling a continuous upward or downward control of the internal organs to maintain homeostasis in the internal environment.

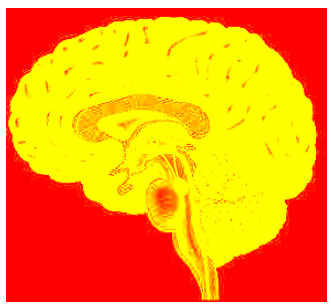
A. The **locus coeruleous** contains most of the neurons that produce **norepinephrine** in the brain. They send projections to just about every part of the central nervous system. Located in the dorsal portion of the pons, these cells are strongly activated by new sensory stimuli. They play a role in regulating vigilance and attentiveness and are inactive during sleep. Overactivity of this system can cause anxiety, while underactivity can lead to depression.



B. The neurons of the **Raphe nuclei** release **serotonin** as a neurotransmitter. These neurons are grouped into about nine pairs, distrtibuted along the entire length of the brainstem. They project very widely throughout the central nervous system. The more rostal nuclei innervate thee cortex and the thalamus, while the more caudal nuclei innervate the cerebellum and the spinal cord. These latter nuclei appear to work in conjunction with the norepinergic neurons: they are active during waking periods and quiet during waking periods and quiet during sleep. In addition to being involved in the sleep/wake cycle, they also appear to affect mood.



C. Diffuse projection neurons that use **acetylcholine** as a neurotransmitter are found in the ventral region of the telencephalon and the rostral portion of the pons. Nearly three-quarters of all acetylcholine in the cortex comes from the **basal nucleus of Meynert**, while the **pedunculopontine nucleus** and the **lateral tegmental pontine nucleus** project to the thalamus. The limbic system also receives acetylcholine from the medial septal nucleus (not shown here). This nucleus is believed to contribute to vigilance and neuronal plasticity, and would therefore play an important role in learning and memory. The memory loss associated with Alzheimer's disease is probably linked to the deterioration of this cholinergic system.



D. The two groups of neurons that diffuse **dopamine** are located in the lower portion of the midbrain. The **substantia nigra** (black substance) projects to the striatal structures (caudate nuclei and putamen). The degeneration of this nigrostriatal pathway that accompanies Parkinson's disease produces the trembling and the difficulty in initiating movement that characterize this illness. Other dopamine-producing cells project from the **ventral tegmental area** to the frontal cortex and to most of the structures in the limbic system. This system appears to be involved in reinforcing certain behaviours by associating them with pleasurable sensations. It also seems to be associated with the mechanisms involved in substance dependencies and in schizophrenia.

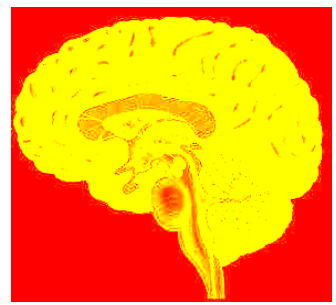


Figure 2.6 Brainstem structures responsible for neuromodulation

The **sympathetic nervous system** (SNS) goes into action to prepare the organism for physical or mental activity of 'fight or flight'. When the organism faces a major stressor, it is the SNS that orchestrates the fight-or-flight response. It dilates the bronchi and the pupils, accelerates heart rate and respiration, and increases perspiration and arterial blood pressure, but reduces digestive activity. Two neurotransmitters are primarily associated with this system: epinephrine and norepinephrine. The **parasympathetic nervous system** (PNS), on the other hand, causes a general slowdown in the body's functions in order to conserve energy. Whatever was dilated, accelerated or increased by the SNS is contracted, decelerated or decreased by the PNS. The only things that the PNS augments are digestive functions and sexual appetite. One neurotransmitter is primarily associated with this system: acetylcholine. The two divisions of the ANS and their functions are illustrated in Figure 2.7.

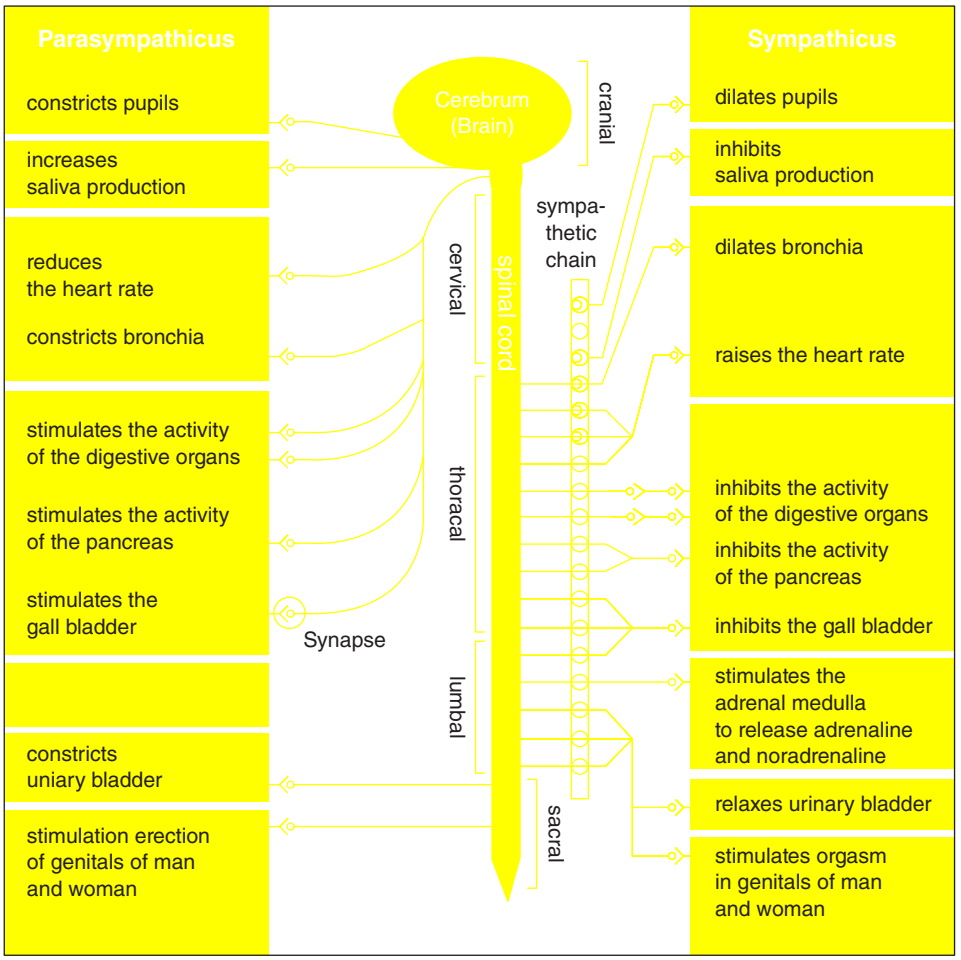


Figure 2.7 Schematic diagram of the autonomic nervous system

Source: Adapted from Geo-Science-International