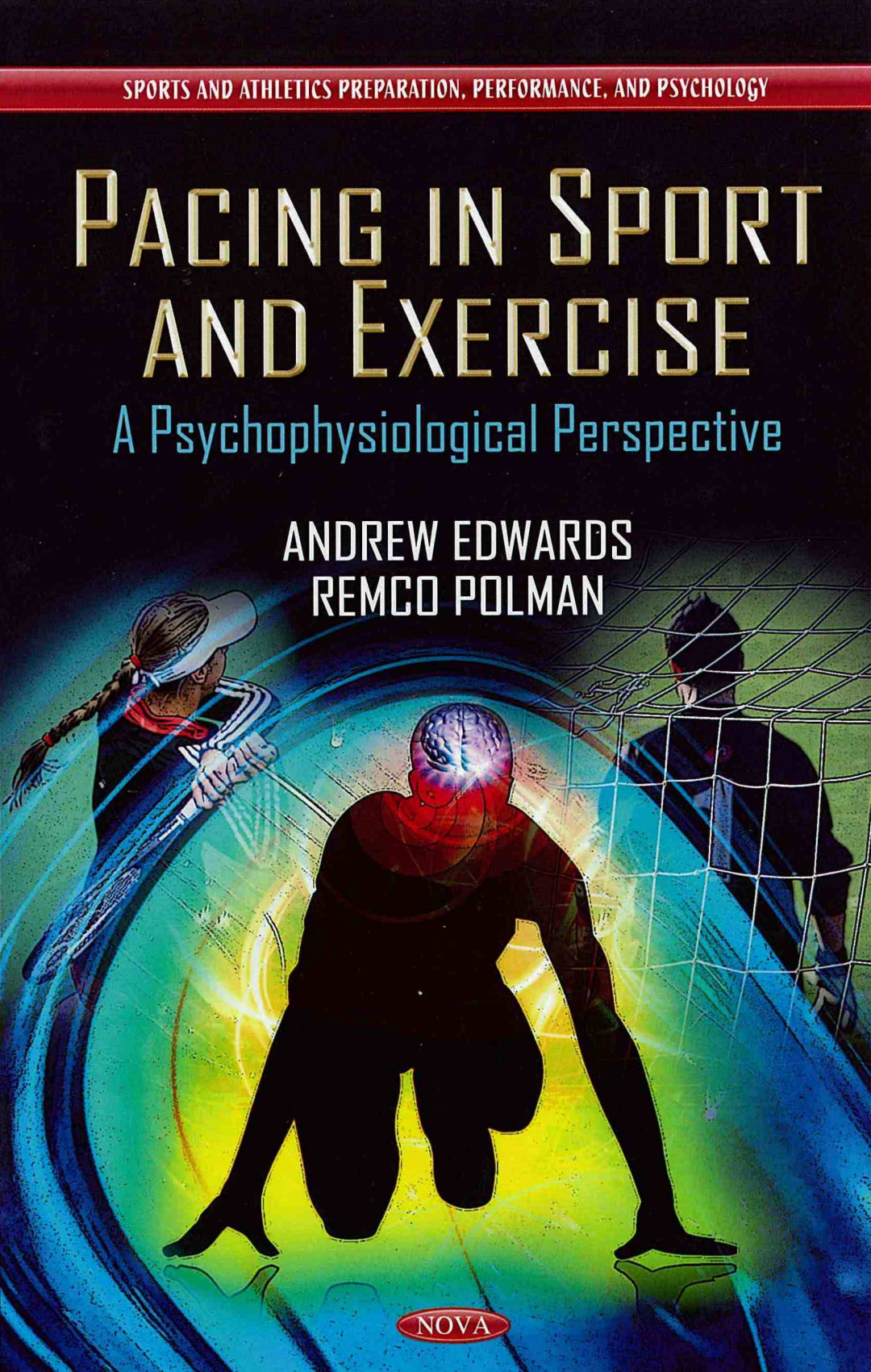
SPORTS AND ATHLETICS PREPARATION, PERFORMANCE, AND PSYCHOLOGY

Pacing in Sport and Exercise

A Psychophysiological Perspective

ANDREW EDWARDS
REMCO POLMAN



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ANDREW EDWARDS
AND
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For all my friends and family who have supported me over the years. In particular this is for my wife Tracy, son Alex and father Harry Edwards.

Andrew

To my mother for all her love and support throughout my life.

Remco

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FOREWORD

Pacing is one of the most important concepts in sport and exercise. The regulation of effort is a choice that every athlete and exerciser must make continuously (if not always with awareness) throughout every workout and competition, and this choice has a profound effect on outcomes. The difference between successful and unsuccessful pacing is often the difference between achieving and falling short of goals; between benefiting and failing to benefit from the work that is done.

Athletes, coaches, exercisers, and trainers have long recognized the importance of pacing and employed experience-based strategies and methods to teach and practice successful pacing. But until recently pacing received relatively little attention from exercise scientists. There was a tendency to view pacing as a psychological phenomenon and therefore outside the purview of mainstream exercise science, whose focus has always been physiological. Inasmuch as pacing *was* studied, it was studied from a physiological perspective that tended to "explain away" the obvious psychological dimension of the phenomenon.

Recent advances in our knowledge of the brain have lately brought long overdue attention to pacing in the exercise science community. There is a growing recognition that pacing is a phenomenon with both psychological and physiological dimensions that are deeply mutually interpenetrating. Improvements in our understanding of how the exercise pacing mechanism really works are opening up exciting new possibilities for the practice of effective pacing in sport and exercise. A need has therefore emerged for a comprehensive and authoritative resource that summarizes what we now know about exercise pacing and more fully realizes the potential for practical

application of this new knowledge for a broad audience of scientists, coaches, trainers, athletes, and exercisers.

Andrew Edwards and Remco Polman have met that need masterfully with this book. *Pacing in Sport & Exercise* presents a cogent and compelling explanation of pacing that, while certainly not representing the last word on the subject, is as close as anyone has yet come. On the solid foundation of their persuasive model the authors have constructed a perception-based system of monitoring and controlling pace, as well as of quantifying and controlling training loads that is easy to comprehend and apply, whether you're a football coach or a beginning jogger seeking weight-loss.

The bias toward physiology and technology that has dominated sport training and exercise prescription for many decades has discouraged people from developing the refined sense of effort perception, the trust in such perception, and particular psychological tools without which optimal pacing is not possible. *Pacing in Sport & Exercise* holds the promise to correct this imbalance with a single stroke, and I expect it to have a revolutionary effect in a wide range of sports and exercise modalities.

For me personally, Edwards and Polman's book fills a big hole that was left open in my own efforts to help endurance athletes conceptually tie mind and body together and become better pacers, hence better racers—most notably in my books *Brain Training for Runners* and *RUN: The Mind-Body Method of Running by Feel.* I intend to rely heavily on Edwards and Polman's invaluable new contribution to the field in my future work as a writer and coach, and I know I will not be alone.

Matt Fitzgerald
San Diego, California, USA

PREFACE

The study of pacing is a relatively new and exciting area of investigation, owing much to original studies by leading academics such as Professors Carl Foster, Veronique Billat and Tim Noakes. These researchers, among others, have demonstrated that pacing is not simply a muscle-driven outcome of performance; it is an important regulatory process that determines performance. Yet, the concept of pacing is not merely confined to elite performance; it underlies all human movements in which voluntary effort is required. As such, the mechanisms by which we regulate pace are complex, requiring mind-body interaction. Therefore, we have considered this topic from a psychophysiological perspective.

Pacing in Sport and Exercise: A Psychophysiological Perspective is, to our knowledge, the first book which comprehensively examines the way humans pace exercise and sporting activities. Research on pacing has been dominated by physiological investigations despite the acknowledgement by many authors on the interdisciplinary nature of pacing. Therefore, we consider both physiological and psychological influences on pacing, before developing an interdisciplinary perspective. This approach explains metabolic regulation during exercise and also facilitates the development of a practical (self-regulatory) means with which to optimise training.

Chapter one of this book provides an overview of the factors associated with the evolutionary development of human athletic performance. It presents a historical view on human training and conditioning perspectives and also on methods including the use of linear and non-linear periodization systems. Chapter two introduces the concept of pacing in sport and exercise. We define pacing as *'the goal directed distribution and management of effort across the duration of an exercise bout'*. Evidence from both animal and human studies is

presented to illustrate the way species adapt behaviour to contextual and personal constraints and pace activities accordingly.

A guiding principle is to see pacing as a neural buffering process preventing premature physical exhaustion. In chapter three, both physical and psychological limitations to human performance are discussed. Limitations of traditional physiological models and also the contemporary central governor model of metabolic control are outlined. We propose a new *'conscious brain regulation'* model as a variation to the central governor model, which provides a simpler but more comprehensive explanation of the many phenomena associated with pacing and fatigue in sport and exercise from a psychophysiological perspective. In chapter four, self-regulatory systems for developing skills and also for monitoring training outcomes are identified and discussed. In particular, the rate of perceived exertion (RPE) for monitoring training is suggested as a practical way of both setting and monitoring training across all modes of exercise. The facilitating and debilitating role of psychological factors like mental toughness, coping strategies and self-confidence are also discussed. Pacing in relation to endurance activities is explored in chapter five. The physiological and psychological demands of activities like marathon running, cycling, rowing and triathlon are outlined. Although the ability to sustain high rate of work output continuously over time is important, from a strategic perspective, front loaded, fast start pacing appears to be optimal for most endurance events. Also, associative coping strategies appear to be related to better performance outcomes in high performance athletes. This chapter provides the reader with a practical example of setting and monitoring endurance training using an example of a RPE-based training programme allowing adoption of an individualised training load.

Although the role of pacing may not be intuitively apparent for power, strength and speed events, in chapter six we provide the reader with information on the relevance of appropriate pacing strategies across anaerobic events. High intensity activities might also benefit from preparatory strategies to control arousal levels or expectancies. This chapter also contains a self-paced system and practical example for training in power, strength and speed activities. In chapter seven, pacing for team (invasion-type) sports is discussed. Most team sports are intermittent in nature requiring utilization of both aerobic and anaerobic energy systems. Pacing strategies are apparent in team games, yet are more complex as energetic demands vary by position and the game situation. A multi-level pacing model is discussed based on observations in soccer, yet which is applicable to all invasion games. A

practical example of self-regulatory training for team sports is provided. Finally, in chapter eight we outline a number of situations in which self-regulation of exercise might need to be accompanied by other extrinsic (support) techniques. For example, accuracy of self-perception is less developed in children because of their inexperience and can also be distorted among all individuals when homeostasis is compromised by illness or medication. The regulation of exercise behaviour in children, in individuals with Multiple Sclerosis and the obese are examined.

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As inspiration, we would like to acknowledge Professor Tim Noakes who, in our opinion, remains the undisputed champion of exercise physiology. For Matt Fitzgerald, we greatly appreciate his foreword to this book and his meaningful contributions to the literature which promote self-regulatory exercise via a collection of books.

AUTHOR BIOGRAPHIES

Andrew M. Edwards BEd (Hons 1), MPhil, PhD

Andrew Edwards gained a PhD in Exercise Physiology from Sheffield Hallam University in December 2003 and has since worked as an academic in the UK, New Zealand and Australia. He is a British Association of Sport & Exercise Sciences (BASES) accredited scientist and is the Director of the Institute of Sport & Exercise Science (ISES) at James Cook University, Cairns, Australia. Andrew's main research interest is the inter-relations between fatigue, pacing and high performance sport. He has written many original research articles and worked as a consultant to several professional UK soccer clubs.

In addition to his academic achievements, Andrew is a former UK nationally ranked 400m hurdler and elite level rower/sculler. He competed at many national events in both sports, such as the AAA athletics championships and Henley Royal Regatta. In recent years he won the 400m and 400m hurdles at the New Zealand and Pan Pacific Masters games respectively. He is committed to examining theory-practice interaction in sport and exercise science.

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Professor Remco Polman DPhil, CPsychol, AFBPsS, Csci

Remco Polman's initial training was in the Faculty of Human Movement Sciences at the 'Vrije Universiteit', Amsterdam, The Netherlands where he

gained a 'Doctorandus' qualification (1992). Following this, he completed a PhD degree at the University of York, England.

Prior to commencing his current post as Professor and Research Leader in Active Living at Victoria University (Melbourne, Australia), Remco was Professor of Sport and Exercise Sciences and Director of the Centre of Applied Sport and Exercise Science at the University of Central Lancashire, Preston UK. He is a chartered psychologist by the British Psychological Society (BPS) and an accredited sport and exercise psychologist by the Health Professions Council in the UK. He is also accredited for psychological research by BASES and for practice, research and teaching by the Dutch Association of Sport Psychology (VSPN). Remco has fulfilled a number of roles with the Division of Sport and Exercise Psychology (DSEP) of the BPS, including chair, chair elect and honorary secretary. His research interests are diverse and include stress, coping and emotions in sport and exercise, the psychology of (sport) injury rehabilitation; personality and sport and exercise (Mental toughness, Type D personality), exercise psychology (special populations, exercise prescription) and ageing (interaction between psychological and biomechanical factors).

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