Introduction

The first edition of this book was published more than 10 years ago, with the aim of providing a comprehensive overview of research, applying a cognitive neuroscience approach to emotion and affective processes in humans. At the time, the scientific study of emotion through a neurobiological lens was still a nascent field compared with the more established and by-then flourishing research on other mental functions such as memory, language, or perception. Today, affective neuroscience has become an independent field, with not only intense research activity and an ever-growing community of scholars but also dedicated journals, societies, conferences, and specialized training programs and institutes in several institutions worldwide. Research on the neural bases of emotional processing has vastly expanded during this decade, with approximately 54,000 publications recorded on PubMed from 2011 to 2021 – almost triple the number during the decade before this book's first edition (19,000 in 2001–2010) and 10 times more than the preceding decade (5,300 in 1991–2000) or the entire half century before the emergence of neuroimaging in the 1990s (6,000 in 1950–1990). Importantly, the field has not only grown but also matured, with an accumulation of more solid evidence for several domains that led to the confirmation or refutation of prior hypotheses, the resolution of open debates or the emergence of new ones, the development of novel conceptual frameworks, and practical applications of emotion research in other fields even outside neuroscience and psychology. There has been a substantial increase in interest in exploring the influence of emotion (either in terms of information or mood states) on many other, more "traditional" processes that were once considered outside the scope of affective sciences, such as motor control, sleep, perception, and executive functions. In parallel, a growing number of disciplines have been explored in new ways, both informing and being informed by the affective sciences – including economics, history, law, linguistics, anthropology, sociology, and computer sciences, to name just a few. This has led some scholars to consider that the last decade marks a new era of "affectivism" that superseded the preceding

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behaviorist and cognitivist frameworks in human sciences (Dukes et al., 2021).[1]

In this context, we felt it was necessary and timely to provide a new synthesis, building on these advances and adequately reflecting the current knowledge on emotion and affective processes in the human brain. This motivated us to conceive a second edition of the Handbook with entirely revised content. This was made possible by the enthusiastic response and hard work of the many authors who contributed to the chapters of this new book. We are deeply grateful to them. These 31 chapters were written by researchers from nearly 40 different institutions across 18 countries, highlighting the international breadth and diversity of current research in affective neuroscience. Relative to the first edition, the chapters are either revised in depth or written entirely anew, reflecting the latest work conducted by these (and other) researchers over the past years. All authors contributing to the Handbook are among world-leading experts in the field, including many who were part of the Generation X that sparked emotion research in the early part of this century and already contributed to the first edition. Several others are younger and constitute the newly emerging generation that now explores further territories with their own work. We believe that this mix offers a rich and exciting survey of the field, bringing together an up-to-date summary of the content from the first edition of the Handbook with the addition of novel topics illustrating new areas of research that are now covered in greater detail in this second edition.

When planning this revision, we had to make choices concerning the themes to cover and their division between chapters so as to keep the book comprehensive but still reasonably sized and accessible to a broad audience with a variety of interests. Like the first edition, the new book concentrates on the study of human emotion processing and omits a detailed survey of nonhuman research using animal models and cellular or molecular approaches, although we do acknowledge the foundational role animal studies can play in the field and the important development of domains and tools explored by such studies in recent years. Accordingly, in the current Handbook, we added two new chapters that provide an overview of cutting-edge methods and paradigms employed in animal or cellular studies, aiming to address key issues of affective processing at the fundamental neurobiological level (Chapter 8) and to develop preclinical models of affective disorders (Chapter 31). In addition, throughout other chapters, the authors were encouraged to highlight the corresponding biological knowledge gained from animal models that is relevant to their own perspective on human emotions. Likewise, purely clinical topics, such as emotional dysfunction in specific mental health disorders, are not a primary focus of the book. However, several chapters address aspects of individual differences that are relevant to clinical diseases (Section VII) and, whenever possible, all other chapters also generally point to relevant implications of their domain for clinical conditions. Overall, we feel that this organization of the book's content should allow readers to gain a rich but concise and structured overview of modern affective neuroscience, covering both fundamental principles and more specific or even applied domains of emotion processing in humans.

To help navigate the diversity of the subject matter, the book is divided into seven sections that illustrate different approaches and perspectives. Section I introduces the study of emotion through two different perspectives based on cognitive psychology and circuit neuroscience, respectively, highlighting the conceptual foundations for dissecting affective processes at behavioral and neural levels of analysis. These introductory chapters illustrate the quest of defining essential features shared by emotions at large, as well as the functional architecture of specific emotions considered as model examples, as is classically done with fear. Section II reviews various research methodologies that provide effective tools for measuring emotional responses, from behavioral through to physiological, neural,

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and biological techniques, with a particular focus on noninvasive brain imaging methods such as MRI, PET, EEG, or MEG. Historically, these imaging methods had an important role in making "subjective" affective phenomena more amenable to "objective" experimental research in neuroscience, and thus facilitated their translation into neurobiological substrates that could then be scrutinized at finer (e.g., cellular) levels across species.

Section III covers emotional perception and expression across different channels, including various sensory modalities such as visual, auditory, and olfactory cues, as well as more abstract signals from music or language. Although in real life emotion is typically elicited or manifested in multimodal ways, these separate chapters provide a useful and complementary survey of very active and informative research directions in current human affective neuroscience. Sections IV and V present the many important (and often bidirectional) interactions between emotion and other cognitive processes, addressing key topics like emotion-attention dynamics, emotion regulation, awareness, decision-making, and the links with memory and learning, including aspects of aversive and reward processing. Section VI then delves into complex facets of emotions at the social and cultural levels, including empathy and morality.

Finally, in Section VII, four complementary chapters review individual differences in emotional processing, such as those linked to age, genetics, and experience, including stress and trauma. These chapters highlight the role of these factors in clinical disturbances, particularly major categories of diseases in which emotion dysregulation plays a key role and neural underpinnings are intensely explored in translational animal models.

Despite these recent advances in our knowledge of affective processing in the brain, as collectively summarized in the chapters of this book, much remains to be uncovered concerning the functional organization and neural mechanisms of emotion. To highlight open questions and future directions of research, each chapter in the book ends with a bullet-point section summarizing the key take-home points of current knowledge along with the major challenges that lie ahead in the domain discussed. As noted by several authors, early neuroscience approaches were often guilty of naive attempts to link a given emotion (particularly basic types such as fear, disgust, etc.) to one or a few unique structures in the brain (e.g., amygdala, insula); in contrast, more recent views generally highlight the role of distributed networks whose activity contributes to diverse emotion types and often overlaps with nonemotional functions. This network perspective is a recurring theme throughout the chapters and accords with the functional characterization of affective phenomena as processes with multiple components and multiple influences on cognition and behavior. Yet, how these networks instantiate the essential constitutive features of emotion and how their interactive dynamics generate emotion experiences is still elusive and will certainly constitute a central issue for research in the next decade(s). We are therefore confident that affective neuroscience will remain a very active and fascinating field of investigation for many years, and hope that the current Handbook will not only offer a broad, accessible, and up-to-date resource for scholars across multiple disciplines but also spark further interest in younger students or readers who are interested in uncovering the cognitive and biological aspects of human emotion. In bringing together a rich and diverse perspective on multiple facets of emotion, resulting from the pioneering and rigorous work of many talented colleagues, we also wish to share the excitement of adventuring in one of the most intriguing realms of brain sciences.

Note

1. Dukes, D., Abrams, K., Adolphs, R., et al. (2021). The rise of affectivism. *Nature Human Behaviour, 5*, 816–820.

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