EDITED BY
VICKY KARKOU
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# The Oxford Handbook *of* DANCE AND WELLBEING

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*and*

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The image used for the cover of the book is created by Professor Raymond MacDonald and it is titled: "Dance in the Sun then Head to water"; used with permission.

*Devoted to our life and dance partners for supporting us*
*in the making of this book.*

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# Foreword

PROFESSOR RAYMOND MACDONALD
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Dance presents beautiful and complex ambiguities. As an elemental mode of expression it has the potential to communicate ideas and emotions that are profound, timeless, and universal. Importantly, as embodied movement, dance opens up a limitless landscape of interpretative possibilities, and this ambiguity of meaning is one of the primary reasons why dance is a powerful communicative medium. Regardless of the specific idea or emotion a choreographer wishes to convey, a dancer, and subsequently the viewer, interprets meaning with reference to a dynamic and constantly evolving stream of variables such as culture, personality, expectations, previous experience, and so on. Ambiguity is celebrated within aesthetic epistemologies, and beauty and meaning are constructed along an infinite number of dimensions. Dance is therefore a powerful, unique, and separate channel of communication and, given these features, the potential links to health and wellbeing are emphatic and clear.

However, within healthcare epistemologies, ambiguity has a more controversial place, not least because in this context goals are to enhance wellbeing, alleviate suffering, and ameliorate pain and distress by accurately predicting the effects of specific interventions. Therefore, with time and resources in demand like never before, researchers working in this area seek to reduce uncertainty to further knowledge about how interventions can be developed and delivered. In contributing to the growing body of knowledge that seeks not only to understand the health benefits of dance, but also to shed light on the mechanisms that underpin these developments, this book is both a celebration of, and desire to reduce, ambiguity.

A wealth of approaches innovatively, systematically, and concisely investigate how embodied movement can be used for healthcare purposes, and this book celebrates both the beauty of dance and its potential for positive effects. Of course, beauty is a controversial word. In the arts, narrow constructions of beauty can inhibit participants' expression or reduce confidence. Nonetheless, beauty can also be conceptual, intellectual, unconscious, and manifested in oblique ways, and this is implied and explored within many of the chapters.

Beauty can also be evident in virtuosic performances, where mesmerizing technique and craft are on display for all to see. However, virtuosity is an overrated virtue, and the debilitating expectations of craft-based virtuosity can be particularly stifling in music and dance. When a baby, in a display of innate creative virtuosity, first explores a musical instrument or responds rhythmically to music, the aim is adventure and discovery. It is a search for newness, for creative expression and for human connection. The desire to communicate and to collaborate in music and movement is universal. Self-expression through movement is not only a quest for self and a desire for expression, but fulfils a need to be connected and feel part of something beyond the boundaries of our body. Creative collaboration is fundamental to music and dance and these features are implied in all the interventions presented.

One challenge for researchers is to develop an evidence base to support the use of these interventions for health and wellbeing purposes. This text demonstrates how the field has moved beyond a reliance on randomised controlled trials and draws evidence from multiple sources including qualitative, quantitative, experimental, anecdotal, neurological, discursive, and so on. What is crucial is that we are able to differentiate between these different types of evidence, while at the same time allowing them to coexist.

'And those who were seen dancing were thought to be insane by those who could not hear the music.' This epithet—of unknown provenance, but possibly (or fancifully) by Nietzsche—not only highlights the subjective nature of mental health but also subtlety signifies the inextricable link between dancing and music. From Elvis Presley's scandalizing gyrations, to the percussive polyrhythms of Will Gaines' tap shoes; from the balletic performances of Evelyn Glennie, to the choreographed feet-stamp and drags and hand-claps of Michael Jackson's dancers in 'Thriller', where music ends and dance begins is often beautifully ambiguous. Moreover, dance shares some fundamental features with music. It is universal—all societies use music and dance for a vast array of social purposes—and it is accessible and social—everybody can dance. Like music, dance is a creative and a particularly potent form of collaborative creativity. Therefore, it is a universally accessible form of collaborative creativity, quintessentially social, and inextricably linked to families, cultures, and educational systems. It is therefore an excellent medium to study in terms of its benefits on health and wellbeing.

Dance, and all artistic endeavours, have issues of 'self' and 'other' as core themes. As suggested previously, artistic expression is often constructed as both an expression of individual identity and also as a form of collaborative creativity that celebrates the importance collectivism. One theme that emerges from this book is the concept of identity and the potential for dance to bring about positive changes. Constructions of the self focus upon a fluid, constantly evolving, and socially constructed view of personality. However, personality, self, and identity are contested terms (MacDonald et al. 2017). For example, are is a finite number of stable enduring building blocks of personality, neurologically determined, identified as traits and constituted by our genetic inheritance that predict our behaviour? Or are we individually so unique, so phenomenologically idiosyncratic, that to understand personality effectively we have to explore subjective

experience? If so, are attempts at population generalization essentially futile? Maybe it makes no sense to think of identity residing within the mind at all, but rather constituted in the language that we use on a day-to-day basis. Alternatively, is the driving force of the self the universal and psychodynamic unconscious motivations of existence that if expressed unaltered lead to our annihilation? These are just some of the approaches to personality, and they produce infinite options when searching for explanations of behaviour.

In endeavouring to understand dance interventions in healthcare contexts, this book makes a bold and innovative step in pulling together a multidisciplinary group of leading international scholars who tackle issues of identity in different yet related ways. The chapters present an overarching view of research highlighting the ambiguities of relating and living in a complex contemporary world. The complexities of relating and the contrasting priorities of the individual versus the group have engaged generations of thinkers. Kierkegaard's reflections on his own identity and relationships was, he believed, transfigured by divine governance into universal significance, and he viewed himself as a 'singular universal' (Lane 2010). Divine governance or not, the father of existentialism did signal that no matter how personal and intimate our psychological journeys, there are commonalities in the ambiguities of relating that resonate universality.

The book does not present comprehensive structures of personality but rather the chapters open up multiple seams, narrow and endlessly deep—multiple seams of personality dilemmas. These dilemmas are interrogated and problematized in such a way that we are invited to speculate on the nature of personality and whether or not we engage with its implications there is no escape from the Faustian *Gretchenfrage* (the big question) of the context. What is personality? While Nietzsche's answer to the original *Grechenfrage* question was 'God is dead', he did view dance as an almost sacred pastime, stating, in *Thus Spoke Zarathustra* (1891): 'I would believe only in a God that knows how to dance'. Nietzsche danced daily, saying that it was his 'only kind of piety', his 'divine service'. Moreover, he was well known to be a proponent of the arts, with dance being his particular favourite. This was partly due to his belief in 'life-affirmation', in which he not only encouraged artistic pursuits such as dancing but, conversely, invited us to question all activities that drain life's vast but finite energy from us. 'We should consider every day lost on which we have not danced at least once.' So, was Nietzsche really a bit of a groover? It has to be said that from an evidence-based perspective we are not sure exactly whether he danced every day or what his precise pronouncements were on dancing, but there is no doubt that he placed immense importance on artistic endeavours and, in particular, was an advocate for the positive effects of dancing.

One of life's fundamental challenges, which dance facilitates, is how to develop, negotiate and maintain intimacy. There are, of course, many barriers to intimacy: the need to ensure that vulnerabilities are not exposed, and that personal space is preserved and not threatened. Issues of vulnerability and intimacy are tied up with how we relate to the world, and these ambiguities of relating begin at birth in the cooing and babbling that takes place between a parent and a baby. There is considerable evidence to suggest that these interactions are musical, rhythmical, and dance-like. Everybody has a social and

biological guarantee of musicianship—not a vague utopian ideal, but the conclusion drawn by scientists researching the foundations of human behaviour (MacDonald et al. 2012). Before we communicate by using language, music plays a fundamental role in the earliest and most important bonding relationship of our life: that with our parents. We sing before we can talk, and we dance before we can walk. These interactions are improvisatory and ambiguous (MacDonald and Wilson 2016)—improvisatory in the sense that improvisation is defined as a spontaneous, creative, and social unfolding of communication. Therefore, not only are we all musical, and not only are we all dancers, but we are all improvisers. Life's beautiful and ambiguous journey is one long improvisation.

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# Foreword

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The scope of this large tome is beyond the usual. It is clearly a reference book to which one can go for numerous reasons such as to gather information, to question, to rethink, and to stimulate new possibilities. The co-editors have made use of their many years of experience in dance, research, therapy, and teaching to formulate the vast scope that dance brings to the newly developing areas called 'wellbeing'. They have called upon a large network of practitioners from several countries to offer their unique perspectives on a wide range of subjects that nevertheless focuses on movement, the body, and dance in relation to the ideas of aspects of wellbeing.

The nature of dance itself is naturally therapeutic as it makes use of the totality of the human being: the physical self, the creative self, the expressive self, and the emotional self. By examining it in more detail to discover how it may be used more purposefully in multiple settings is a fruitful endeavour. This is certainly accomplished in many chapters offered under the categories of the body, performance, education, community, and health. The authors describe how each of their areas of expertise is used to enable growth and self-satisfaction. Some make use of various forms of research in describing the results while others are more of a narrative. However, all have a point of view which pinpoints an aspect of the work which leads to the idea of wellbeing.

Wellbeing is developing as an idea in many fields, such as public policy, psychology, psychiatry, and physical and mental health. It is generally described as satisfaction with life as long as basic needs are met economically, if one has health and strong personal relationships and there is a sense of purpose and accomplishment that sustains one in daily life. Each of the authors has examined, through the lens of their practice, how the use of their knowledge and skills make use of dance in its many forms, and the possible implications that provide depth to their work in meeting one or more aspects of the above description of wellbeing.

My own experiences as a performer and long-time practitioner of dance therapy in mental-health settings, as well as teaching my profession in graduate schools and workshops internationally, resonate with many of the ideas and possibilities set forth within

the many chapters. Some of them stimulated new thinking about areas less familiar to me. It would be my assumption that even those who are knowledgeable in the art of dance, will find much to hold their interest as they explore the work of others in related but different areas.

It has been a vast task to gather so much information into one handbook, for which the editors are to be commended. It not only their vision but their openness to many unusual possibilities that may be beneficial to the reader. What makes this book of particular value is that there is recognition that words do not always do service to the topic of movement. Movement is an ephemeral art form that cannot be recorded on a piece of paper satisfactorily. In recognition of this, the editors have therefore gathered a large array of videos connected to the various chapters, which are then made accessible. To see what the author is describing adds a whole new dimension to understanding and learning. To my knowledge, this is a powerful addition that has not been available before.

The understanding of all that dance has to offer has been slow in acceptance among the many systems that provide multi-services to people of all ages and many needs. In some countries it has been suspect, as the body is usually disconnected from the thinking self and is not thought to provide more than functional or sexual use. In others, dance might be more acceptable as part of the culture but not yet integrated as offering more in-depth personal resources for a variety of needs. For those who believe in its incredible possibilities in providing aid for such problems as learning disabilities, depression, social isolation, chronic pain, and a multitude of other issues that cry out for attention, we are patiently hoping that the larger world will soon understand the power of dance. This addition to the literature will offer the opportunity for others to learn what dance has to offer and therefore include it as an idea whose time has come.

# Editors

**Vicky Karkou**, PhD, is Professor of Dance, Arts and Wellbeing at Edge Hill University, Ormskirk, UK. She is a qualified researcher, educator, dance teacher, and dance movement psychotherapist, having worked with vulnerable children and adults in schools, voluntary organizations, and the NHS. Her main research and teaching area is in the arts for wellbeing. She has an honorary doctorate of medicine from Riga Stradins University in recognition of her contribution to the development of arts therapies training in Latvia. She is well published in national and international journals, and is the co-editor for the international journal *Body, Movement and Dance in Psychotherapy*. She travels extensively as a speaker at conferences and educational programmes around the world and as a consultant in those fields.

**Sue Oliver**, PhD, M.Ed., BA, PGCE, Cert. Dance in Ed., is a freelance dance tutor and researcher. Based in Scotland, she left her post as senior teacher and dance tutor for her local education authority to concentrate on her research in creative dance and wellbeing, focusing on children, adolescents, and latterly older adults, including seated movement to music in daycare settings. Current projects include dance for people with Parkinson's disease, and community-based choreographic projects.

**Sophia Lycouris**, PhD, is Reader in Interdisciplinary Choreography at the University of Edinburgh, Edinburgh College of Art, with responsibility for Interdisciplinary Creative Practices, Masters and PhD programmes. Her research specialism is in haptic experiments.

# Contributors

**Thania Acarón**, PhD (University of Aberdeen), MEd (New York University), DMP, is a performer, choreographer, and dance movement therapist from Puerto Rico, and is currently based in Scotland and Wales. She obtained her PhD on the role of dance in violence prevention, and is currently working as a performing arts lecturer at University of Wales Trinity Saint David. Thania offers international workshops on movement, wellbeing, and interdisciplinary, practice and is co-artistic director of Orphaned Limbs Collective. <http://www.thania.info>; <http://www.orphanedlimbs.com>

**Beatrice Allegranti**, PhD, is Reader in Dance Movement Psychotherapy and Director of the Centre for Arts Therapies Research at the University of Roehampton. She is Senior Registered Dance Movement Psychotherapist and Clinical Supervisor, ADMPUK. Her international experience encompasses choreography and film-making, as well as clinical practice and supervision. Her clinical experience spans UK NHS work in adult mental health, dementia, special needs, autism, and training staff in dementia units to engage with service users through kinaesthetic empathy in treatment. Beatrice's feminist research investigates the boundaries and politics of moving bodies in performance, psychotherapeutic, and scientific contexts. She is passionate about the power of the arts as a vehicle for not just showing, but of 'knowing', giving us a way to understand the complexity of human experiences in a multilayered and creative way. She has numerous publications.

**Abdulazeem Alotaibi**, PhD (Queen Margaret University, Edinburgh), is head of physical education and kinaesiology at Qassim University, Alqassim, Saudia Arabia, and has an MSc in kinaesiology. His special interest is in movement therapy with children who have mild learning difficulties.

**Diane Amans** is a freelance dance artist, lecturer, and consultant offering professional development, arts and health projects, evaluation, and mentoring. She is course tutor on the annual Introduction to Community Dance Practice summer school organized by People Dancing: Foundation for Community Dance, and runs a similar course for the Japan Contemporary Dance Network in Osaka. In the UK she delivers training and follow-up mentoring for dance artists, volunteers, and activity leaders working with groups in a range of settings around the country. Her published work spans dance in communities and arts and health sectors, including dance with older people. She is a 2014 Winston Churchill Fellow, and has worked with community dance practitioners in Australia and New Zealand.

**Foteini Athanasiadou**, MSc, RDMP, has worked as a primary school teacher in Anatolia College, Greece, for three years. She has been involved in NGO activities, working with deprived children with emotional difficulties on a voluntary base. She has also worked with dementia suffers, children on the autistic spectrum, and adults on the autistic spectrum as a dance movement psychotherapy student.

**Zoë Avstreih**, PhD, is Professor Emeritus (Naropa University), the Founder and Director of the Center for the Study of Authentic Movement, a Board Certified dance/movement therapist (American Dance Therapy Association), a licensed professional counsellor in Colorado, and a licensed psychoanalyst and creative arts therapist in New York State. Currently, she devotes her professional time to offering retreats and training opportunities for mature individuals to immerse in the practice of Authentic Movement for personal and professional development. A pioneer in the development of Authentic Movement, she lectures and teaches internationally and has published widely in the field.

**Gonzalo Bacigalupe**, EdD (University of Massachusetts at Amherst), MPH (Harvard University), is Professor of the Master of Science in Family Therapy Program and the PhD in the Department of Counseling and School Psychology, College of Education and Human Development at the University of Massachusetts in Boston. He is a Visiting Senior Researcher at the National Research Center for Integrated Management of Natural Disasters, and Visiting Professor at the Catholic University of Valparaiso in Chile. He is a representative of the APA International Relations in Psychology Committee, and is member of several editorial boards and co-editor of *Psicoperspectivas*, an open-source Chilean psychology journal dedicated to the interface of the individual with society.

**Jane Bacon** is Professor of Dance, Performance, and Somatics at the University of Chichester, and has a private practice as a Jungian analyst, focusing trainer, and Authentic Movement practitioner. She teaches Authentic Movement, and is co-director of the Choreographic Lab and co-editor of the journal *Choreographic Practices*. Her key interest is in creative processes—artistic, psychological, and spiritual approaches such as 'focusing', 'active imagination', and 'mindfulness'. Her work is widely published.

**Fiona Bannon**, PhD, is Chair of Dance in Higher Education in the UK, and is based at the University of Leeds, working with students exploring collaborative practice, choreography, research methods, and improvisation. Her main work with doctoral researchers touches on investigations of varied arts practice as research. Her current research includes the preparation of a manuscript, 'Approaching collaborative practices: ethical considerations in performance and dance'. She is part of the team currently exploring the relaunch of World Dance Alliance-Europe.

**Nancy Beardall**, PhD, BC-DMT, LMHC, CMA, is Dance/Movement Therapy Coordinator in the Graduate School of Arts and Sciences at Lesley University, Cambridge, Massachusetts. As a dance/movement therapist, consultant, Certified

Movement Analyst, and educator, her work has focused on dance, dance/movement therapy, and cognitive, social/emotional, and relational development using dance/movement therapy and the expressive arts in the public schools. Her community-building programmes through the expressive arts have involved students, parents, and community members. She is a co-author of *Marking Connections: Building Community and Gender Dialogue in Secondary Schools*. She is active in the American Dance Therapy Association, and currently serves on the Approval Committee, Educator's Committee, and ADTA Standards Task Force.

**Bettina Bläsing**, PhD, is a post-doctoral researcher and responsible investigator at the Center of Excellence Cognitive Interaction Technology (CITEC) at Bielefeld University, Germany. Her academic background is in biology, leading to work as a scientific editor and science journalist for various newspapers. As scientific coordinator at Leipzig University she conducted postdoctoral work in Leipzig before joining the Neurocognition and at Bielefeld University, Germany. Her main research interests are mental representations of body, movement, and space, the control and learning of complex movements and manual actions, and expertise in dance.

**Jan Bolwell** is a choreographer, dance educator, performer, and playwright. She is Director of Wellington's Crows Feet Dance Collective, a community dance company for mature women. Since its inception in 1999 she has created twenty-five works for the company, including 'The Armed Man' in commemoration of World War I, and 'Hākari: The Dinner Party', which examines the lives of ten iconic historic and contemporary women from Asia and the Pacific. She has also written and performed in five plays, all of which have toured extensively throughout New Zealand. Jan works as a tertiary dance educator. She writes education resources for the Royal New Zealand Ballet, and is an adviser to Te Kura, New Zealand's national distance education school.

**Iris Bräuninger**, PhD (University of Tübingen), MA (Laban Centre/City University London), completed her dance studies (TELOS Dance Theatre) in Stuttgart. She is a certified psychotherapist (ECP), registered senior dance therapist, supervisor (BTD, ADMTE), and KMP notator. She worked as a postdoctoral researcher at the University of Deusto, Spain. She is a lecturer and tutor at the DMT Master Program at the Universidad Autonoma Barcelona, Spain. She has published numerous articles and two books. Iris has more than twenty years of clinical practice in hospital and psychotherapeutic settings, and was formerly a researcher and deputy head of the Dance Movement, Music and Physio Therapy Department, Psychiatric University Hospital, Zürich. She is currently affiliated to the University of Applied Sciences of Special Needs Education, Zürich.

**Jo Bungay-Orr**, MSc (Queen Margaret University), studied dance from the age of three at the Susan Robinson School of Ballet, and completed her training at the Royal Ballet School. She worked and performed as a professional ballet dancer under her maiden name, Bungay, primarily with the Scottish Ballet, before embarking on her studies in dance movement psychotherapy. Jo has mainly worked with children in mainstream

schools, but also has experience with adult mental health groups in Glasgow. She now lives with her husband in Scotland, where they provide support to vulnerable young people who are leaving care.

**Ramsay Burt**, PhD, is Professor of Dance at De Montfort University, Leicester, UK. His publications include aspects of gender, race, and modernity. In 2013–14, with Professor Christy Adair, he undertook a two-year funded research project in British Dance and the African Diaspora which culminated in an exhibition at the International Slavery Museum in Liverpool. With Susan Foster, he is founder editor of *Discourses in Dance*. Since 2008 he has been a regular visiting teacher at PARTS in Brussels.

**Luis Calmeiro**, PhD, MSc, is a lecturer in sport and exercise psychology at Abertay University, Dundee. His research focuses on stress, cognitive appraisals, coping mechanisms when performing under pressure, and the study of health-related behavioural and psychosocial correlates of physical activity and wellbeing. He maintains a number of national and international collaborations, and his work has been published in peer-reviewed journals in the areas of sport and exercise psychology and public health.

**Chan Nga Shan** is a dancer, dance instructor, choreographer, and dance movement psychotherapist. After graduating from the Hong Kong Academy for Performing Arts, She began her career by working in different media with different artists, including visual arts, films, site-specific dance, musical and theatrical performances, and international commercial events with renowned brands. As a dancer, she has always been fascinated with the power of movements, and began her journey to discover the knowledge of dance movement psychotherapy. Her main area of interest is in non-pharmaceutical interventions for mental illness. She has worked with adults showing symptoms of schizophrenia, dementia, and autism, and with children with special needs. Shan is recently volunteering in Kenya and China, providing DMP sessions for children suffering from HIV and children who have had traumatic experiences.

**Athiná Copteros**, PhD, MSc, is a registered dance movement psychotherapist having completed her MSc at Queen Margaret University, Edinburgh. She has recently completed her doctoral studies at Rhodes University, Grahamstown, South Africa. Her work currently focuses on the relationality between people and ecology and the role that body and movement can play in healing the split within and between ourselves, each other and our environment. Coming from a country with a history of colonialism and apartheid, social justice is critical to her work, and involves a focus on creating effective agency. Her PhD with a transdisciplinary group of researchers explores ways of working within transdisciplinary complex social–ecological systems using DMP.

**Joan Davis** is a certified BMC® practitioner, an Authentic Movement practitioner, and a Hakomi Sensorimotor Trauma Psychotherapist based in Wicklow, Ireland. She pioneered contemporary dance in Ireland in the 1970s and 1980s, and has experimented with collaborative art as a professional artist and therapist. She has authored

two books on Authentic Movement and performance, and has developed and taught somatic practice for many years. In 2012 she began Origins, a three-year somatically based training programme, approved by ISMETA, of the human developmental and evolutionary process from preconception to standing.

**Louise Douse**, PhD, is a Lecturer in Dance at the University of Bedfordshire, specializing in dance and technology, on which she has presented papers at several international conferences. She is Secretary of the Laban Guild in the UK, and continues to develop her research in the area of movement analysis and optimal experience. Louise has also recently been granted funding from her institution for research in the area of, and motivation in, student learning, with the aim of developing an interactive digital tool for skill development and personal goal setting.

**Kim Dunphy**, PhD, has worked as a dance educator and therapist in a range of settings, including community groups, schools, hospitals, and disability services. She has lectured on dance education at Deakin and Melbourne Universities, and on dance movement therapy at RMIT University. She is a partner in Making Dance Matter, a consultancy which contributes to evidence for the efficacy of dance-movement and other expressive arts therapies. Her PhD thesis (Deakin University, Melbourne) investigated 'The role of participatory arts in social change in East Timor'.

**Mark Edward**, PhD, is a performance artist, dance maker, and educator. He has worked for Rambert Dance Company and Senza Tempo Dance Theatre, and with Penny Arcade in her seminal work *Bad Reputations*. His principle research areas include gender, sexuality, ageing, and wellbeing in performance. He has published in scholarly and non-academic books and journals in these areas. At the core of his investigations is the idea of self in research, or, as he puts it, 'mesearch'. Mark was awarded a PhD in 2016 for his mesearching into ageing in dance and drag queen performance cultures. He continues to deliver his mesearch at various conferences throughout the world, and creates work for various companies and arts organizations.

**Barbara Erber**, MSc (Dance Movement Psychotherapy), also holds a Diploma in Integrative Bodywork. She first trained in various forms of music therapy. Illnesses in her teens and early twenties led her on a profound healing journey, which inspired a passionate discovery of psychotherapy and the world of the body and movement. She has been working with traumatized adults and children in various settings, focusing on the relationship between trauma and physical symptoms. Her life and work are profoundly influenced by the discipline of Authentic Movement. She recently embarked on a PhD, studying how fear of self-expression is processed in Authentic Movement.

**Paola Esposito**, PhD (Brookes University), MA (Goldsmiths College), is an Early Career Research and Teaching Fellow in Medical Anthropology at the Institute of Social and Cultural Anthropology, University of Oxford. Her main research interest is the social articulation of the lived body through performative and therapeutic practices. She is

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**Anita Forsblom**, PhD, is a music therapist, supervisor, dance/movement therapist, and Fellow of the Bonny Method of Guided Imagery and music, granted by the Association for Music and Imagery (USA). She is a private practitioner of music therapy and dance/movement therapy in Finland, and is interested in people's experiences of music listening, and therapy processes in music therapy and dance movement therapy.

**Carolyn Fresquez** received an MSc in Dance Movement Psychotherapy (DMP) from Queen Margaret University in Edinburgh, Scotland, and is a registered member of the Association for Dance Movement Psychotherapy, United Kingdom (ADMP UK). She received her undergraduate degree in Creative Studies, Literature from the University of California, Santa Barbara. She believes strongly in a mind–body connection, in movement's capacity for transformation, and in the power of a therapeutic relationship. She has experience working with a variety of people and clients in many different artistic, therapeutic, and educational capacities. She lives with her family in Albuquerque, New Mexico.

**Thomas Fuchs**, MD, PhD, is a psychiatrist and philosopher, and Jaspers Professor and head of the section 'Phenomenological Psychopathology and Psychotherapy' at the Department of Psychiatry in Heidelberg, Chairman of the Section 'Philosophical Foundations of Psychiatry' of the German Psychiatric Association (DGPPN), and Fellow of the Marsilius-Kolleg (Centre for Advanced Interdisciplinary Studies) at the University of Heidelberg. His major research areas are phenomenological psychopathology, psychology and psychotherapy; coherence and disorders of self-experience, phenomenology and cognitive neuroscience, and history and ethics of medicine and psychiatry.

**Doran George**, PhD (UCLA), has published extensively on somatic training in late-twentieth-century contemporary dance. He trained at the European Dance Development Center (NL). He has secured public and other funding (for example, Arts Council of England, British Council) for choreography that interrogates the construction of (trans)gender, queer, and disabled identities. He also applies dance in non-arts contexts; for example, in residency with the Alzheimer's Association. He produces academic and professional symposia and conferences, while in universities, art colleges, and professional dance, and teaches critical and studio courses in dance, performance, and cultural studies.

**June Gersten Roberts**, is a senior lecturer in dance at Edge Hill University, Liverpool, where she teaches dance theory and choreography. Her dance videos and tactile installations explore sensory experiences, closely observing texture, skin, and incidental movement. She works across the disciplines of video, dance, writing and textile arts, exploring the haptic image, body and touch. Collaborative projects with dancers and visual artists include performances, videos and installations created for galleries, hospitals, libraries and museums.

**Nancy Goldov**, PsyD, BC-DMT, is a psychologist and board-certified dance/movement therapist, in Seattle, Washington. She provides dance/movement therapy, psychoanalytic psychotherapy, Eye Movement Desensitization and Reprocessing, and neuropsychological testing to adults. Her dissertation research, on the effects of medical dance/movement therapy on body image in women with breast cancer was supported, in part, by a grant from the Marian Chace Foundation of the American Dance Therapy Association. She is the Washington State Public Education Coordinator for the American Psychological Association, and is also a dancer and musician.

**Marie-Helene Grosbras**, PhD, holds the research chair of Laboratoire de Neurosciences Cognitives at Aix Marseille University. Her research interests include the relationships between the control of action and the control of perception, with a particular interest in social perception. More precisely, she studies how the brain mechanisms involved in those processes can change as a function of experience, brain damage, or development. She uses a variety of psychophysics and brain-imaging techniques in healthy humans (functional magnetic resonance imaging, electroencephalography, and non-invasive brain stimulation).

**Judith Lynne Hanna**, PhD (Columbia), is an affiliate research scientist in the Department of Anthropology at the University of Maryland, College Park, USA, and a consultant in the arts, education, health, public policy, and the United States Constitution's First Amendment protection of speech, including dance. See www.judithhanna for publications on dance and the body, within performative contexts, in education, and in the community. As a dancer, anthropologist, and critic, she examines dance in its many manifestations and in diverse locations internationally. Her work has been published widely in thirteen countries and in several languages.

**Erika Hansen**, EdD (Counselling Psychology), has focused on military sexual trauma and predictive variables of PTSD among victims and perpetrators. She is a case manager in the CDCR prison population, and has worked in the mental health field as a crisis counsellor, detox counsellor, case manager, resident assistant, mentor, intake worker, and domestic violence crisis counsellor. She focuses on building relationships with safety, using existential, social construction approaches aimed to empower the clients with emphasizing their human potential

**Heather Hill**, PhD, is a dance movement therapist and professional member of the Dance-Movement Therapy Association of Australia. Much of her work is with people living with dementia, in the role of consultant in dementia care, offering experiential/embodied training in person-centred care practice. She continues to work as a dance movement therapist and teacher. She has published extensively and contributed several chapters to books in the fields of nursing, dementia, and dance movement therapy, as well as authoring her own.

**Michael Huxley**, PhD, is Reader in Dance at De Montfort University, Leicester, UK. His work has been widely published in books and journals, and his published research has been on early modern dance and dance history. He has been a senior member of various boards, committees, and teams, and is currently Director of De Montfort University's

Centre for Interdisciplinary Research in Dance. His most recent publication is *The Dancer's World 1920–1945: Modern Dancers and Their Practices Reconsidered*.

**Lindesay M. C. Irvine**, PhD, MSc, BA, FHEA, RNT, RGN, is a senior lecturer in nursing at Queen Margaret University, Edinburgh. Her main academic interests are in how and why people learn and change through education, along with a continuing enthusiasm for helping people achieve the best they can by facilitating their learning. She supervises and facilitates students at all levels of study, and is particularly interested in using person-centred approaches as a means of engaging students in developing their own learning with relevance to their professional practice or learning contexts.

**Corinne Jola**, PhD, is a lecturer in psychology at Abertay University, Dundee, Scotland, and is a trained choreographer (MA, Laban Trinity College, London), dancer (IWANSON, School of Contemporary Dance, Munich), and cognitive neuroscientist (PhD, University of Zurich), and has held a number of post-doctoral posts in the field of arts, especially interdisciplinary approaches. She has published extensively, and has collaborated and trained with the dance company EG|PC in Amsterdam. Her own artistic installations and choreographic work was presented across the UK and in Switzerland, and her teaching spans the intersection of dance and science to artists across Europe (for example, Impulse Tanz Festival, Vienna, Tanzfabrik, Berlin, and FAA, Bataville in France).

**Julie Joseph**, MSc (Queen Margaret University), is Chief Executive of Common Thread, a Scottish company offering therapeutic residential care and education to some of the country's most vulnerable young people. She has worked with adolescents for more than fifteen years, and as a movement psychotherapist she works with young people within the care sector and secondary schools. Her work is strongly influenced by attachment and trauma models. She is presently engaged in her PhD study, which focuses on the effect of dance movement psychotherapy on adolescents with symptoms of moderate depression.

**Toshiharu Kasai** is a professor and the director of Master course of Clinical Psychology, Sapporo Gakuin University, Japan. He is also a Certified Dance Therapist and Vice president of Japan Dance Therapy Association. As a Butoh dancer he is known as Itto Morita of Butoh GooSayTen, performing around the world since 1980s.

**Rosie Kay** trained at London Contemporary Dance School, and after a career as a performer formed the Rosie Kay Dance Company in 2004. She has created award-winning theatre work that includes 'Soldiers: The Body Is The Frontline' (2010 + 2015), based on extensive research with military, which toured the UK and internationally, 'Sluts of Possession' (2013), in collaboration with the Pitt Rivers Museum, 'There is Hope' (2012), exploring religion, and 'Double Points: K', in collaboration with Emio Greco|PC. Site-specific works include 'Haining Dreaming' (2013), 'The Great Train Dance' (2011), on the Severn Valley Railway, and 'Ballet on the Buses'. Kay was the first Leverhulme Artist in Residence at the School of Anthropology and Museum Ethnography,

University of Oxford, and is a former Rayne Foundation Fellow and Associate Artist of DanceXchange, Birmingham.

**Janna Kelbel**, Master Student at the University of Heidelberg, Department of Psychology, Heidelberg, Germany.

**Anna Kenrick** trained at the Northern School of Contemporary Dance, Leeds, after which she worked with the Education Team at The Place, London. In 2002 she joined the Ludus Dance Company, where she worked as both a dancer and teacher. She performed in the tours of 'Perfecting Eugene', 'Trapped', and 'Zygote', as well as working with choreographers Rosie Kay, Filip Van Huffel, and Hannah Gillgren. She joined YDance in 2007 as Project Director for the Free To Dance project, and has choreographed a number of pieces for Project Y, YDance's National Youth Dance Company.

**Anna Fiona Keogh** is a dance movement psychotherapist, researcher, and Laban-based creative dance teacher in Dublin, Ireland. She works in private practice and in a variety of settings with people of all ages and diverse needs. She is influenced by movement and dance forms such as Authentic Movement, butoh, contact improvisation and tango, and is particularly interested in exploring the relationship between mindfulness practice and movement.

**Ann Kipling Brown**, PhD, is Professor Emerita of the University of Regina, having worked for many years in the arts education programme in the Faculty of Education. She works extensively in dance education, focusing on assisting children, youth, and adults in finding passion and personal expression in dance. Her research and teaching include dance pedagogy, curriculum development, dance creation, and movement notation. In her professional and community service Ann has served on many committees—provincial, national and international—that focus on the research and role of the arts/dance in community, education, and professional programmes. She also has been involved in hosting provincial and international dance and arts education conferences.

**Sabine C. Koch**, PhD, MA, BC-DMT, is a psychologist and dance/movement therapist, and a researcher and lecturer at the University of Heidelberg and the University of Alanus in Alfter. She is a specialist in Kestenberg Movement Profiling (KMP), movement analysis, and dance/movement therapy, and her current work includes 'Embodiment: The Influence of Movement on Affect, Attitudes and Cognition', and a national research project on 'Language of Movement and Dance' (BMBF). She has worked with children, and with depressed, psychotic, autistic, psychosomatic, elderly, trauma and dissociative identity disorder patients. Her research interests include embodiment, personality, social psychology, observational methods, psycholinguistics, non-verbal communication, gender, health psychology, phenomenology, body psychotherapy, movement analysis, and creative arts therapies.

**Astrid Kolter**, Dipl. Psych. (University of Marburg), is a dance/movement therapist (Institute of Frankfurt, 2014). She is a dance teacher, and was a research assistant on the project Body Language of Movement and Dance (University of Heidelberg, 2009–11).

**Monika Konold** is a certificated music therapist and physiotherapist, living and working in Germany.

**Periklis Ktonas**, PhD, is Professor Emeritus at the University of Houston, and a senior researcher on biomedical engineering applications with the Department of Psychiatry, University of Athens Medical School. He has conducted several funded research activities, many of which have focused on the development of methodologies for the accurate and efficient analysis of bioelectrical signals, in particular the electroencephalogram (EEG), with clinical applications in neurology and psychiatry. He has been an Associate Editor of the *IEEE Transactions on Biomedical Engineering* and chair of the IEEE EMBS Technical Committee on Neuroengineering. He received the IEEE Third Millenium Medal for his contributions to biomedical engineering.

**Kristo Kaarlo Matias Kulju**, PhD, is a dance/movement therapist who studied dance and somatics at ISLO. He is currently working as a private practitioner of dance/movement therapy in Finland.

**Petra Kuppers**, PhD, teaches performance studies and disability studies at the University of Michigan. She is a disability culture activist and a community performance artist. She also teaches at Goddard College's Low Residency MFA in Interdisciplinary Arts, and leads The Olimpias, a performance research collective (<http://www.olimpias.org>). Her *Disability Culture and Community Performance: Find a Strange and Twisted Shape* (2011/2013) explores The Olimpias' arts-based research methods, and won the Sally Banes Prize of the American Society for Theatre Research. Her work has been widely published, and her most recent book is *Studying Disability Arts and Culture: An Introduction* (2014). The Olimpias, of which she is the artistic director is an artists' collective founded in Wales in 1996 during work with mental health system survivors.

**Carolyn Lappin** was educated at Glasgow University, and began working in the arts at the Citizens' Theatre. From 1984 until 2001 she worked with Scottish Youth Theatre as General Manager, also managing the Old Athenaeum Theatre in central Glasgow. She has also been Administrator for Winged Horse Touring Productions, IPB Productions, and Spontaneous Combustions, and was Chair of the Independent Theatre Council in Scotland from 1996 to 1998, and a member of the UK ITC Board of Directors. She is a mentor for the Federation of Scottish Theatre Step-Up scheme, and a member of the Advisory Board of Conflux. She joined YDance (Scottish Youth Dance) in 2002.

**Christina Larek** attended the University of Hildesheim, where she studied physical education and German to become a primary-school and secondary-school teacher. Since her early youth she has danced ballet, modern dance, and Latin/standard. Since 2008 she has worked as a professional teacher with pupils of various ages in northern Germany.

**Outi Leinonen**, MSc (Sports Science), trained in dance from childhood, within a variety of groups, and has performed and competed in Finland and internationally. As a dance teacher she has worked in youth camps in Finland, Brazil, Germany, and Croatia.

Currently, she is teaching in the Christian Dance School of Jyväskylä and dancing in the Campuksen Koonto Dance Team of yje University of Jyväskylä. Her Master's thesis was a research project at the Department of Music, University of Jyväskylä, entitled 'Movement analysis of depressed and non-depressed persons expressing emotions through spontaneous movement to music.'

**Susan Loman**, MA, BC-DMT, NCC, KMP analyst, is Director of the Dance/Movement Therapy and Counselling Program, and professor and associate chair of the Department of Applied Psychology, Antioch University New England. She has been co-editor of the *American Journal of Dance Therapy*, and has served on numerous boards, including as chair of the ADTA Education Committee. She is a co-author of the book *The Meaning of Movement: Developmental and Clinical Perspectives of the Kestenberg Movement Profile*, and is the author of numerous articles, chapters, and books on the Kestenberg Movement Profile and dance/movement therapy. She teaches her specialities at Antioch and throughout the United States, and has taught in Germany, The Netherlands, Italy, England, Scotland, South Korea, Argentina, and Switzerland. In 2014 she was awarded the Lifetime Achievement Award from the American Dance Therapy Association.

**Elizabeth Loughlin**, MA, B. Litt Hons Performing Arts, BA Dip. Social Studies, Dip. Dance Movt Th. (IDTIA), is a dance therapist and social worker. She is a professional member of the Dance Therapy Association of Australia, and works as part of the healthcare team in the Parent–Infant Research Institute (PIRI) set within the Australian public hospital system. Her mother–infant dance therapy and her former dance therapy with girls and women with Turner syndrome have been regularly presented at national and international health conferences, and her dance therapy and social work is published in dance therapy, health, social work, and medical publications. She has a continuing private studio dance practice, and is lecturer and supervisor in the International Dance Therapy Institute of Australia.

**Geoff Luck**, PhD (Keele University), has worked at the Department of Music of the University of Jyväskylä, Finland, and latterly as an Assistant Professor. In 2008 he was awarded a five-year Academy of Finland Research Fellowship to study the kinematics and dynamics of musical communication. This interdisciplinary project incorporated elements of biomechanics, psychology, and neuroscience to examine the role of body movement in both rhythmic and expressive musical communication. During his tenure in Jyväskylä, he carried out an extensive range of human-centred scientific studies on a range of topics, and has published more than fifty scientific works. A large proportion of his research has focused on quantifying, classifying, and predicting music-related behaviour using a wide range of statistical techniques.

**Alexia Margariti**, PhD (University of Peloponnese and University of Athens Medical School), is a teacher of dance, a dance therapist, and past President of the Greek Association of Dance Therapists. She studied at the State School of Dance in Athens, and at the Sorbonne, France, where she obtained a Maitrise de Danse. She has worked at several institutions in Greece with psychiatric populations, children with special needs,

drug addicts, and other special groups. Her research interests involve quantification of body movement and neurophysiological parameters in dance therapy.

**Mariam Mchitarian**, RN, MSc, is a dance/movement psychotherapist who currently works at the Ministry of Health in the Republic of Cyprus. In private practice she is actively involved with dance movement therapy of patients with chronic disease. She studied nursing in Larissa, Greece, and qualified with distinction in 2007. Apart from her nursing duties, she participated in the survey of coronary heart disease in Paphos district, and as speaker in health sciences and medical conferences in Cyprus. She is mainly interested in medical dance movement psychotherapy, and especially the role of dance movement psychotherapy in cardiac rehabilitation and other chronic diseases.

**Joseph A. Moutiris**, MD, PhD, MSc, FESC, is Associate Director of Cardiology in Nicosia and Paphos General Hospitals, Cyprus, and external lecturer in the University of Nicosia. His special scientific interests include prevention of coronary heart disease. He was the coordinator of the Cyprus Survey of Coronary Heart Disease and of the Paphos Heart Study, the results of which were announced at the 2006 WCC/ESC Congress of Cardiology and the 2010 EuroPrevent Meeting. He is actively involved in teaching medical students trainees in cardiology and other health professionals. He is a member of the board of the Society of Cardiology, and is the coordinator of training in cardiology in Cyprus. He is a reviewer of medical journals, and is the author of a significant number of papers and articles.

**Sue Mullane**, PhD (Deakin University, Melbourne), BEd, Grad. Dip. Special Education, Grad. Dip. Movement Dance, M.Ed. (dance therapy research), is a partner in Making Dance Matter, a consultancy that seeks to contribute to evidence for the efficacy of dance-movement and other expressive arts therapies. She is a professional member of the Dance Movement Therapy Association of Australasia (DTAA), and is also a primary/special-education teacher who works as a dance-movement specialist in a large special needs school in Melbourne. She has a particular interest in the relationship of dance movement therapy to the education curriculum and in the assessment of dance with special-needs students.

**Andrea Olsen** is a Professor of Dance and has held the John C. Elder Professorship in Environmental Studies at Middlebury College in Vermont. She is the author of a triad of books: *The Place of Dance, Body and Earth*, and *Bodystories* in collaboration with Caryn McHose, and she performs and teaches internationally.

**Tally Palmer** is Professor and Director of the Unilever Centre for Environmental Water Quality, Institute for Water Research, Rhodes University, South Africa.

**Heidrun Panhofer** PhD (University of Hertfordshire), MA (Dance Movement Psychotherapy, London City University), created the Master and Postgraduate Programme of Dance Movement Therapy at the Department of Psychology, Universitat Autònoma de Barcelona, Spain, and has coordinated it since 2003. Originally Austrian, she edited the first book on dance movement therapy in Spanish—*El cuerpo*

*en psicoterapia: La teoría y práctica de la Danza Movimiento Terapia* (*The Body in Psychotherapy: Theory and Practice of Dance Movement Therapy*)—and has published extensively on DMT skills, embodiment approaches, supervision in DMT, and so on. Formerly President of the Spanish Association for Dance Movement Therapy (ADMTE), she lectures in DMT at universities and institutes in Spain, France, Italy, Portugal, and Austria, and her clinical practice includes group and individual work with children, adolescents, and adults in special educational institutions, different psychiatric settings, and in private practice in the UK, Germany, and Spain.

**Thomas Paparrigopoulos**, PhD, is Associate Professor of Psychiatry at the Department of Psychiatry of the University of Athens Medical School. His clinical and research activities have focused mainly on sleep medicine, alcoholism, psychoneuroendocrinology, neuropsychiatry, disaster psychiatry, and clinical studies in psychiatry. He is member of several Greek, European, and international medical societies, and is co-chair of the WPA section on psychiatry and sleep/wakefulness disorders. He is currently heads the Inpatient Alcohol Detoxification Clinic, the ATHENA Outpatient Detoxification Service, and the Neuropsychiatry Unit at the First Psychiatric Clinic of the Department of Psychiatry, University of Athens Medical School, at Eginition Hospital, and is co-director of the Sleep Study Unit at the same hospital. He is the author or co-author of numerous publications.

**Helen Payne**, PhD (London), is a professor at the University of Hertfordshire and is principal supervisor for a number of PhD candidates in arts psychotherapies, health, and education. She is an accredited psychotherapist with the United Kingdom Council for Psychotherapy, and is a senior registered dance movement psychotherapist with the Association for Dance Movement Psychotherapy/DMP UK. Her publications include numerous peer-reviewed articles and books. She has led funded and non-funded research projects, and leads a University spin-out Pathways2Wellbeing delivering services using the BodyMind Approach™ for patients in primary health care. She is founding editor-in-chief for the international, peer-reviewed journal *Body, Movement and Dance in Psychotherapy*.

**Marcia Plevin** is a choreographer, professional dancer, and dance movement therapist, BC-DMT, American counsellor, NCC, and Italian psychologist. She is affiliated as a teacher and supervisor with the Institute of Expressive Psychotherapy, Bologna, the Institute Inspirees of Creative Education, Beijing, Bilgi University, Istanbul, and APID, the Italian association for dance movement therapists. She was co-founder of Creative Movement method Garcia-Plevin, and has taught Authentic Movement throughout Europe for more than twenty years.

**Frank Pollick**, PhD, is Professor of Psychology at the University of Glasgow, and has previously worked as a research fellow at Advanced Telecommunications Research (ATR) in Kyoto, Japan. His research explores how we experience the sights and sounds of human actions. This includes using behavioural experiments to understand the boundaries of human perception, and brain imaging experiments to understand how brain systems process audio and visual information. He is interested in how experience

and development influence the ability to understand actions, and has studied brain mechanisms of action recognition in dancers, drummers, and individuals on the autism spectrum.

**Cynthia Pratt** is Professor of Dance at Butler University Indianapolis, as well as being a dancer, teacher, and choreographer whose work often reflects her continued interest in dance as both an aesthetic art form and as a catalyst for community building. She received her MFA from Temple University, and is a Certified Movement Analyst through the Laban/Bartenieff Institute for Movement studies in New York City. For the past two decades she has been the Guest Choreographer in Residence for Dance Kaleidoscope, Indiana's premier modern dance company, and has had set works throughout the United States and abroad.

**Marko Punkanen**, PhD, is a music therapist, dance/movement therapist, and trauma psychotherapist who currently works as a music/dance-movement/psychotherapist and supervisor in private practice. He is actively involved with music therapy and dance/movement therapy training. Previously, he was a researcher in the Finnish Centre of Excellence in Interdisciplinary Music Research at the University of Jyväskylä. He was part of the research team which investigated the perception and preferences of emotions in music of depressed patients and the efficacy of improvisational, individual music therapy for depression.

**Matthew Reason** is Professor of Theatre and Performance at York St John University, UK. His research engages with theatre and dance audiences, theatre for children, performance documentation, and photography. His publications include *Documentation, Disappearance and the Representation of Live Performance* (2006) and *The Young Audience: Exploring and Enhancing Children's Experiences of Theatre* (2010), and he co-edited, with Dee Reynolds, *Kinesthetic Empathy in Creative and Cultural Contexts* (2012).

**Maralia Reca**, PhD (Psychology, Palermo University, Buenos Aires), BC-DMT, is a certified dance/movement therapist (American Dance Therapy Association) and a lecturer at Caece University, Buenos Aires, where she founded and directed postgraduate training in dance/movement therapy, as she had also done in San Juan. Formerly, she was a professional dancer at Manhattan Festival Ballet and the Martha Graham School of Contemporary Dance, New York, where she studied DMT. She presents regularly at conferences, teaches abroad, and has much published work. She was elected President of the Argentinean Association of Dance Therapy in 2011.

**André Luiz Teixeira Reis**, PhD (University of Bristol), MEd (University of Brasilia), is a lecturer and researcher at the University of Brasilia. He graduated in physical education, and later attained his Master's degree and PhD, using capoeira—the Brazilian dance-art-form—as the subject of his studies on health and well-being.

**Taira Restar**, MA, RSMT, is a somatic movement therapist and coach. She offers international workshops in wellbeing.

**Emma Roberts** is a movement and drama therapist and certified 5RHYTHMS® teacher, and is currently teaching 5Rhythms internationally. She also works as a freelance movement director in theatre. Her previous work includes movement and drama therapy in mental health, adults with autism, vulnerable families dealing with trauma, bereavement, addiction, abuse, and teenage parenting. Additionally, she has worked as a trainer and actor in public and corporate settings as well as in film, television, and theatre, including as a director and movement specialist for Still Point Theatre.

**Suvi Saarikallio**, PhD, works as an Academy of Finland Research Fellow at the Department of Music, University of Jyväskylä. Her research focuses on the psychosocial aspects of musical behaviour, including mood and emotion, personality, adolescent development, and wellbeing. She is an internationally acknowledged expert, particularly in research on music as emotional self-regulation, and has presented invited lectures and published articles in international peer-reviewed journals.

**Heribert Sattel** is Scientific Assistant at Klinikum Rechts der Isar, Munich, Germany.

**Claire Schaub-Moore**, PhD, CPsychol, AFBPsS, MA DMP, is a Professor of psychology, a chartered psychologist, a counselling psychologist, an Associate fellow of the British Psychological Society, Psychologische Psychotherapeutin, and a dance and movement psychotherapist, group therapist, traumatherapist, and supervisor. Currently, she works with children, adolescents, and adults in her practice, and as a supervisor for various institutions within the social and health welfare system. She teaches in HE in Germany, England, and Austria, and has taught trauma-pedagogics and therapy for several years. She has also published her research work.

**Ilene A. Serlin**, PhD, BC-DMT, is a licensed psychologist and registered dance/movement therapist in practice in San Francisco and Marin county. She is the past President of the San Francisco Psychological Association, a Fellow of the American Psychological Association, and a past President of the Division of Humanistic Psychology. She has taught at Saybrook University, Lesley University, UCLA, the NY Gestalt Institute, and the C. G. Jung Institute in Zurich. She is the editor of *Whole Person Healthcare* (2007) and the author of much published work. She serves on the editorial boards of *PsycCritiques*, the *American Journal of Dance Therapy*, the *Journal of Humanistic Psychology, Arts and Health: An International Journal of Research, Policy and Practice*, the *Journal of Applied Arts and Health*, and *The Humanistic Psychologist*.

**Sherry B. Shapiro**, EdD, is Professor Emeritus of Dance and past director of Women's Studies at Meredith College, Raleigh, North Carolina. She has served in state, national, and international organizations, presented nationally and internationally, and is the author or editor of four books. She has been a recipient of a Fulbright Scholarship and Fulbright Specialist, and has received awards for research and artistic work, as well as her work as a dance educator. She has served as a project coordinator for a programme in peace education research developed as a joint effort between North Carolina and the University of Haifa, Israel, and served for six years as the Research Officer for Dance and The Child International.

**Allison Singer**, PhD, is currently lecturer in Applied Theatre and programme leader for the MA in Applied Theatre and Intervention at the University of Leeds. She is a dance movement psychotherapist, dramatherapist, dance anthropologist and ethnomusicologist. Central to her work is the integration of applied anthropological approaches and arts psychotherapy practice, and the use of a multi-modal approach in arts psychotherapies. Her clinical work includes work with people with profound and complex learning difficulties, elderly people, refugees, and internally displaced children and their families. She has numerous publications, and has presented her research widely. She has led and taught on several drama therapy and dance movement psychotherapy programmes in the UK.

**Laura Hope Steckler**, PhD, CPsychol, RSMT, is a clinical and somatic psychologist, body psychotherapist, somatic movement therapist, and mindfulness instructor. She trained with body psychotherapy pioneer Ilana Rubenfeld, who integrated the Alexander technique and Feldenkrais method with gestalt psychotherapy. She has danced professionally, and has extensive experience with various movement and somatic disciplines and their use in clinical work. She has a deep and abiding interest in the mind–body connection and how movement can be used to facilitate wholeness and wellbeing.

**Jayne Stevens** is Principal Lecturer in Dance at De Montfort University, Leicester. Her roles within the University have included Head of Dance (until 2016) and Head of Pedagogic Research in the Centre for Excellence in Performance Arts (2005–09). In 2000 she was awarded a National Teaching Fellowship in recognition of individual excellence and innovation in teaching. She is an editorial board member of the journals *Research in Dance Education* and *Journal of Dance and Somatic Practices*. Her current research encompasses creative practices and pedagogy, dance and spirituality, the history of community and participatory dance, employability and the creative industries.

**Marcus Stueck**, PhD, is scientific head of interdisciplinary scientific projects on Biodanza and health at the University of Leizig, researching the immunological, endocrinological, physiological, and psychological effects of Biodanza in adults and children. He is also Professor for Educational Psychology in Riga, Professor of Psychology, Leading Scientist, at the University of Applied Science, Saxony (DPFA), and Director of the Institute of Biodanza Research Leipzig (IBR BIONET).

**Haodan Tan** is a PhD student in human–computer interaction design programming at the School of Informatics, Indiana University. Previously, she obtained her MSc (Psychology, University of Glasgow) and MDes (Hong Kong Polytechnic University). With an interdisciplinary background, her research interests lie in the social and cultural aspects of computing, with an emphasis on the emotional and aesthetic experiences. More specifically, her work includes understanding people's emotional attachments with objects through the lens of heritage perspective, and the implication for HCI and interaction design.

**Marietta L. van der Linden** PhD (Bioengineering, Strathclyde University, Glasgow) is a senior research fellow at the School of Health Sciences, Queen Margaret University,

Edinburgh, and has an MSc in Human Movement Sciences (VU Amsterdam). She has a special interest in exercise and assistive technology interventions for people with long-term neurological conditions such as cerebral palsy and multiple sclerosis.

**Mati Vargas-Gibson**, MA (History, Northeastern University, Boston), MA (Fine Arts, Illinois University), has danced ballet, folk, flamenco, and belly dance since an early age. She is an accredited 5Rhythms™ teacher and a member of the International 5Rhythms Teacher's Association, currently teaching regularly in United States and Mexico. Her interests lie in body–mind techniques, and she has complemented her learning and experiences with other body awareness methods, such as SoulMotion™, Feldenkrais™, Authentic Movement™, process work, gestalt movement therapy, yoga, pilates, sufi whirling, ecstatic dance, and ritual trance dance. She is interested in using music as medicine to support the dance and then presencing the unique way each dancer's spirit reacts.

**Grigoris Vaslamatzis**, MD, is a physician and Professor of Psychiatry at Athens University Medical School (Eginition Hospital). He is a training member of the Hellenic Society of Psychoanalytic Psychotherapy, where he acted as a President 1998–2002 and 2009–13. From 2001 to 2012 was Director of the Department of Psychoanalytic Psychotherapy of Athens University Medical School, and since 2011 he has been Director of the Psychotherapy Centre, the Director of the Department of Personality Disorders, and Director of the Unit of Group Analytic Psychotherapy. He is a Fellow of the American Academy of Psychoanalysis and Dynamic Psychiatry, and a member of the editorial board of *Psychoanalytic Psychotherapy*. He is the editor of four psychoanalytic books, and his work is widely published in international journals.

**Alejandra Villegas**, PhD, is Director of the Biodanza schools in Leipzig and Riga. Stemming from her work in Argentina and Spain, she produced the first PhD on Biodanza, at the University of Leipzig, researching the psychological effects of Biodanza. She has participated in many Biodanza research projects, and is the author of several scientific publications.

**Hilda Wengrower**, PhD, is a dance movement therapist and counsellor. She is a lecturer in the Academic College for Society and Arts, Israel, and head of the dance movement therapy section of the Israeli Association of Arts Therapies. She has co-edited and authored work on dance, creative processes, intergroup conflict, clinical aspects of dance movement therapy, artistic methods for research, and principles and methods of arts therapies in non-clinical settings. She is also a journal editor. She teaches and supervises internationally, and retains an active private practice in Jerusalem.

**Sarena Wolfaard**, BA (Hons), is an accredited 5Rhythms® teacher, which has taken her to Finland, Scotland, and South Africa. She is an Open Floor International Teacher, studying process-oriented psychotherapy, and works in private practice with individuals, incorporating elements from 5Rhythms® and Open Floor International with psychotherapy. As a co-founder of Handspring Publishing, she works with researchers and prominent teachers in manual therapy, bodywork, and movement. She is a member

of the International 5Rhythms Teacher's Association, the Complementary Therapy Association, and the Fascia Research Society, and is a UKCP trainee member.

**Ania Zubala**, PhD, is a psychologist who trained in psychodynamic and arts psychotherapies. She has worked in clinical roles with adults experiencing mental ill-health in Scotland, and is dedicated to improving clinical practice by advancing research in the area of psychotherapy and non-pharmaceutical interventions. Following a research bursary award from Queen Margaret University, Edinburgh, she has been exploring the value of arts psychotherapies in the treatment of adult depression in the UK. This work concluded with a PhD and a number of publications in peer-reviewed journals. Her research focuses on evidence-based interventions to enhance psychological wellbeing of diverse populations, and she is currently a postdoctoral researcher with the Scottish Improvement Science Collaborating Centre at the University of Dundee.

# About the Companion Website

**www.oup.com/us/ohdw**

Oxford University Press has created a password-protected website to accompany *The Oxford Handbook of Dance and Wellbeing*. Video content on the site illustrates concepts discussed throughout the *Handbook* by both academics and practitioners. Examples available online are indicated with ▶

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# INTRODUCTION

VICKY KARKOU, SUE OLIVER,
AND SOPHIA LYCOURIS

Dance—from the work of the baby kicking his/her legs with excitement when the adult sings a song, to the work of a professional ballet dancer who skilfully performs multiple pirouettes on stage—regards the body as the main agent for creative and artistic engagement. From the breath of an improviser to the contraction and release movement of a contemporary dancer, the body is present, rising, falling, expanding, shrinking, advancing, and retreating, often sensing the inner self, connecting with the environment, living and dying. The body is currently receiving renewed attention from neuroscientists that shifts our understanding of its relationship with the mind. Instead of being treated as inferior to the mind, body and mind as seen as interlinked and interconnected; the body and mind are one. Research studies in neuroscience, for example, provide evidence for the biological basis of thoughts and feelings, and links between the body and cognition and the body and emotions (Schore 1994; Damasio 2000, 2005). The Cartesian split is questioned, giving way to terms such as 'embodied emotion' and 'embodied cognition'. The discovery of mirror neurons in the brain (Rizzolatti et al. 1996; Gazzola et al. 2006) and their links with empathy, and kinaesthetic empathy in particular, also takes a central place in contemporary debates; how we interact with others, what we see and what we experience while we exist in the world are all important and deeply imprinted in our brains and bodies. Finally, the plasticity of the brain, and thus a lifelong ability for humans to make new synaptic connections (Edelman 1987), is another interesting area of work that encourages us to think of humans as being in a state of ongoing change, and in a constant interaction with the environment—an environment we shape, and one that also shapes us. In response to these discoveries, a rippling effect has been created in a number of other fields such as psychology, psychotherapy, education, community practice, and the arts. New ways of thinking have emerged that place the body, movement, and dance in a much more central place than what they had previously, and

with renewed significance for wellbeing. However, so far there have been no attempts to examine this topic in a comprehensive manner.

Even less attention has been placed in *dance* and its contribution for wellbeing. Dance—a form of art that is often associated with children, women, or gay people—has suffered from hegemonic notions that attach negative references to this form of art (Polhemus 1998; Meekums 2000; Karkou 2012). Because of this, dance—perceived as insubstantial, frivolous, or even dirty—has received much less attention.

Furthermore, as an embodied art form, the discussion around dance through the written word, and in this case through a book, offers inherent challenges and perpetuates the Cartesian superiority of thought (and 'word') over matter (in this case, 'body'). Books that cover the topic of dance are therefore relatively few. In addition, a range of dance styles from modern and contemporary dance to Biodanza and 5Rhythms and from improvisatory practices and Authentic Movement to Butoh and Capoeira have hardly ever been seen together in one publication. Even more unusual is to bring professional, educational, and community dance practices alongside contributions from the field of dance movement psychotherapy. Finally, the topic of dance as an agent of health and wellbeing that goes beyond popular connections of dance with joy has only recently received some attention (e.g. Beecher 2005; Burkhudt and Rhodes 2012). The scope for exploring this topic further is very wide.

Turning to the concept of wellbeing, there is an overall consensus that health and wellbeing are closely connected with a complex network of interrelated factors (Harris and Hastings 2005). Furthermore, the World Health Organisation (2006) defines health as 'a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity' (p. 1).

Interestingly, in recently years the concept of 'wellbeing' is gaining increasing popularity. Governments in Europe, for example, argue that the economic wealth of a country is not a sufficient measure to capture growth. Following governmental intervention, the Office for National Statistics (ONS) in the UK has recently, and since 2011, begun to measure wellbeing, offering a loose definition of the term, associating it with how people, neighbourhoods, and countries are doing beyond Gross Domestic Product (GDP), the traditional measure of economic growth. Based on a national debate (Office of National Statistics 2011), the same source proposes ten 'measureable' dimensions:

1. Personal wellbeing.
2. Our relationships.
3. Health.
4. What we do.
5. Where we live.
6. The natural environment.
7. Personal finance.
8. The economy.
9. Education and skills.
10. Governance.

These have been turned into quantifiable measures which are now used not only in the UK but in the whole of Europe, if not beyond. The sceptics amongst us may think that these measures have been introduced at an interesting time in order to shift attention away from the economic crisis. However, for those of us who have an interest in dance (and the arts more generally) and wellbeing, the new measures and associated policies bring to the foreground the discussion on wellbeing, and personal wellbeing in particular—an area that has been traditionally neglected.

Of course, we cannot disconnect economic growth from measures of wellbeing; comparing wellbeing measures across European countries, for example—the countries at the top of the ladder in terms of scores of wellbeing measures—tend to be places such as Finland and Denmark: countries with high GDP. Still, this shift of attention to wellbeing and a presentation of this concept as a complex construct affected by multiple factors are indeed very welcomed and offer a good foundation for further explorations of the topic of dance and wellbeing, and this is indeed what we are trying to do in this book.

We have therefore invited contributors to discuss the underlying principles of their work, question given assumptions, and add to existing theoretical and practical knowledge on the topic. In all cases we have offered our understanding of the concept of wellbeing as a complex concept which involves the interplay between physical, psychological, social, and spiritual aspects. We have invited them to comment on this definition, redefine it, or focus on one aspect of wellbeing as it is relevant to their own work.

Furthermore, this book looks at diverse types of dance and related movement practices aspiring to contribute towards understanding their impact on wellbeing, offer new understanding of existing practices, and support the development of new ways of working. In particular, the book aims to:

1. Explore useful ideas, while critically considering existing concepts and models with which different forms of dance and movement make contributions towards wellbeing.
2. Bring together and discuss diverse research-based dance and movement examples for their input to wellbeing.
3. Create a space where sufficient exchange is enabled, different views of wellbeing are explored, professional borders are expanded, and improvement of current and future practice can be considered.

The research components of the book are kept intentionally broad to include quantitative, qualitative, and arts-based research, and thus to cover diverse discourses, methodologies, and perspectives that will add to the development of a complete picture about the topic. Therefore, objective observations, felt experiences, and artistic explorations are all equally valued as being able to make an important contribution to wellbeing from different perspectives. Different perspectives are also encouraged through bringing together dance and movement practitioners, community artists, teachers, health professionals, psychologists, and psychotherapists from around the world. In all cases, contributors have anchored their input on the particular way in which they view dance and

movement as impacting on wellbeing. Their inputs are organized within five parts, all of which are seen as framing contexts to which contributors to this book have been invited to respond:

A. Dance and the Body. The body is seen as the smallest 'context'; contributors are invited to discuss this topic either through an objective or subjective stance. Neuroscientific, physiological, anatomical, somatic, philosophical, and spiritual perspectives are included.
B. Dance within Performative Contexts. In this part the emphasis is on dance as an art form, including processes of creation and modes of presentation in both conventional, and less conventional, settings. It includes chapters on therapeutic or transformative performance on stage, but also performances in urban communities, derelict old buildings, or selected locations in the countryside.
C. Dance in Education. Dance within primary (mainstream and special schools), secondary, and tertiary education is explored for its potential effect on wellbeing as it impacts learning. Topics on policy, theory, practice, and research are covered.
D. Dance in the Community. This part places a particular emphasis on the sociological, anthropological, and political aspects of dance as they impact wellbeing, covering a diversity of styles, perspectives, types of participation, and participating groups.
E. Dance within Healthcare Contexts. This last part deals with the use of dance within health, including work taking place in primary, secondary, and tertiary care as well as public health.

As a way of helping the reader to synthesize these diverse views, in each of the introductions to these parts we identify overlapping practices, clarify themes, and highlight contradictions or paradoxes. Furthermore, as editors we ask questions attempting to stimulate thinking and generate debate, and thus support readers to process the material presented.

We hope that the supplementary video material available on the companion website adds another layer to this unique book, offering opportunities to understand and process information in a way that is not available in other texts dealing with dance. It offers the opportunity for an engagement with the topic which is not based simply on words. For a book on dance, this online accompaniment becomes crucial.

Finally, as editors we ask you, the readers, to approach this text not only as an academic publication. Since we argue for the value of an embodied cognition and an embodied emotion, we ask you to play with the idea of engaging with this text as embodied beings, and to respond to the text through your emotive selves. We hope this way of approaching this text will stimulate you and offer alternative understandings of what is a very complex and multilayered topic.

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PART I

# DANCE AND THE BODY

# INTRODUCTION TO PART 1

VICKY KARKOU AND SUE OLIVER

This first part intends to set the scene in its rightful home: the body. As such, it treats the body as the primary 'location' of dance where wellbeing, measured or felt, can be found. Chapters refer to neuroscientific, physiological, psychological, philosophical, and spiritual approaches to movement and dance and reflect a continuum from objective to subjective experiences and from scientific reasoning to transpersonal discourses. In all cases, contributions are brought together to reflect multiple and, we would hope, coherent ways in which dance can contribute to wellbeing.

Jola and Calmeiro begin this part with a very comprehensive overview of research-based explanations of the 'feel-good effect' of participating in dance. Biochemical, neuronal, and psychosocial mechanisms are explored and explained, rooting the reader to the scientific basis of the contribution of dance to wellbeing. A critique of the quality of current research is also offered identifying areas where our scientific knowledge is still limited and areas where further research can take place.

A more in-depth discussion of neurocognitive research in particular is explored in Chapters 2 and 3, reflecting the increased interest of neuroscience on dance and embodiment in general. Bettina Bläsing, from Germany, is the author of Chapter 2, which discusses the impact of dance on the brain. Different technologies used in these studies are presented and key findings are discussed, while the limitations of both available technologies and research designs are acknowledged. The text, clear and informative, provides a useful overview of a research area that can be highly jargonistic and, for this reason, potentially inaccessible to lay readers.

Chapter 3, by Grosbas, Reason, Tan, Kay, and Pollick, involves results from a particular brain study: a large multicentred study in the UK called 'Watching Dance' and funded by the Arts and Humanities Research Council. The chapter offers a very insightful perspective of how brain scans can be used to offer an understanding of what happens to the brain when one views dance (contemporary dance in particular in this case), and how qualitative data can explain, complement, and enhance findings from these brain scans to improve our understanding of the impact of dance on wellbeing.

In Chapter 4, neuroscientific and neurocognitive perspectives give way to physiological insights. Biodanza—a form of dance more often found as a community-based practice for adults—is modified to address the needs of kindergarten and primary-school children. The authors, Stück and Villegas, from Germany and Brazil respectively, argue that there are potential benefits of this practice for children. They review and present study results that suggest that Biodanza for children can have a direct impact on hormones, and as a consequence in the capacity of these children to self-regulate. Although the studies referred to are small and the designs naturalistic and pragmatic, some interesting trends are apparent that may be relevant not only for Biodanza but also for other forms of dance.

In Chapter 5, Judith Hanna indeed acknowledges the impact of dance on physiology, linking scientific evidence with anthropological perspectives and shifting our attention from one type of dance to diverse forms: dance for fitness, cultural dance, and educational, professional, and amateur dance as treatment. The impact of these diverse types of dance on stress is explored, creating a bridge between different types of dance and different types of perspectives.

Chapters 6, 7, 8, and 9 are all written by therapists. Panhofer and Avstreih are dance-movement therapists, Steckler is a Body Psychotherapist and a dancer, and Bacon is a choreographer and Jungian analyst. As a result, all four chapters bring a different perspective in this part that address philosophical considerations (Panhofer) and highlight dance techniques that can be used within a therapeutic context (Steckler) or explore spiritual dimensions (Bacon and Avstreih).

For example, Heidrun Panhofer—the leader of the Catalan dance movement therapy programme in Barcelona—discusses the concept of body memory and proposes a shift away from the Cartesian split though the introduction of 'thinking in movement'. Drawing from her own empirical research, she claims that through the use of movement, different types of information can be accessed that can be useful not only for therapy, and Dance Movement Psychotherapy in particular, but also for supervision.

Similarly, Laura Steckler, an American practitioner based in Scotland, discusses the value of diverse uses of movement and dance activities within Body Psychotherapy—a form of psychotherapy stemming from Wilhelm Reich. Drawing from choreographic practices and Butoh, her choices are underpinned with psychotherapeutic theory and are illustrated through clinical vignettes.

Authentic movement—a practice developed in the 1950s by movement therapist Mary Starks Whitehouse (1999) and based on the theories of C. G. Jung (1961)—is explored in Chapter 8 by Jane Bacon, a dancer and Jungian analyst from the UK. Jane argues that this practice, with its inner focus, can encourage people to a level of authenticity which can make a valuable contribution to the therapeutic transformation of trauma and thus to the development of wellbeing.

Similarly, in Chapter 9, Zoe Avstreih, a dance/movement therapist from the USA, argues that this inner focus can also create direct links with a sense of embodied

spirituality, connecting with what she calls the 'sacred'. She also argues that authentic movement can potentially facilitate the development of a therapeutic thread between the self, the community, and the life in all its mystery.

This part ends with Chapter 10 by Andrea Olsen, a somatic dance practitioner also from the USA, who encourages the reader to engage with the text in an active way—one that moves beyond a simple reading. Scientific distance and objectivity are here challenged to the core, inviting us, the readers, to not simply engage with the text cognitively, but to also bring our body into the experience and engage as whole human beings. Moving beyond our usual ways of relating to our bodies, and through a series of experiential tasks, Olsen invites us to increase our awareness of our anatomy and reconnect with our bodies and the environment around us. This chapter also includes references to some beautifully created video material, completing the first 'bouquet' of perspectives covered in this book, and available with the online version.

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CHAPTER 1

# THE DANCING QUEEN

## *Explanatory Mechanisms of the 'Feel-Good Effect' in Dance*

CORINNE JOLA AND LUIS CALMEIRO

## Introduction

Over the last decade, an increasing number of research publications have shown evidence for positive effects of dance participation on individuals' health and wellbeing across a large spectrum of age groups and societies (Gardner et al. 2008; Keogh et al. 2009; O'Neill et al. 2011). Beyond improvements in physical fitness and cognitive abilities, the positive effects include a strengthening of group coherence, an increasing willingness to help others, and an improvement of successful rehabilitation (Quiroga Murcia et al. 2010), as well as accident prevention (Fernandez-Arguelles et al. 2015); to name just a few. The rise in empirical investigations into the benefits of dance is surprising: dance is still frequently stigmatized as a low-level leisurely activity on the one hand (e.g. Walker 2010) and as an unhealthy profession on the other hand (e.g. Koutedakis and Sharp 1999). Moreover, dance professionals were socially and intellectually denounced well into the twentieth century (Garfola 2010). Based on such myths, many sceptics do not even consider dance as a profession per se.

However, with an emphasis on dance as a form of physical activity and the surge to find solutions to reduce obesity and other health-related issues that are based on the populations' increasing physical inactivity, dance offers great opportunities. Notably, dance is a very popular joyful activity to do as well as to watch. It is second only to football as the most commonly offered physical activity in UK schools' physical education curriculum. In addition, school links to clubs showed the biggest increase for dance since 2008 (Quick et al. 2010). Nevertheless, for a successful implementation of dance interventions it is important that dance overcomes the stigmas attached to it—predominantly those regarding age, class, race, gender, level of physical activity, and appearance.

According to Lansley and Early (2011, p. 12), ageism is the most critical prejudice in dance, as it affects dance hardest and often remains unvoiced. Due to physical and psychological demands, dancers' careers are understood to be extremely short (e.g. Wanke et al. 2012). However, recent trends provide encouragement that performing dance is possible at a higher age (e.g. Pina Bausch, Sylvie Guillem, Carlos Acosta, Tamara Rojo, Steve Paxton, Jane Dudley, Julyen Hamilton; see also Figure 1.1). Furthermore, with mature dancers becoming increasingly present, the possibilities when defining goals and designing appropriate training schedules for dancers at different levels and stages are more tangible.

Another poignant misconception of and in dance is related to the intensity and level of physical activity. With so many different dance styles, the physical demands are almost impossible to summarize, and dance-specific knowledge is required to recognize the demands on dancers' bodies (Wanke et al. 2012). Notably, while the cardiovascular and muscular efforts dance demands may be discredited by some, professional dancers are expected to have a mind-set of 'never giving up' which poses risks for their health and wellbeing.

Clearly, professional dance expertise is a highly trained skill achieved through a huge amount of deliberate practice (Ericsson 2008). However, recent research conducted at top UK universities (e.g. Trinity Laban, Royal Holloway) provided evidence that

FIGURE 1.1. An elderly couple dancing, by Rebecca Leith (© C. Jola and L. Calmeiro). Dance is not restricted to age, gender, or physical appearances, and dance intervention benefits can be found over a wide age-range. In fact, while age as an indicator of physical maturity should be taken into consideration for the outline of appropriate training, encouragement is plentiful that performing and enjoying dance is possible at a higher age, and that training can start late.

tailored high-intensity training programmes should include resting periods for optimal dance performance and injury prevention and focus on quality, not quantity (Wyon 2010). The importance of rest periods for consolidation processes of general complex motor (Rieth et al. 2010) and cognitive tasks (Mercer 2014) is an established fact. It is thus important that pauses in dance practice are credited. Wyon (2010), for example, suggested that a rehearsal can end early, particularly when the desired quality is achieved. For most professional and vocational dancers, however, this is not common practice.

De facto, it is often the case that insights that go against existing cultural practices are particularly slow in being implemented. This is true for dance with its prejudices and expectations, as well as for science with its established empirical standards. For example, while the amount of research on the physical, psychological, and neuronal processes linked to dance increased tremendously over the last decade, the predominantly reductionist scientific approach has often failed to capture the complexity of dance (Jola, Grosbras, and Pollick 2011; Jola 2016) and interpretations need to be handled carefully. We argue that with a better understanding of the underlying physical, neuronal, and psychological mechanisms of dance, more substantial critiques of existing practices and better targeted propositions for novel approaches in support of health and wellbeing in dance are possible—even if some of these scientists may not have initially set out to target those aspects (e.g. Cross et al. 2014).

In general, physical activity has been associated with a variety of health benefits, including a sense of feeling good (Haskell et al. 2007; Penedo and Dahn 2005; Warburton et al. 2006). This 'feel-good effect' associated with physical activity is linked to physiological as well as psychological effects (Ekkekakis 2003; Hyde et al. 2011). Notably, positive effects through dance participation can be expected to go beyond physical health, since dance in its optimal form combines physical activity with cognitive, social, psychological (including emotional), spiritual, and creative processes (e.g. Burkhardt and Rhodes 2012; Siddall 2010). Indeed, dance participants reported beneficial effects on all of these factors (Quiroga Murcia et al. 2010) with a more positive-activated (e.g. feel happy, elated, energetic, euphoric) as well as a more positive-deactivated (e.g. feel released, relaxed, calm) feeling after dancing. Furthermore, quantitative studies found positive effects of recreational dance interventions on physical and psychosocial health and wellbeing in children and adolescents (Burkhardt and Brennan 2012), as well as in the older population (Connolly and Redding 2010).

While there is considerable consensus in what pertains to the health and wellbeing benefits of physical activities in general, the research concerning the explanatory mechanisms of such benefits is less conclusive. This chapter thus aims at initiating a pathway towards a more comprehensive understanding of the underlying mechanisms of the benefits of dance as a special form of physical activity. We emphasize the physical activity component of dance to the detriment of other, nonetheless relevant, components (e.g. Christensen and Jola 2015; Jola 2016) because of (a) the contemporary political relevance of viewing dance as a physical activity and (b) the need to understand mechanisms of health and wellbeing that underpin the physical aspects of dance.

We argue that a better understanding of the complexity and interaction of these explanatory mechanisms will provide substantial support for the successful continuation of dance participation with a focus on health and wellbeing. This is particularly important, since dance also entails considerable health and wellbeing risks (e.g. Padham and Aujla 2014) in addition to the high risk of dance-specific physical injuries (e.g. Russell 2013). In the professional, vocational, and sometimes recreational sectors, high incidences of injuries, fatigue, and psychosocial pressures are common, potentially related with distorted eating habits prevalent in ballet dance (e.g. Aalten 2007; Macleod 1998), continuous practice despite serious injuries (e.g. Nordin-Bates et al. 2011), and drug misuse (Sekulic et al. 2010), respectively. According to some authors, the most prevalent risk factors are of cultural and aesthetic origin (see Aalten 2007; Wanke et al. 2012). For example, ballet dance defies gravity and the anatomy of the human body, causing stress on the dancer's body and mind (see also Wyon et al. 2011). Thus, concerns about professional and vocational dancers' health and wellbeing are understandably high and its potential effects on the recreational sector should not be ignored. The aim is therefore to sensitize the reader to the characteristic effects of dance practice that allow a more informed understanding of often contradicting findings. Each section can be read independently.

# Explanatory Mechanisms

Among the various hypotheses advanced to explain a relationship between physical activity and wellbeing in dance, we emphasize the biochemical, neuronal, and psychosocial mechanisms. Notably, while some of the explanatory mechanisms in relation to dance have been studied extensively (e.g. psychosocial effects of dance movement therapy or self-perception, functional brain changes), others have received little attention (e.g. structural brain changes, neurohumoral and serotonin (5-HT)/dopamine (DA) responses; but see Quiroga Murcia et al. 2009). Hence, for those cases where no specific reference to dance is available, we report from a general physical activity/exercise perspective and discuss potential links to dance practice to stimulate further research.

# Biochemical Mechanisms

## The Endorphin Hypothesis

Endorphins such as β-endorphins, encephalins, and dynophin are hormones that have an important role in the regulation of pain perception and feelings of euphoria. Due to its analgesic effects, these opioid peptides can mediate psychological benefits of physical activity; it has been suggested that the increase of circulatory endorphins—particularly β-endorphins—observed during physical activities is responsible for the 'runner's high' so often reported by regular joggers (Marieb 2012).

Presently, evidence for the increase of plasma-level endorphins exists in relation to the increasing effort demands of the activity in anaerobic exercise (e.g. Schwarz and Kindermann 1992), aerobic dance (Pierce et al. 1993), and the interactivity of the movements with music (Tarr et al. 2014). Whether the anaerobic threshold is reached in dancing or not is dependent on the dance style (Angioi et al. 2011; Liiv et al. 2014; Wyon et al. 2011). Also, not music listening per se, but the creation of music and interaction with music, was shown to determine endorphin release (Dunbar et al. 2012). For example, interactive musical feedback during a repetitive machine supported workout was found to enhance the individuals' mood compared to passive music listening (Fritz et al. 2013). In addition, Tarr et al. (2014) proposed that agency and/or group co-ordination are necessary for music-induced endorphin levels to rise. These findings support the notion that during dance practice, live music should be preferred over recorded music and that dancers release more endorphins—even when the dancers may not reach the anaerobic threshold—when a communicative interaction between performers and the musician is present.

It is less clear, however, whether the feeling of 'high' after performing could be induced by endorphins. To our knowledge, only one study addressed the endorphin response specifically to dance (Pierce et al. 1993), showing an increase of circulating endorphins after forty-five minutes of aerobic dance. However, the endorphins are unlikely to be directly responsible for the 'feel-good effect' in dance as well as other physical activities: although blood concentration of endorphins is generally increased during exercise, its effects on mood states are questionable. Researchers have failed to demonstrate that endorphins are able to pass through the blood–brain barrier to act on the brain centres responsible for the regulation of mood (Boecker et al. 2008; Buckworth et al. 2013; O'Neal et al. 2000). However, Boecker et al. (2008) were the first to show in vivo evidence in human participants that sustained physical exercise resulted in release of endogenous opioids (within the central nervous system) in the fronto-limbic regions of the brain (see Figure 1.3), responsible for affective modulation. More importantly, such increased opioid activity was associated with the euphoric sensation characteristic of the 'runner's high'. Further investigations are required into studying how mood in recreational and professional dancers may depend on endogenous opioid levels. Although these are associated with wellbeing as discussed, it may also explain the possible 'exercise addiction' observed in injured professional and recreational dancers (Nordin-Bates et al. 2011) and athletes alike (Boecker et al. 2008), who continue their training regardless of the harmful consequences to their health. Nevertheless, it appears that the feeling of 'high', particularly experienced after performance, is more likely related to cortisol levels.

## Dance and Cortisol Response

As represented in Figure 1.2, the hypothalamic–pituitary–adrenal (HPA) axis regulates the stress response of an organism, ultimately through the liberation of a number of hormones such as cortisol. Exercise has been shown to influence the HPA system that regulates stress responses. While 'acute' exercise activates this system, adaptation to repeated

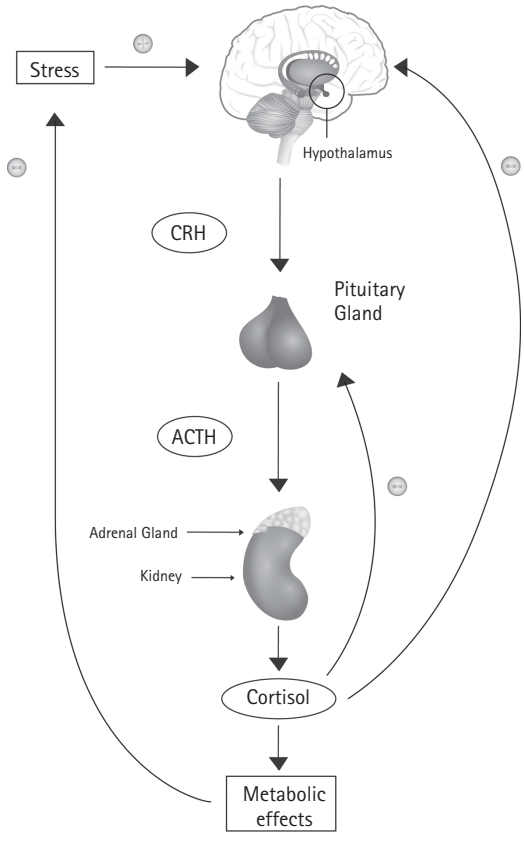


FIGURE 1.2. The hypothalamic–pituitary–adrenal system, by Rebecca Leith. (© This figure is adapted by Jola and Calmeiro from S. Hiller-Sturmhöfel and A. Bartke (1998), 'The endocrine system: an overview', *Alcohol Health and Research World*, 22(3): 153–64, PubMed 15706790.) The hypothalamic-pituitary-adrenal (HPA) axis that regulates the stress response of an organism through the production of the hormone corticotropin releasing factor (CRF) in the pituitary gland is illustrated. CRF liberates the adrenocorticotropic hormone (ACTH); and in turn, the ACTH acts on the adrenal glands, liberating a number of hormones into the blood stream, including mineralocorticoids (mainly aldosterone) and glucocorticoids (such as cortisone, corticosterone, and, most importantly in humans, cortisol). A small fraction of these glucocorticoids remains 'free' in the blood stream (that is, unbounded to chemical substances) and is eventually diffused to the saliva (Rohleder et al. 2007). The main goal of the HPA system is to prepare the organism for an efficient 'fight or flight' response to a stressor and to protect against long-term stress. An excessive activation of this system induces biochemical alterations, which interfere with the functioning of brain structures that regulate the emotional states, such as the amygdala, the hippocampus, and the nucleus accumbens (O'Neal et al. 2000). Therefore, low levels of cortisol are a biomarker of good health (Miller et al. 2009).

bouts of exercise ('chronic' exercise) attenuates the effects of acute exercise regardless of its intensity; therefore, repeated exercise results in decrease HPA activation (Buckworth et al. 2013). Hence, as a form of physical activity, regular dance can have a beneficial impact on wellbeing through the regulation of the HPA axis activation.

Although exercise is a physical strain that can activate the HPA axis, particularly in episodes of intense physical exertion (Davies and Few 1973; McMurray et al. 1996; Tremblay et al. 2005), the psychological demands of the stimuli can activate the HPA axis more strongly than the physical demands (Berndt at al. 2012; Rohleder et al. 2007).

Increases in positive affect and decreases in salivary cortisol concentrations were found in a sample of Tango Argentino dancers (Quiroga Murcia et al. 2009). Specifically, regular dancing (with partner and music) resulted in lower levels of cortisol than dancing with a partner without music. In addition, music also had an influence on the neurohumoral responses to dance as significant decreases were observed in tango dancing with music but without a partner. Conversely, elevated cortisol levels were also found in competitive ballroom dancing (Rohleder et al. 2007) and dance students during short solo performances (Quested et al. 2011). Notably, these changes were shown to occur due to the social-evaluative threat associated with the competitive nature of the tasks rather than the physical exertion required. Berndt et al. (2012) argue that professional dancers are subject to a variety of stressors that may result in acute increased cortisol responses that when repeated over a long period of time (i.e. chronic stress exposure) can lead to loss of quality of life associated to increased stress sensitivity, pain, and fatigue.

Quested et al. (2011) argue that the positive effect of dance on wellbeing can be due to fulfilment of individuals' basic psychological needs; that is, the need to feel competent, in control of our own behaviour, and socially connected with others (Ryan and Deci 2000). Quested et al. (2011) found evidence that low levels of satisfaction of dancers' basic psychological needs may result in prolonged or repeated cortisol elevation, which can have negative consequences on long-term wellbeing (Burns 2006). Dancers who reported higher basic psychological needs satisfaction had lower cortisol responses and reduced levels of anxiety. In addition, Rohleder et al. (2007) demonstrated lower cortisol levels in group formation dancers in comparison to individual couple dancers, which the authors attributed to the social support experienced during the group dancing. These results demonstrate that the psychological satisfaction is crucial for dancers' health and wellbeing—potentially more so than the type or level of physical exertion while dancing.

## Brain Neurotransmitters

Whether physical, social, or psychological the causes for the benefits of physical activity on wellbeing, there is a documented association between physical activity and exercise with an enhancement of the transmission of brain chemical neurotransmitters—specifically DA, norepinephrine (NE), and 5-HT (Hyde et al. 2011). Notably, the study of changes in brain neurotransmitters following exercise relies primarily on animal models (Dishman 1997).

DA has an important role in initiating and controlling movement (Meeusen and De Meirleir 1995). Habitually physically active animals have an enhanced brain DA synthesis (Foley and Fleshner 2008) and DA metabolism in the brain as a whole (Chaouloff 1989) or in specific regions (see Figure 1.3) such as the midbrain, hippocampus, striatum, and hypothalamus (Davis and Bailey 1997). Exercise affects the dopaminergic system as

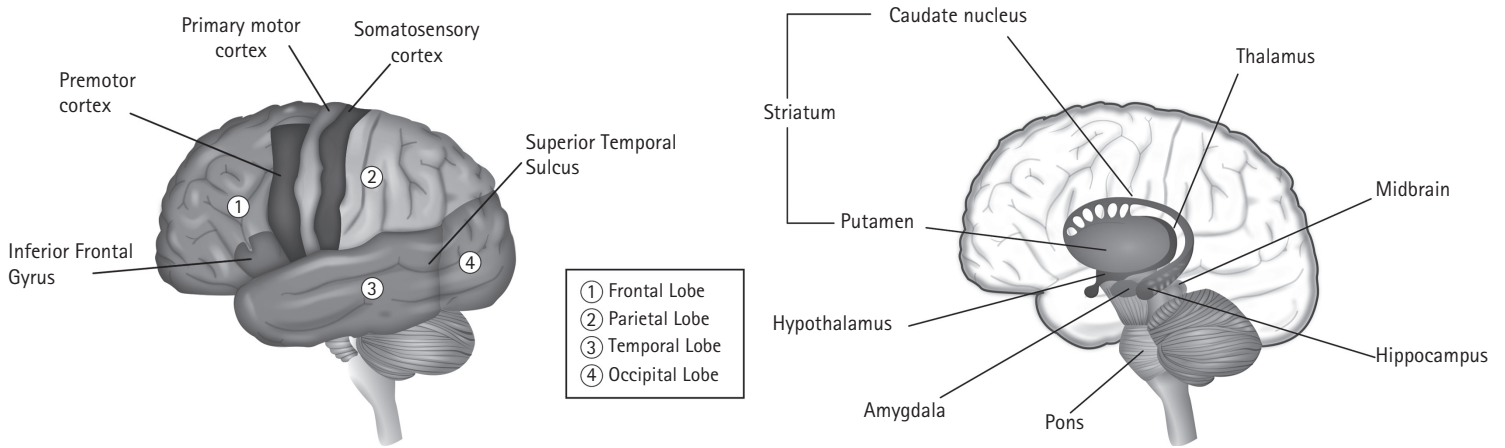


FIGURE 1.3. Internal structures (image right) and outer cortical surface from the lateral (side) view (image left), by Rebecca Leith (© C. Jola and L. Calmeiro). Indicated are (image left) the four main lobes of the cortex (outer layer of neural tissue—grey matter/cell bodies), areas considered part of the mirror neuron network (primary motor cortex, the inferior frontal gyrus, the inferior and superior parietal lobe, the superior temporal sulcus, and the somatosensory cortex), and (image right) internal structures associated with relevant biochemical mechanisms.

suggested by the association between fatigue and reductions of DA synthesis and metabolism in the brain stem and midbrain. Furthermore, when brain DA levels are maintained, fatigue is delayed.

Notably, DA is also one of the regulators of appetite (Abizaid 2009). Therefore, the increased dopaminergic activity after the intense physical exertion associated with professional dance practice could explain the experience of dancers in suppression of their appetite (Crabtree et al. 2014). In combination with aesthetic or schedule enforced diets (e.g. Aalten 2007; Koutedakis and Jamurtas 2004), these exercise-induced appetite suppressions can lead to detrimental effects on the individual's health that have not yet been systematically researched (Howe et al. 2014).

Moreover, empirical studies that specifically target dancers' nutritional needs are to this day marginal but much needed. For example, Brown and Wyon (2014a) showed evidence that dancers' positive mood is significantly linked to their nutrition behaviour and blood sugar—i.e. glucose levels. The authors' also showed that attempts to educate dancers on the nutritional needs, potentially in the form of supplements, are important (Brown and Wyon 2014b). Clearly, more field studies are needed to gain a better understanding of the specific needs and problematic issues related to changes in biochemical mechanisms and nutritional modifiers of the 'feel-good effect' (such as increased proneness to injury due to inadequate diet; see Wanke et al. 2012).

NE is a major modulator of neural activity in the brain (Dunn and Dishman 1991) and the primary brain site for its production is the locus coeruleus, located in the pons (Buckworth et al. 2013; see Figure 1.3). Noradrenergic responses regulate autonomic arousal, attention vigilance, and neuroendocrine responses to stress (Dishman 1997), including those associated with anxiety and depression (Soares et al. 1999). Studies suggest that chronic physical activity alters brain levels of NE and its major metabolites in regions of the brain known to be involved in integrating behavioural and endocrine responses to stressors other than exercise (Dishman 1997; Sothmann and Kastello 1997). Research also suggests that in physically active animals there was less NE depletion or higher synthesis rates during exposure to controllable and uncontrollable stressors when compared with sedentary animals (Dunn et al. 1996). Furthermore, research also suggests the role of exercise in increasing brain NE activity in conditions of chronic hypoadrenergic activity (Sothmann and Kastello 1997) by providing 'psychopharmacological evidence consistent with an anti-depressant effect of physical activity' (Dishman 1997: 67). In fact, chronic activity-wheel running protected against the depletion of NE in face of stressors (e.g. uncontrollable foot-shock) in sedentary animals (Dishman et al. 1993; Dishman et al. 1997; Soares et al. 1999).

5-HT neurons are distributed to all areas of the central nervous system. Activity of 5-HT neurons is associated with pain, fatigue, appetite, sleep, and corticosteroid activity (Dunn and Dishman 1991). Levels of 5-HT or its metabolite, 5-hydroxyindoleacetic acid (5-HIAA), in the cerebrospinal fluid and urine are below normal during depressive episodes in humans (Landers and Arent 2001). Although research that focused on the effects of exercise on the serotonergic system has generated mixed results (Dunn and

Dishman 1991), there is some evidence that exercise increases brain 5-HT synthesis and metabolism (Chaouloff 1989; Davis and Bailey 1997). Analysis of regional differences in 5-HT and 5-HIAA following ninety minutes of treadmill running showed increases of both substances in the midbrain, hippocampus, and striatum (Davis and Bailey 1997; see Figure 1.3). Such increases are thought to be facilitated by improved concentration of free tryptophan levels in the blood after exercise, which stimulates tryptophan entry in the brain for 5-HT synthesis (Chaouloff 1997; Meeusen and De Meirleir 1995). Chaouloff (1997) showed that one hour of treadmill running resulted in increased brain tryptophan concentration accompanied by a small but significant increase in 5-HIAA, indicative of increased 5-HT synthesis and turnover.

In addition to the focus on brain monoamines in animal models, studies of the presumed anxiolytic effects of exercise focused on increased locomotion, which reflects an adaptive motivational state indicating reduced behavioural inhibition (e.g. few approaches to the centre of the open field, freezing) (Dishman 1997). Fearful locomotion is regulated through reciprocal inhibition between gamma aminobutyric acid (GABA) and DA transmission within the corpus striatum (Dishman et al. 1996). The corpus striatum is a set of nuclei located in the forebrain, responsible for the coordination of slow sustained body movements and inhibition of unnecessary movement patterns. Consistent with the suggestion that exercise has an anxiolytic effect in rats, Dishman et al. (1996) observed that chronic activity-wheel running increased locomotion during open field behaviour and decreased the density of $GABA_A$ receptors in the corpus striatum subsequent to increased GABA concentration.

Animal studies have showed that environmental manipulations, such as exercise, induced biochemical changes that have been found to mediate the antidepressive benefits observed by pharmacological treatments (Remington 2009). However, studies with humans are limited for technical and ethical reasons, making measurement of brain neurotransmitters difficult. For example, in a rare study performed with humans, Wang et al. (2000) did not detect any changes in DA striatal release after thirty minutes of vigorous aerobic exercise on the treadmill. The authors attributed this failure to corroborate the research with animal studies to the poor sensitivity of the method used to detect low levels of DA increase. Therefore, studies focus mainly on peripheral levels of these catecholamines. Plasma levels of NE and DA were found to be increased after both moderate and intense bouts of physical exercise (Winter et al. 2007). Jeong et al. (2005) have identified increases in plasma 5-HT concentration and decreases in DA concentration in adolescents with mild depression following twelve weeks of dance movement therapy (DMT).

In summary, because monoamines contribute to the adjustment of the activity of the thalamus and limbic system (see Figure 1.3), responsible for the regulation of mood states and emotional functioning (Buckworth et al. 2013), the possibility that exercise may stimulate production and release of monoamines in the brain may justify the preventive and therapeutic role of exercise (Biddle and Mutrie 2008) and, by extension, dance.

# Neuronal Mechanisms

## Background Dance and the Brain

As Figure 1.3 illustrates, the outer surface of the brain is divided into four main lobes. These lobes entail formations called gyri and sulci, which are used to identify the lobes. In analogy to landscape, the gyri and sulci would be the 'hills' and 'valleys', respectively. En gross, the different lobes are found to process different types of information. For example, the occipital lobe processes visual information, the temporal lobe auditory information, the parietal lobe spatial and physical properties, and thinking has been located in the frontal lobe. The more inferior structures are considered to process emotional information. While there is good reason to assume a close relationship between functional processes and the underlying neuronal architectures, to assume such a distinct modular structure of the human brain is a tremendous simplification. The cognitive and perceptual processes are complex, depend on several parts of the brain, and are inevitably interlinked, leading to a network of activity across the brain when conducting a task. In the case of dance, it is important to understand that the brain's activity spans across an extended network of areas involved in the processing of multiple sensory, motor, cognitive, and emotional functions.

These diverse ranges of functions are 'orchestrated' in the grey matter—the outer layers of the cortical surface, consisting of nerve cells. The underlying white matter contains connections between nerve cells, mostly myelinated axons. Here, our main interest is in how a dancer's brain adapts to its demands and how this may explain some of the effects on health and wellbeing.

Adaptations to environmental inputs as well as internal modulations are an intrinsic property of the human brain (Pascual-Leone et al. 2005). Novel techniques, such as magnet resonance imaging (MRI), electroencephalography (EEG), or near-infrared spectroscopy (NIRS), allow assessing such neuroplasticity non-invasively, in form of changes in brain function (activity of grey matter in response to particular stimuli or tasks) and the brain's architecture (structural anatomy of grey matter and white matter). Notably, however, each method has its particular limits. For example, measuring brain activity during large whole body movements presents a challenge due to movement artefacts. Moreover, the narrow space in an MRI scanner poses an undeniable adversity when aiming to study activity in response to dance.

Other restrictions are the spatial and temporal resolutions of each method (Logothetis 2008). The vast amount of neuroscientific studies on dance published over the last ten years has predominantly looked at functional brain processes in the domain of perception and cognition in response to dance practice without considering accompanying structural differences (Blaesing et al. 2012; Sevdalis and Keller 2011). Direct links between functional and structural changes in 'motor training-induced neuroplasticity' (Bezzola et al. 2012) have as yet received limited attention. Notably, in particular for

health and wellbeing (Bolandzadeh et al. 2012) as well as brain changes based on learning and expertise (Fields 2010), the white matter structure is nonetheless important.

Nevertheless, studies that acknowledge dance in its full complexity (i.e. high ecological validity) as an audio-visual stimulus that contains multiple sensory practices impacting on vision, audition, touch, and somatosensory processes have increased in number. This led to an even stronger presence of dance in science with advancing interdisciplinary approaches and novel methodologies. This interdisciplinary approach is important because, as discussed previously, the multiple sensorial aspects of dance (i.e. movement and music) are vital for the health and wellbeing benefits of dance.

## Functional Changes: Mirroring and Empathy

The main body of the early research on dancers' functional brain changes predominantly investigated neuronal processes of passive action observation. This research was in particular stimulated by the finding of the 'mirror neurons' in the macaque monkey's frontal and parietal brain areas (Rizzolatti et al. 1996). The authors made the coincidental finding that neurons in the area relevant for motor execution (e.g. when the monkey grasped a piece of food) were also activated when the monkey passively observed an action (e.g. when it observed the experimenter grasping food), as if internally 'mirroring' or simulating the observed action and thus potentially building the basis for understanding others and experiencing empathy.

An interesting means of studying these mirror neurons is dance. Dance is a universal phenomenon, developed to a variety of cultural forms, with movements ranging from object-unrelated gestural to fully abstract actions. These characteristic properties allow studying action observation in refined forms. For example, comparing brain activity of spectators with different levels of physical and visual expertise in different styles of dance advanced our understanding of the role of context effects in abstract as well as gestural dance movements (Jola et al. 2012; Jola et al. 2013; Jola and Grosbras 2013). Largely, action observation studies with dancers showed that brain activity is dependent on physical familiarity with the observed movements. In other words, dancers who watched movements that closely matched the movements they master showed enhanced activity in areas considered part of the mirror neuron system (see Figure 1.3), also described as the action observation network (e.g. Calvo-Merino et al. 2005; Calvo-Merino et al. 2006; Cross et al. 2006).

Specific roles have been associated with the different parts of the mirror neuron system. The primary motor cortex is relevant for the motor action, the superior temporal sulcus—considered lacking motor execution functions (Rizzolatti and Craighero 2004; but see also Gazzola and Keysers 2009)—is relevant in the perception and recognition of a human body (see Noble et al. 2014) and thought to further process the visual properties of motor actions (Werner et al. 2012). While the parietal lobe has been described frequently as part of the mirror neuron system, its superior parts are more likely related with the preparation to imitate an action (Cattaneo and Rizzolatti 2009).

Finally, the role of the inferior frontal gyrus has just recently been associated with the processing of complex movement structures (e.g. Noble et al. 2014; Bachrach et al, 2016). Furthermore, the somatosensory cortex is the part of the brain that is involved in the sensation of motion, or in the case of passive action observation it signifies 'how the action would feel if executed' (Gazzola and Keysers 2009).[1]

It is interesting to note that one would expect dancers to engage particularly in the sensation of movements when watching dance. As Kandel (2012, p. 393) states: '. . . art is an inherently pleasurable and instructive attempt by the artist and the beholder to communicate . . . with each other.' He emphasizes the 'the sudden recognition' when we can, through art, see into another person's mind. In line with Kandel's quest into the perceptual, cognitive, and emotional response processes involved in looking at visual art, when looking at dance, the focus is on kinaesthetic processes of the spectator. Although dance spectators are immersed in a kinaesthetic, visual, and auditory stimulation (Glass 2005), audience interviews showed that the experience of pleasure when watching dance is predominantly rooted in the kinaesthetic sense (Reason and Reynolds 2010). Furthermore, dance has been described as a fundamentally kinaesthetic art form (Daly 2002). Therefore, one would predict that, particularly for professional dancers when they observe dance themselves, the exchange between the performer and the observer would happen through movement. However, even though dancers indulge in kinaesthetic pleasures of movements and potentially employ somatosensory information in lieu of visual information (e.g. Ehrenberg 2010; Jola, Davis, and Hoggard 2011), the somatosensory cortex activity was not consistently identified in studies designed to test the mirror neuron theory. Sensory experiences evoked through dance as well as the influence of context related elements (e.g. watching with or without music, as in Reason, Jola, Kay, Reynolds, Kauppi, Grosbras, Thoka, Pollick 2016) have been studied less. Hence, the seemingly obvious link between dancers' health and wellbeing (enjoyment) and activity in their neuronal action observation processes (enhanced somatosensory activity) may have been missed. In fact, since neuroscientific studies often neglected the rich variety of dynamic gestures in dance by defining dance along the lines of 'a kind of movement pattern' (see Christensen and Jola 2015: 230; for a critical review of dance in scientific studies see Jola et al. 2012), suggestions on how functional changes related to dancers' mirror neuron system activity can be linked to their health and wellbeing are hitherto limited. Yet there exists hope that future research in dance, art, and cognitive neuroscience will follow the ideas with dance not being a purely visual or cognitive art form, but embodied (e.g. Block and Kissell 2001; see Jola 2017).

An interesting aspect of functional brain imaging studies and dancers' health and wellbeing not yet discussed relates to dancing in synchrony with a partner or to a beat that potentially acts as a mood enhancer. For example, several studies found that prosocial behaviour is enhanced through moving in synchrony (Reddish et al. 2013; Hove and Risen 2009; Wiltermuth and Heath 2009; see also Keller et al. 2014). More specifically, Kokal et al. (2011) showed that drumming in synchrony enhances brain activity in areas that are active in reward contexts (that is, the caudate nucleus; see Figure 1.3) and facilitates future prosocial behaviour.

Since the seminal study by Hasson et al. (2004) on the synchronization of spectators' brain activity while watching parts of the feature film *The Good, the Bad and the Ugly*, methods to analyse neuronal synchronization across a group of spectators have advanced notably. For example, a group of novice spectators watching Indian dance in the scanner showed a wider network of brain areas synchronized when the music that accompanied the dance moves was audible (Jola et al. 2013). While the authors suggested that the increased synchronization is based on enhanced shared understanding of the movements by means of coherent multisensory stimulation (vision and audition), the exact source for increased synchronization when audio-visual stimulation in dance is combined could not be identified in this particular study. However, it encouraged a number of following publications that suggested activity in inferior frontal areas, also known for language production, to be enhanced through shared perceived boundaries of complex edited dance movement (e.g. Noble et al. 2014; Herbec et al. 2015).

Finally, spectators' resonance with a dance style was suggested to be affected by the narrative (Jola, Grosbas, and Pollick 2011), the live presence of the performers (Jola and Grosbras 2012), and their personality (Jola et al. 2014). Moreover, resources of cognition and emotion potentially compete when watching dance (Grosbras et al. 2012). Hence, dance may simply take your mind off other things and thus improve your health and wellbeing.

In conclusion, although we have learned considerably about modifiers of action observation processes over the last ten years (physical and visual experience, presence of the performer, complexity of dance structure), the links between functional brain processes and dancers' health and wellbeing are yet largely unexplored.

## Structural Changes: Expertise, Specificity, and Efficiency

A close link between structural brain changes and health and wellbeing of an individual has been shown in both directions, positive (e.g. changes leading to enhanced health and wellbeing) and negative (e.g. changes leading to decreased health and wellbeing). Evident cause-and-effect relationships between structural brain changes and wellbeing are examples of brain lesions (i.e. damages to brain tissue) that significantly impact on an individual's health. For example, lesions by injury (e.g. stroke) or infections (e.g. multiples sclerosis, cerebral palsy) have significant effects on the individual's motor control ability. Alzheimer and dementia are examples of disorders with detrimental effects on health and wellbeing that are accompanied by structural brain changes (i.e. progressive loss of specific neuronal populations). Furthermore, ageing, with its evidently detrimental effects on health and wellbeing, was found to be related with reduced grey-matter thickness and white-matter signalling across sensory, somatosensory, and motor lobes, as well as in parts of the frontal lobe (Salat et al. 2009).

Although structural deterioration is linked directly to a decline in health and wellbeing, as already indicated, the causing effects are often unknown. Moreover, the cognitive, sensory, and motor functioning in the elderly are not necessarily impaired as a

result of these structural brain changes. On the plus side, it is well known that acquiring new skills prompts positive structural and functional brain changes. Notably, physical activity in the form of sporting or musical expertise (Chang 2014) as well as physical intervention (Draganski et al. 2004) repeatedly showed increased grey matter volume in the areas of the trained activity, suggesting motor-training-induced neuroplasticity. While most research on neuroplasticity compared experts with novices in cross-sectional studies, longitudinal studies that measure the effect of training over time showed evidence that neuroplasticity is not only fast and efficient but that even low to moderate leisure activity can evoke structural improvement (e.g. Bezzola et al. 2012). Research on structural changes in dancers' brains is, however, unfortunately sparse and less conclusive (Chang 2014).

To our knowledge, only two studies have yet specifically investigated structural plasticity through dance training. Hänggi et al. (2010) compared white and grey matter volume and fractial anisotropy (FA) between professional ballet dancers and non-dancers. FA is a measure of diffusion (directionality of transfer of material, such as water molecules) from one spatial location to other locations over time, thought to vary with fibre density as well as myelination of axons, but is yet poorly understood. Contradicting a number of studies which showed a correlation between brain volume and physical expertise, the authors reported decreased GM and WM volume as well as decreased FA in dancers compared to non-dancers. While the interpretation of the latter is confined to speculations based on the lack of knowledge on the modifying mechanisms, the decreased GM and WM volume is surprising. Hänggi et al. (2010) provided a number of potential explanations, one of which is the model of expertise efficiency. The idea is that 'the higher the expertise, the more efficient the neuronal processing', which is based on the observation of decreased neuronal activity in experts' action execution and interpreted as a functional outcome of optimization of the underlying neuronal mechanisms (see Chang 2014). However, as acknowledged by Hänggi et al. (2010), the interpretation does not resonate with a number of findings. Notably, it is inconsistent with the assumptions of the mirror neuron theory and the increased activity measured during experts' action observation. Other suggestions given by the authors refer to the significant differences in dancers' weight and years of education. In fact, the latter relates to an earlier observation by Jola and Mast (2005). The authors noted that dancers compared to the control group had reduced levels of higher education (HE) and minimal computer experience, which potentially affected their mental rotation test scores. Hence, when comparing dancers as experts with a control group, rigorous control for potential confounding variables is crucial.

The second study which compared dancers' GM volume with that of non-dancers, controlled indeed for dancers' computer experience (Hüfner et al. 2011). In contrast to controls, the experts showed decreased GM volume of the anterior parts of the hippocampal formation (see Hippocampus in Figure 1.3); however, they also showed increased GM volume of the posterior parts of the hippocampal formation and in several other areas in the frontal, temporal, and occipital lobes and the cerebellum. Although explanations of the functional specificity for all of the areas with significant

volume differences between experts and novices can be given, the hippocampal formation was of particular interest for the authors due to its involvement in vestibulo-visual stimulation, navigation, and memory. While this study was well-controlled for confounding factors as well as effects of expertise with a number of additional tests, it is not clear which brain differences are specific for dance, as ice dancers and slackliners were also included in this study.

More research is needed into how dancing experience leads to structural brain changes in order to advance both direct and indirect neuronal exploratory mechanisms on the dancing benefit for individuals' health and wellbeing. Further studies are needed that control for different levels of intellectual abilities and different physical demands, such as cardiovascular activity, across the range of dance styles. Finally, a major criticism of most studies on motor-induced neuroplasticity is that the special skills acquired are often defined only on a descriptive qualitative basis. It is not unlikely that they are expressed post hoc, following the identification of brain areas with significant changes instead of a theoretically based approach.

# Psychosocial Mechanisms

A variety of psychosocial factors that may justify the benefits of physical activity in wellbeing have been reported (Buckworth et al. 2013): increased perceived competence, control of own body or physical appearance, increased perception of autonomy and self-acceptance, affiliation, and belonging through improved social contact, are likely to impact individuals' self-concept and self-esteem. In dance, these elements were often identified as beneficial factors (Quiroga Murcia et al. 2010) but sometimes as detrimental (Aalten 2007). Therefore, we summarize the psychosocial mechanisms in body image and self-perceptions, mastery and perceived competence, and social affiliation.

## Body Image and Other Self-Perceptions

Body image is a psychological construct that represents the 'individual's perceptions, feelings and thoughts about one's body and incorporates body size estimation, evaluation of body attractiveness, and emotions associated with body shape and size' (Burgess et al. 2006: 57). Negative body image has been associated with low self-esteem, obesity, depressive states, and other clinical conditions (e.g. eating disorders, social physique anxiety) (Hausenblas and Fallon 2006). Burkhardt and Brennan's (2012) systematic review showed limited effects on self-concept and body image of children and adolescents' participation in recreational dance. Connolly et al. (2011) observed significant increases in self-esteem in adolescent girls in response to contemporary dance classes. Notably, attitudes and intrinsic motivation were initially high, indicating that dance is a promising avenue to promote active lifestyles, at least among females. However, the

lack of a control group undermines validity of the results. In a methodologically stronger study, Burgess et al. (2006) reported that involvement in biweekly aerobic dance sessions for six weeks significantly reduced body image dissatisfaction and enhanced physical self-worth in female adolescents, compared to swimming sessions in physical education classes. Specifically, self-perceptions of attractiveness, physical self-worth, feeling less fat and fit significantly improved after the aerobic dance class. The authors point out that aerobic dance may be particularly suited to promote psychological benefits in young girls, predominantly in those who have low levels of self-esteem (Biddle and Mutrie 2008). Other studies (e.g. Aşçi et al. 1998) failed to find significant differences in self-perceptions after an aerobic dance programme in college-aged women, which may indicate an age-moderating effect. However, Burkhardt and Brennan's (2012) meta-analysis provides limited evidence that dance may improve self-concept and body image in dancers aged 5 to 21 years old. In a systematic review on effects of dance intervention in cancer patients, Bradt et al. (2015) also failed to find positive improvements of body image. These controversial results may be due to developmental differences in the participants, as well as the level to which dance participants rely on dancing for self-definition (Quiroga Murcia et al. 2010; Padham and Aujla 2014).

## Mastery Experiences and Perceptions of Competence

Another mechanism that can explain the effects of physical activity (and dance) on well-being is the mastery hypothesis. According to this hypothesis, the successful completion of a challenging and personally meaningful task brings about feelings of accomplishment and mastery (Biddle and Mutrie 2008). Considering the performing context of dance, particularly at the professional level, challenging tasks are required for dancers to achieve a degree of excellence. Therefore, it is not surprising that risk-taking is one of the sought features of contemporary dancers, as Dummont (2012) has illustrated.

Grounded on Bandura's (1997) self-efficacy theory, regardless of the level of the dancer, promoting mastery experiences will increase participants' self-efficacy which in turn influences participants' choice of task, perseverance in task completion, and positive affective states (Bartholomew and Miller 2002). Bartholomew and Miller (2002) demonstrated that participation in aerobic dance classes resulted in increased positive affect and vigour and in decreases in negative affect, tension, and tiredness. However, those who rated their performance as 'high' reported greater increase in positive affect five and twenty minutes after the class than did those who rated their performance as 'low', indicating that a mastery experience may have moderated the experience of positive affective states. Based on the knowledge that high challenges are an important aspect of dance for contemporary performers (Dummont 2012), the dynamic interplay of personal achievements and dance participants' health and wellbeing becomes apparent.

Haboush et al. (2006) found support for increase in self-efficacy and decrease in hopelessness as an outcome to a programme of ballroom dancing in depressed older adults compared to a group on a waiting list. It is thought that the ability to successfully

master a particular task brings about positive emotional changes. Another dance intervention with middle-aged psychiatric patients resulted in reductions of depression compared to two control groups (music-only and exercise-only). Increases in vitality compared to the music-only group were further observed (Koch et al. 2007). In line with suggestions concerning general physical activity (e.g. Matos et al. 2009), dance/movement therapy—a psychological intervention that uses dance and movement as a way of exploring personal difficulties and relationships—can be an adjunct for the treatment of depression (Cruz and Sabers 1998; but see Meekums et al. 2012).

## Social Affiliation

One important element of dance is the social bonding, based through touch and 'entrainment'—a spontaneous synchronization to the rhythm of others which is present in humans and animals (Phillips-Silver et al. 2010). It can be found in response to music and movement, while participating in dance (in the form of external, motor synchronization) or while watching dance (in the form of internal, sensory synchronization). Entrainment provides a strong sense of presence, liveness, and connectedness (Jola and Grosbras 2013), and thus potentially enhances psychosocial wellbeing through dance (Quiroga Murcia et al. 2010). Hence, entrainment may have a positive effect on wellbeing, as it may contribute to the fulfilment of individuals' basic psychological need of affiliation (amongst competence and autonomy) (Ryan and Deci 2000). Research is needed to explore this mechanism.

It has been argued that certain types of dance have the potential to improve participants' sense of connectedness (Burgess et al. 2006; Quested et al. 2011; Quiroga Murcia et al. 2010). In a participatory phenomenological study, Cook and Ledger (2004) reported that adult female participants in a 5 rhythms dance programme experienced a sense of social connection and belonging while experiencing a safe place where they could express themselves. However, these improvements were not sustained after termination of the programme. These results are consistent with literature in the physical activity domain (e.g. Biddle and Mutrie 2008), suggesting that long-term interventions are necessary.

The positive effects of dance on psychosocial health were also demonstrated in non-clinical and clinical populations in the elderly. For example, Mavrovouniotis et al. (2010) have demonstrated that 60–91-year-olds experienced reductions of anxiety and psychological distress after one session of Greek traditional dances, compared to a group who discussed and watched television for one hour. Kluge et al. (2012) further conveyed that women who were recently relocated to a care retirement community reported more social connectivity, realized they had found a new and improved self, and reported improved mobility. It appears that dance participation promoted personal growth and decreased stress associated with relocation.

Guzmán-García et al.'s (2013) meta-analysis has shown some evidence of increased social interaction and enjoyment among care-home residents with dementia, and

care staff. Specifically, decreases in problematic behaviours, enhancing mood, cognition, communication, and socializing after the dancing session were observed. Recent Cochrane Reviews on dance movement therapy also suggest that there are some positive effects of this dance-based intervention for clients with dementia (Karkou and Meekums 2014) or schizophrenia (Ren and Xia 2013). Notably, this research is afflicted with methodological limitations, small sample sizes, and an overall small number of studies with randomized controlled trial design.

## Conclusion

Dance has gained increased recognition as a form of physical activity with considerable benefits for health and wellbeing. However, research specifically conducted on psychosocial wellbeing in dance is limited compared to research on physical activity and exercise. Although it is reasonable to expect that some mechanisms are shared between dance and physical activity/exercise contexts, it is also reasonable to explore the uniqueness of dance as a creative and performance-related activity. Therefore, there is a need to engage with the different demands of different dance styles, separate recreational dance from elite or vocational dance contexts, and take a developmental approach by considering different elements according to age groups (Burkhardt and Brennan 2012) or other personal characteristics not discussed here (e.g. gender, social status, race). Unfortunately, research focusing on public and leisure settings is scarcer than research in clinical settings (Cook and Ledger 2004), which suggests the need to focus on the different communities within a broader health-promotion agenda. Such knowledge would improve the level of consultations on dance intervention programmes, allowing better identification of target groups and precision of optimal intervention designs, and provide a framework for predictable and testable intervention strategies.

For example, based on literature on music and movement, we found that dance with interactive, live music provides feedback that also increases levels of endorphins more than dance without live music. Moreover, we showed on the basis of recent research on functional brain activity that watching dance with music enhances spectators' brain synchronicity and has significant effects on the enjoyment of the spectators. We outlined that the current understanding of social cohesion further supports that entrainment (synchronization of movement and music) is a hugely relevant factor for successful intervention strategies—in particular, when working with groups and the elderly. Hence, explanatory mechanisms for the effect of dance with music are prevalent in all neuronal, psychological, and biochemical areas.

Furthermore, in order to better support dance intervention programmes it is essential to understand the level of cardiovascular intensity of different types of dance forms. As outlined, cardiovascular intensity is related to levels of endorphins and cortisol, which need to be known in order to activate the intended health and wellbeing changes related, for example, to unacknowledged nutritional needs (e.g. due to aesthetic demands and/

or appetite suppression) as well as increased risks of injury (e.g. continuous training despite injury or fatigue).

Researchers should also determine a dose-response relationship in relation to the proposed mechanisms and examine how the different mechanisms interact in the context of dance to promote wellbeing (Buckworth et al. 2013). For example, few authors have measured changes in the brain alongside physiological changes in the body. We believe that in the near future, interdisciplinary research will further advance and studies combining structural changes and functional brain activity with physiological and psychosocial measures will increase. Such approaches would allow us to more closely relate subjective health and wellbeing with objective brain measures.

To conclude, hopefully, we have clarified the importance of the interplay of the brain and the body when considering health and wellbeing effects in response to dance. Moreover, we believe that this is the first condensed review that presents dance-related processes on the outer cortical surface as well as the inner brain structures equal attention. We anticipate that the increasing presence of dance in science will further signify the value of dance as an embodied art form and evidence its benefits on recreational as well as professional level as a form physical practice that includes further psychosocial and artistic aspects worth practicing and researching (Giersdorf 2009).

## Note

1. It must be noted, however, that Gazzola and Keysers (2009) contrasted brain activity within each individual participant during the execution of an action with the observation of the action. This is an appropriate approach to assess mirror neuron activity. Notably though, it is in contrast to most studies involving dancers, most of which only measured brain activity during passive action observation. (One exemption is the study by Brown et al. 2006, who measured tango dancers' brain activity during dancing steps using PET.)

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CHAPTER 2

# DANCE IN THE BODY, THE MIND, AND THE BRAIN

## *Neurocognitive Research Inspired by Dancers and their Audience*

BETTINA BLÄSING

## Introduction

According to the author's personal experience, many people seem to share the perspective that dancing can make us feel happy and energetic, and that regular dance activities can contribute to our perceived quality of life on different levels. Experience gained from an increasing number of community dance projects with participants of all ages and social backgrounds has confirmed that dance can strengthen our social bonds and improve our self-esteem. How can dance have such far-reaching positive effects? Dancing allows us to be creative, to experience our body and its ways of moving in novel ways, and thereby to learn about ourselves. Dancing in sync with others or with a musical beat can elicit a feeling of joy, harmony, and alignment that can easily be shared. All of the above help us experience our bodies in a multiplicity of pleasurable ways, thus contributing to our sense of well-being. Furthermore, even if we do not dance ourselves, watching others dancing can be also enjoyable and energizing, and can thereby also have a positive effect on our well-being. Recently, dance has begun to attract scientists interested in how the brain links action with perception, how such processes are influenced by expertise, and how they evoke positive emotions. Various aspects of dance expertise have been addressed by neurocognitive research (see for reviews, Bläsing et al. 2012; Sevdalis and Keller 2011), and the dance community has begun to contribute to this development by providing their own

questions and ideas (see Bläsing et al. 2010; May et al. 2011; Waterhouse et al. 2014). One of the most recent questions asked in this field is 'what makes dance pleasurable to watch?', and more specifically, 'which processes in the human brain underlie positive emotional responses to dance?' These questions have inspired studies in neuroesthetics (see Cross and Ticini 2012; Christensen and Calvo-Merino 2013), and recent research in this field has indicated how the function of one's central nervous system while watching dance relates to the generation of a sense of wellbeing, as a result of experiencing positive emotional responses. In the following, I will regard how the brain controls and processes movement in general, before I turn to dance as very special type of human motor action. I will then present neurocognitive studies with dancers and dance spectators, to propose a physiological perspective on how dancing and watching dance can contribute to wellbeing.

## Movement and the Brain

We tend to think of our brain as a machine for reasoning and problem solving. However, if we look at the different tasks of our everyday life, it is clear how great an extent our brain is involved in generating and controlling motor actions, including locomotion, posture and balance control, facial expressions, and manual actions such as grasping, manipulation, and gestures. Remarkably, dance makes use of all these aspects of human motor action. Therefore, before we turn to more specific aspects of dance, let us briefly reflect on the various parts of the brain concerned with motor action.

The neocortex, the outermost and youngest part of the human brain, can be anatomically divided into four lobes (Figure 2.1A). The frontal lobe is most strongly involved in planning and executing movement. Adjacent to the central sulcus (which separates the frontal lobe from the parietal lobe) is the primary motor cortex (also called M1, see Figure 2.1B), which directly controls intentional movements. From here, large neurons project to the spinal cord via the pyramidal tract, where they connect to motor neurons that innervate the muscles in the body periphery. In front of the primary motor cortex is the premotor cortex (PMC), which contributes to motor control and motor planning, as well as integrating sensory and spatial information with the planned movements. Next when moving in the mediofrontal direction is the supplementary motor area (SMA), which is involved in posture control, alignment of movement sequences, and coordination of bimanual actions. The most frontal part of the brain, the prefrontal cortex (PFC), is concerned with action plans on a higher cognitive level, hierarchical organization of actions according to their goals and their context, and decision making.

The parietal lobe is involved in many different activities related to the perception and higher-level processing of perceived information that is crucial for motor action, including spatial integration and navigation. Its most frontal part, next to the primary motor cortex, is the primary somatosensory cortex (S1), in which all

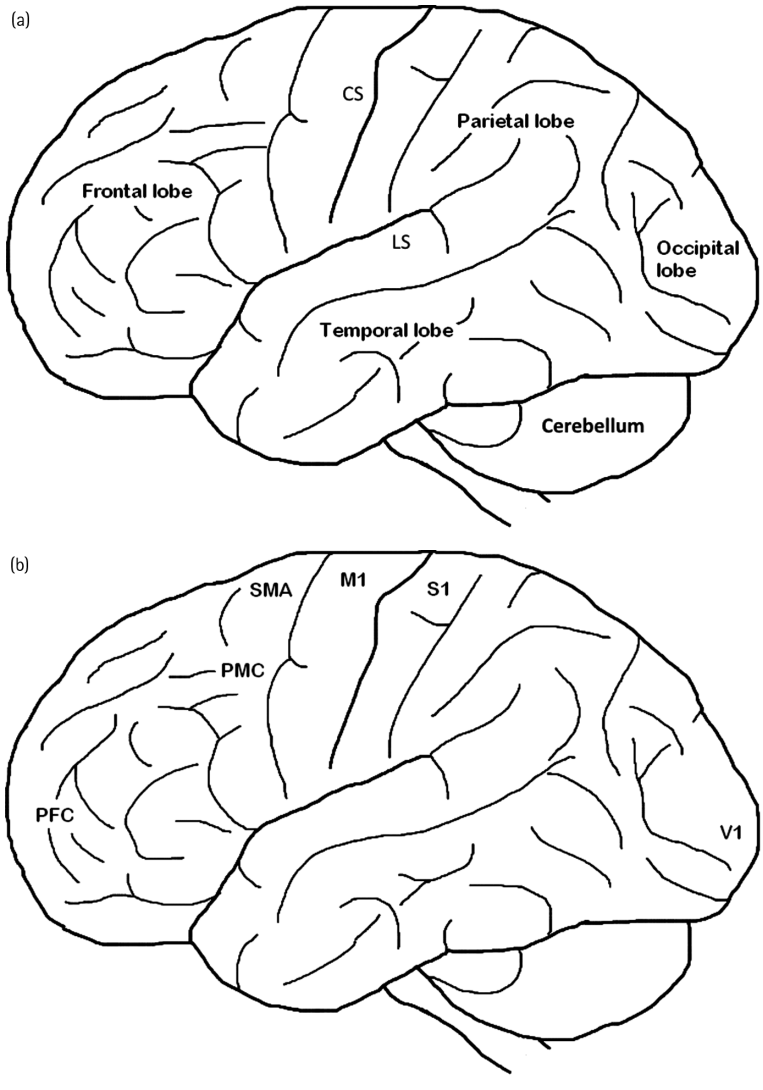


**FIGURE 2.1.** Human brain, from the lateral perspective. A: The neocortex can be subdivided into four lobes: the frontal lobe, the parietal lobe, the temporal lobe and the occipital lobe. The frontal lobe and the parietal lobe are separated by the central sulcus (CS), the temporal lobe is separated from the parietal lobe by the lateral sulcus (LS). The cerebellum, positioned below the hemispheres of the cerebral cortex, is strongly involved in motor control and motor learning. B: Areas of the cerebral cortex that are relevant for planning, performing, and perceiving movement: PFC Prefrontal cortex, PMC Premotor cortex; SMA Supplementary motor area; M1 Primary motor cortex; S1 Primary somatosensory cortex; V1 Primary visual cortex. (Credit: B. Bläsing.)

tactile, proprioceptive, and kinesthetic information is assimilated. In subsequent parts of the parietal lobe, this information is integrated with visual and other sensory information, contributing to multimodal representations of the body and the way it is embedded in its environment. The other two lobes of the neocortex also

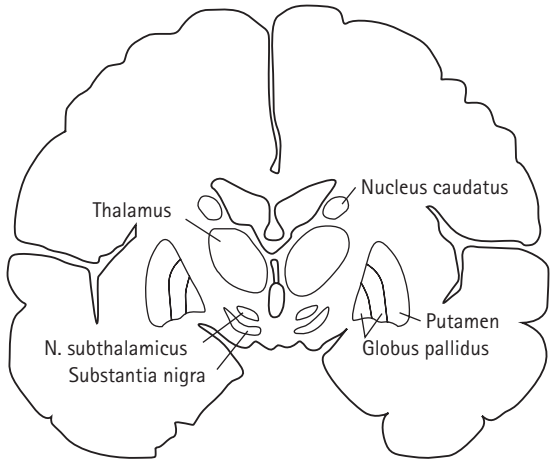


FIGURE 2.2. Subcortical areas of the human brain involved in movement production (coronal view). The basal ganglia include the Nucleus caudatus, Putamen, Globus pallidus, Nucleus subthalamicus, and Substantia nigra. The Thalamus acts as a relay between the basal ganglia and the cerebral cortex. (Credit: B. Bläsing.)

contain regions that process sensory information and contribute to multimodal perception, such as the visual cortex in the occipital lobe and the auditory cortex in the temporal lobe.

Below the neocortex, at the base of the forebrain, the basal ganglia (Figure 2.2) form a group of heavily interconnected nuclei with multiple functions, several of which are also crucial for motor control, motor learning, and the performance of voluntary actions. One main function of the basal ganglia is to generally inhibit motor systems and selectively allow access to motor output, thereby playing an important role in selecting actions. Several diseases with symptoms related to overshooting or the suppression of motor behaviors (e.g. Parkinson's disease, Huntington's disease, Tourette's syndrome) are linked to malfunction in the basal ganglia. Finally, the cerebellum (see Figure 2.1A), located below the occipital lobe of the neocortex, has most strongly been identified with motor control in the past, and its relevance for higher cognitive functions has only recently been investigated. The cerebellum is connected to the spinal cord and to most other parts of the brain, contributing extensively to the coordination, accuracy, and precision of movements, and carrying action plans to their relevant position in the body. The cerebellum also plays an important role in motor learning by monitoring the fit between executed and intended actions (in terms of an efference copy).

This brief overview of the brain gives an impression of the broad network of brain areas related to and necessary for performing motor actions. Dance, as a special type of complex human motor action, makes use of all these parts and their functions; however, dance is more than just movement, and it differs from everyday activities in several ways, as we will see in the following section.

## What is Special about Dance?

Dance can be seen as an art form intricately linked to the human body on different levels, from the most basic physical level to the higher-order conceptual level. Even though dancers performing on stage in classical, modern, or contemporary choreographies are movement experts comparable to athletes who perform with high skill in different sports disciplines, their expertise comprises additional features that makes dance an art form and the dancer an artist as well as an athlete. This can, of course, also apply to dancers engaging in other dance disciplines, such as traditional dance in many cultures, novel dance styles developed within urban subcultures such as hip hop or break dance, or competitive dancing that formally is a sports discipline. Additional to different movement vocabularies and expressive styles, all these types of dance have their own challenges, and, performed on an expertly level, can elicit amazement and admiration in the spectator. The content and character of what a type of dance can convey, however, is often inextricably linked to its cultural background and can hardly be determined with general validity.

Despite the differences and specialities, there are characteristics that seem to apply, on a broad level, to most types of dance. In addition to complex coordinated movement, dance typically involves entrainment on different levels to music or rhythm and between partners (Waterhouse et al. 2014), and interaction or communication among dancers and between dancers and their audience. Dance has been developed as part of almost every human culture, fulfilling various social functions. There is obviously something about dance that makes it useful and enjoyable for us humans, on a deeper level than can be explained by tradition or fashion. To find out more about how dance is embedded in our human nature, it is certainly worthwhile to take a closer look at the human brain. Neuropsychological studies have shown that the perception of others' bodies in motion is substantially influenced by reciprocal top-down and bottom-up processes between actors and observers (e.g. Blake and Shiffrar 2007). We perceive moving humans' (and also other animals') bodies differently from inanimate moving objects. Furthermore, specific parts of our brain have been shaped by evolution to preferentially attend to movements that are of the highest social relevance for us, those of our conspecifics, our partners and opponents. These specialized brain regions naturally respond to dance, indicating that, in certain contexts, dance can convey information about the dancer's emotional state (Dittrich et al. 1996; Sawada et al. 2003) and physical condition (Brown et al. 2005). Some dancers and choreographers deliberately make use of such effects by creating, modifying, and shaping the implicit and explicit messages that the movement of human bodies can convey, using metaphorical thinking as a cognitive and emotional mode of communication. Choreographies in contemporary dance often evolve in a creative process from the choreographer's ideas than can be based on concepts, feelings, words, images, or sounds, reflected and further developed by the dancers' thoughts and associations, and mediated through bodily action (see Stevens et al. 2003; Stevens and

McKechnie 2005; Zöllig 2010). Stevens and McKechnie point out that contemporary dance, as a heightened form of non-verbal communication rich in gesture, expression, and affect, can be viewed either as non-representational, non-symbolic, and formalist 'movement pure and simple', or as representational in some sense, a 'symbolic transformation of experience' (Stevens and McKechnie 2005). They suggest that different cognitive processes underlie these perspectives, including the direct perception of movement and force that does not depend on the observer's knowledge of performing the observed actions, and the neural mirroring of observed actions that involves the same repertoire of motor representations that is used for the production of these actions, and is therefore strongly influenced by motor expertise. As a third cognitive process, the authors add the implicit learning of the movement vocabulary and grammar that is specific for a dance style or the work of a choreographer. Even without being aware of this knowledge, an experienced spectator might therefore be more successful than an inexperienced one in predicting the trajectories and dynamics of movement in an unknown dance piece. Interestingly, the balance and tension between intrinsic reward following successful movement prediction and the surprise following a deviation from the prediction have been proposed as major sources of the pleasure experienced while watching dance (Hagendoorn 2004).

## The Dancing Brain in the Scanner

After we have briefly reviewed how various parts of the human brain process movement, and subsequently focused on dance as a special type of human motor action, the question that naturally comes to mind is: What happens in the brain of a dancer while dancing? This question is not easy to answer, for mostly technical reasons; neuroimaging techniques such as functional magnetic resonance imaging (fMRI) or positron emission tomography (PET) require the participant to move as little as possible in order to minimize artifacts. But even though scanning a dancer's brain during active dancing is difficult, it has been mastered. In order to explore the neural correlates of specific tasks involved in dancing, PET was used to measure brain responses in ten amateur tango dancers (five women and five men) performing tango steps on an inclined board while they were lying in the scanner (Brown et al. 2006). The PET method makes use of a radioactive tracer to record three-dimensional images of metabolic processes in the brain. Molecules carrying a short-lived radioactive isotope are injected into the bloodstream and transported via the blood circulation to the area of interest. As the tracer decays, it emits positrons, anti-particles of electrons. When a positron meets an electron in the body tissue, both particles are annihilated and a pair of gamma photons is emitted. These gamma particles are recorded by a luminescent material in the PET scanner. As the blood flow is increased in brain areas with high activity levels, the gamma radiation measured from these areas will also be higher than the one from less active areas.

Brown and colleagues used PET to measure dancers' brain activity under six conditions: 1) while they were stepping to metric tango music (i.e., tango music with a regular rhythmical beat of equal time intervals); 2) while they were stepping to non-metric music; 3) while they were stepping without music; 4) while they were listening to metric music and contracting their leg muscles as if stepping, but without leg displacement; 5) while they were lying motionless listening to music; and 6) while they were lying motionless, resting without music. As expected, a large neuronal network of cortical, subcortical, and cerebellar regions was found to be active during dancing. Contrasting the different conditions revealed that certain brain areas are specifically involved in individual components of the dancing action. Movement to metric (in contrast to non-metric) music was found to correlate with activity in the right putamen, which is part of the basal ganglia, whereas movement to non-metric music correlated with activity in the ventral thalamus (see Figure 2.2). Entrainment to music was correlated with activity in the vermis, the medial part of the anterior cerebellum, and patterned stepping correlated with superior parietal activity. These findings support that dancing activates the brain regions commonly involved in complex motor action in general, and that individual regions respond selectively to dance-specific tasks, such as those related to music and rhythm.

## Imagery and Creativity

The previous study has demonstrated that it is possible to dance even under very restricted conditions; however, experienced dancers are even able to dance without moving at all. Trained dancers are experts in movement imagery, and both motor and visual imagery are frequently used as tools in dance training to improve movement quality in terms of spatiotemporal adaptation and artistic expression, to exercise the memorization of long complex phrases, and even to create novel movements (e.g. May et al. 2011). Dance training has been found to increase the amount and efficiency of kinesthetic imagery, making kinesthetic sensations more complex and vivid (Golomer et al. 2008; Nordin and Cumming 2007). Alternative methods for dance training based on mental imagery have been recommended to decrease physical stress, especially during recovery from injury (e.g. Krasnow 1997). Theory states that motor imagery is based on simulation processes that recruit motor representations (Jeannerod 1995, 2004), and empirical findings have provided evidence that brain activity during motor imagery closely resembles brain activity during physical performance. During motor imagery, increased cortical activity of high frequencies has been observed in addition to increased cardiac and muscular activity, indicating states of high concentration and attention that are comparable to those seen during active movement (Blaser and Hökelmann 2004, 2009).

In a recent study, motor imagery was used to investigate brain processes underlying creativity in dance improvisation (Fink et al. 2009). Two groups of participants—fifteen

trained dancers with a classical background who were also experienced in dance improvisation and seventeen dance novices who had only participated in a basic course in ballroom dancing—completed two motor imagery tasks while their brain activity was measured by electroencephalography (EEG). EEG records the activity of neurons mainly in the cerebral cortex using a set of electrodes placed on the scalp. Potentials of single neurons are summarized, and the resulting brain waves (characterized, for example, as alpha, beta, or gamma waves) can be used to monitor the activity of the cortex. In one condition of the study, the participants imagined dancing a waltz with a fixed simple stepping pattern, while in the other condition they imagined performing a dance phrase which they were spontaneously improvising, trying to make it as original and unique as possible. Additionally, all participants took part in a verbal test in which they were asked to quickly invent unusual applications for conventional objects. Dancers performed better than novices in the alternative uses test, and showed stronger alpha synchronization (known as an indicator of creative processes) during this task. Dancers also showed stronger right hemispheric alpha synchronization during the creative dance imagery task compared to novices, whereas brain activity did not differ between the groups during the waltz imagery. Studies like this one suggest that imagery and creativity are sensitive to training effects (as an alternative explanation, more genuinely creative minds might be found among dancers engaging in dance improvisation), and that such effects can be demonstrated on the neural level.

## Observing Dance Observers' Brains

Evidence from studies investigating the activity in the human and non-human primate brain that is elicited by observing actions (see Rizzolatti and Craighero 2004; Rizzolatti and Sinigaglia 2010) suggests that when we observe actions performed by others, we simulate the observed actions without actually executing them, using similar brain regions as we would for executing the movements ourselves. A network of such brain regions has been found active during movement execution, imagery, and observation. This network, which mainly includes regions in the inferior parietal and premotor cortices (see Figure 2.3), has been described as the *human mirror system* (Grèzes and Decety 2001) or *action observation network* (see Calvo-Merino et al. 2005; Cross et al. 2009).

Scientists interested in studying action-perception links on the neural level have recently turned to working with dancers, using dance as a distinguished example of skilful human motor action. Several studies have applied this expertise-based approach for investigating how the brain is engaged in learning, executing, observing, and simulating complex coordinated full-body movements. One of the first studies in this line of research used functional magnetic resonance imaging (fMRI) to investigate the effects of movement expertise on movement observation (Calvo-Merino et al. 2005). fMRI is a method that measures brain activity on the basis of blood flow, or more specifically,

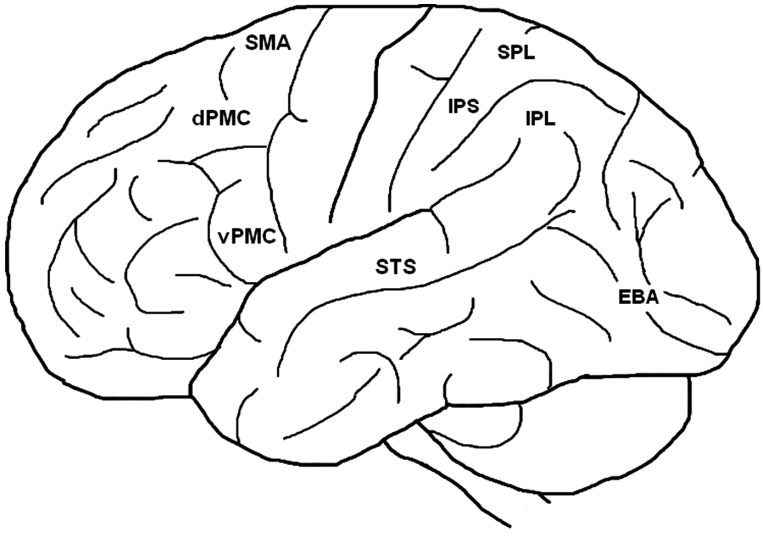


FIGURE 2.3. Areas of the neocortex that have found to be active during activities related to watching human movement such as dance (relevant studies are described in the text). SMA Supplementary motor area; dPMC Dorsal premotor cortex; vPMC Ventral premotor cortex; STS Superior temporal sulcus; SPL Superior parietal lobule; IPL Inferior parietal lobule; IPS Intraparietal sulcus; EBA Extrastriatal body area. (Credit: B. Bläsing.)

of the difference between levels of haemoglobin before oxygen release and after oxygen release. As active neurons need increased levels of oxygen, the blood flow is dynamically regulated to supply oxygenated haemoglobin to active brain areas. As oxygenated and deoxygenated haemoglobin differ characteristically in their magnetic susceptibility, activated brain areas show a different magnet resonance from less active brain areas. This effect—the blood oxygen level dependent (BOLD) response—is measured in fMRI.

In the study by Calvo-Merino and colleagues, short video clips of dance movements were presented to three groups of male participants: ten professional ballet dancers from the London Royal Ballet, nine professional capoeiristas, and ten non-dancers. The video clips showed typical movements from ballet or capoeira, matched for similarity of movement types. Brain activity was measured while the participants watched the clips, and the results revealed significant effects of the observers' own movement expertise. Brain areas belonging to the action observation network, including the PMC, the intraparietal sulcus (IPS), the right superior parietal lobule (SPL), and the left posterior superior temporal sulcus (STS) (see Figure 2.3), showed stronger activation in the experts than in the control group. Furthermore, responses were stronger when the experts watched movements from their own area of expertise (i.e., ballet dancers watching ballet movements and capoeiristas watching capoeira movements) compared to movements not belonging to their own repertoire, whereas the non-dancers showed no effect of movement type. The authors argued that the observers' movement expertise

modified the responsiveness of the corresponding brain areas to the movements they were familiar with from their own training.

Notably, the findings of the latter study did not specify whether the observed effects were based on visual or motor familiarity of the presented movements, as ballet dancers and capoeiristas would be used to performing and watching only movements from their own discipline. An expedient situation to differentiate between visual and motor experience within the same expert population exists in classical dance, where a few movements are exclusively performed by male or female dancers, while the majority of movements are not gender-specific. As male and female dancers train and rehearse together, they are familiar with such gender-specific movements of the opposite gender, but have never performed these movements themselves. In an fMRI study, twelve male and twelve female ballet dancers from the London Royal Ballet watched short video clips of female-specific, male-specific, and gender-common classical dance movements (Calvo-Merino et al. 2006). The results revealed that within the action observation network, the left dorsal PMC, the IPS, and the cerebellum responded specifically to motor familiarity of observed movements from the dancers' own repertoire when compared to visual familiarity of movements performed exclusively by the opposite gender.

A study that aimed to further differentiate the responsiveness of the action observation network to observational versus physical learning made use of a dance video game (Cross et al. 2009). The sixteen student participants, all without dance experience, physically trained short sequences of steps presented partly by abstract cues (arrows) and partly by a human demonstrator, and watched comparable sets of stimuli without practicing them physically, over five consecutive days. Brain responses to watching the trained cues along with similar untrained cues were measured using fMRI before and after the training days, and participants reported that they spontaneously engaged in mental imagery while watching the rehearsed sequences. The fMRI results revealed:

- greater activity in the right premotor cortex and left inferior parietal lobule (IPL, see Figure 2.3) in response to trained compared to novel sequences, and
- greater activity in the right premotor cortex in response to physically trained sequences compared to sequences learned from observation.

These findings provide evidence that observational learning and physical practice engage several parts of the action observation network (specifically premotor and inferior parietal regions) in a similar way, and that part of these regions is specifically responsive to physical training compared to observational learning.

The presented studies suggest that brain regions belonging to the action observation network are responsive to watching dance, and that their activity is modulated by the observer's own visual and motor experience of the observed movements, with physical practice enhancing the brain's responsiveness even more strongly than repeated observation.

## Watching Dance and Liking It

We stated previously that there is more to dance than just movement. In a similar way, we can argue that there is more to watching dance than just observing others performing more or less familiar actions—otherwise dance performances would not have an audience. There must be a reason why dance appeals to spectators, linking watching dance to wellbeing. Why and how an audience enjoys watching dance is not easy to pinpoint, given the various disciplines, styles, and artistic intentions. Dance can be beautiful, disturbing, touching, provocative, arduous, even terrifying; it can raise a multitude of emotions, making audience members feel happy, sad, angry, bored, contemplative, energetic, or exhausted. Interestingly, such emotional responses in the spectators can be evoked by the coordinated movement of human bodies. Neurocognitive research has developed a growing interest in the neural correlates of such positive emotional responses to watching dance, asking why spectators enjoy watching certain movements more than others, and how this is represented in their brains (see Christensen and Calvo-Merino 2013).

In an fMRI study that aimed at defining neural correlates of aesthetic evaluation of dance, scientists presented video clips of ballet and capoeira movements to six male participants who were naïve to both disciplines (Calvo-Merino et al. 2008). A year after the fMRI data were collected, the same participants were invited back for a questionnaire study. This time, they were presented the same dance clips and had to rate them in five aesthetic dimensions: how simple or complex, dull or interesting, tense or relaxed, weak or powerful they perceived each movement, and how much they liked or disliked it. From the participants' ratings, a general consensus was calculated for each movement and compared to the fMRI results. It turned out that high ratings for liking correlated with increased activity in the bilateral occipital (visual) cortices and in the right PMC, suggesting that these areas represent neural correlates of positive aesthetic experience of dance. Remarkably, no other aesthetic dimension from the questionnaire was significantly correlated to any brain response. The questionnaire also assessed movement characteristics related to aesthetic evaluation. It turned out that, according to the participants' consensus, full-body movements with strong horizontal or vertical displacement were liked best, whereas movements of single limbs without displacement of the body and without vertical variation were most disliked. This, however, represents only the preferences of the participants who took part in this study, and cannot be regarded as a general finding.

As shown by the previous study, the subjective assessment of liking can be used as a measure of aesthetic evaluation, and evidence for neural correlates of such personal preference has been found. A question that remains to be answered is what makes us like a dance movement or dance piece in general, beyond personal taste for certain movement characteristics. An fMRI study approached this question by linking the participants' aesthetic evaluation of dance movements to their estimation of their personal ability to perform the movements, thereby necessitating motor simulation (Cross et al. 2011). Twenty-two dance novices watched video clips of dance movements and had to

indicate for each movement how much they liked it and how well they thought they could reproduce it. Results revealed that the two ratings were not independent of each other; participants liked those movements best that they rated as most difficult to perform. Ratings for liking movements and perceiving them as difficult were correlated to activation in the right IPL and in occipitotemporal brain areas, including those involved in the visual processing of motion patterns and human bodies. These findings suggest that spectators specifically enjoy watching dance movements they perceive as demanding, and that liking movements and judging them as physically difficult share neural correlates. Interpreting these findings remains a challenge: did the participants like certain movements best because they perceived them as the most difficult, or did they like certain movements and therefore made the strongest effort to simulate them, which made them perceive these movements as the most difficult?

Neuroimaging techniques such as fMRI or PET can reveal correlations between behavioral tasks and brain activity (measured via blood flow and oxygen metabolism). Transcranial magnetic stimulation (TMS), in contrast, influences neuronal activity in the brain and can thereby be used to investigate causal relationships by showing that certain tasks cannot be performed while the correlating brain areas are briefly 'knocked out' by strong magnetic pulses. Rapidly changing magnetic fields applied with high precision by an electric coil induce weak electric currents in the brain tissue. These electric currents interfere with the neuronal activity in the target areas, which can lead to measurable effects on task performance, such as increased reaction times, or even different response behaviour. In a recent study, TMS was shown to interfere with aesthetic judgements of dance stimuli (Calvo-Merino et al. 2010). In this study, sixteen dance novices rated images of dance postures and abstract patterns, indicating how much they liked them. Later, the same task was repeated while TMS was applied to the participants' ventral PMC or to their extrastriatal body area (EBA, see Figure 2.3), a small region in the occipital cortex that is associated with the visual processing of human bodies and body parts. The ratings obtained before and after TMS application were compared, showing that ratings differed significantly for stimuli depicting dance postures, but not for abstract patterns. Interestingly, the direction of the effect was different for the two brain regions to which TMS was applied: TMS over the EBA resulted in higher ratings, whereas TMS over the PMC resulted in lower ratings compared to the baseline. The authors produced a model for explaining these findings, according to which the PMC processes rather configural aspects of human bodies, whereas the EBA processes local aspects. Disconnecting the configural processing area in the PMC via TMS should result in heightened aesthetic sensitivity via the EBA (the local processing area), thereby decreasing liking ratings. Disconnecting the local processing area, the EBA, should result in blunted aesthetic sensitivity via the PMC (the configural processing area), thereby increasing liking ratings.

Findings from the presented studies emphasize the importance of sensorimotor mechanisms for the aesthetic experience of dance, suggesting the existence of a complementary network that includes visual and motor regions. Notably, these studies used a subjective approach for evaluating aesthetic quality (i.e., liking) that enabled them

to examine which movements appealed most to their participants, rather than asking for objective movement characteristics. Information gained from such studies can be of interest for the dance community, as it reflects probable reactions of the audience, at least as far as a generally positive response is concerned. When choreographers aim at creating works which are aesthetically pleasant, they could use this information to anticipate which dance phrases would be perceived as such (Cross and Ticini 2012). The subjective nature of the aesthetic evaluation used in the presented studies also has potential relevance for exploring the aspect of wellbeing. These studies indicated that watching dance makes us feel good by engaging our brains more strongly in simulating the observed action, whether we are dancers or not.

## Conclusions

When we dance, a broad neural network that includes regions in almost every part of our brain is activated. This network comprises regions commonly involved in controlling complex motor action and also additional regions related to tasks that are special to dance, such as entrainment to music or rhythm. When we watch others dancing, many of these regions are also active—our brain engages in the dance even if our body remains motionless, by simulating the observed movements. The degree to which our brain becomes active while observing dance depends on our own dance experience—the more we dance ourselves, the more strongly the motor areas in our brain respond to watching dance. Furthermore, the degree of our brain's activity while watching dance depends on how much we like what we see, and this seems to be linked to how challenging we judge the dance to be. As evidenced by empirical studies, the experience of being totally absorbed by watching a sophisticated dance piece, feeling almost as if we were dancing ourselves inside the dancer's body, does have neural grounding.

Dancing and watching dance are intricately linked, not only in the way that action and perception are interconnected in our brains, but also ecologically. Dance enables social interaction and communication on levels far more basic than language—there is hardly any other type of human motor action that is so closely related to watching others and being watched. Nevertheless, in terms of how dance in the body, mind, and brain can contribute to wellbeing, this is not the full story. Even though social interactions do not necessarily require movements to be complex, dance implies highly coordinated and orchestrated movements based on creativity and cooperation, challenging our neurocognitive apparatus to integrate sophisticated physical and social skills. We can argue that dancing has a highly beneficial effect on our whole system, as it has the potential to integrate our most basic and most advanced skills on different levels into one activity that has the intrinsic goal to be enjoyed by actors and observers. Due to the nature of our neurocognitive apparatus, simply watching dance shares many qualities with active dancing, but not all. Dancing, which always includes watching dance, can stimulate the best part of our abilities, including social, communicative, and creative skills. A high

level of physical skill is less important for dance to have this beneficial effect; however, dancers who enjoy what they do will naturally be drawn toward acquiring more sophisticated and challenging movement skills.

Taken together, to make the most of dance for ourselves, we should first engage in some dancing activity that we personally enjoy, that involves creativity and social interaction, and that offers a way to reach a higher level of movement skill. Secondly, we should also at times engage in watching dance in an active way, simulating the dancers' movements and letting our mind dance while our body rests, and enjoy the way this perspective broadens our personal experience.

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CHAPTER 3

# SUBJECTIVE AND NEUROPHYSIOLOGICAL PERSPECTIVES ON EMOTION PERCEPTION FROM DANCE

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## Introduction

The appreciation of art is a subjective process often linked to emotional/hedonic experiences. Emotional responses have been intensively studied in the measurement of the aesthetic evaluation of art (e.g. Belke et al. 2010; Daprati et al. 2009; Di Dio and Gallese 2007; Vartanian and Goel 2004). The responses to art that are measured (pleasure and preference) reflect the observer's emotional feelings towards those works of art. The emotions aroused from viewing art are defined as 'aesthetic emotions', and these are claimed to be closely related to artistic appreciation. Positive emotions have been studied most in aesthetic psychological studies; for example, pleasure (e.g. Fechner 1876) and liking (e.g. Belke et al. 2010; Daprati et al. 2009; Di Dio and Gallese 2009; Vartanian and Goel 2004). However, some other studies indicate that negative emotions may also be associated with art appreciation, such as anger, disgust (e.g. Silvia and Brown 2007) and hostile emotions (Silvia 2009). Silvia (2005a, 2005b) introduced an appraisal model of emotions into the psychology of aesthetics, which posits a linear relationship between emotion and aesthetic judgement. Other models take into account a more complex relationship that includes emotional, aesthetic, and cognitive appraisal. The 'hedonic fluency model' (Reber et al. 2004) claims that the appreciation of artwork is not limited to the perception of object properties, but is also influenced by pleasant feelings arising from the observation of artwork, and is closely related to successful

cognitive processing. Leder et al. (2004) suggested that artistic experience may be based on the cognitive interpretation, with processing fluency leading to a feeling of aesthetic pleasure. They proposed an information-processing framework to explain why the appreciation of artwork is always accompanied by affective reactions. This multi-stage model involves different levels of processing: pre-classification, perceptual analyses, implicit memory integration, and explicit classification, as well as cognitive mastering and evaluation. Affective evaluation is continuously taking place, and impacts on the cognitive mastering process at each stage. In summary, according to this model, 'An aesthetic experience is a cognitive process accompanied by continuously upgrading affective states that *vice versa* are appraised, resulting in an aesthetic emotion' (Leder et al. 2004: 493).

These models are supported by studies in the Arts and Humanities, which have investigated appreciation and emotional responses. Considering the complexity of emotional reaction to art appreciation, qualitative research methods are often important approaches to understanding subjective feelings and audiences' individual experience involved in the appreciation process (Reason and Reynolds 2010). Neuroscience research has also started to shed light on the brain and body correlates of the arts appreciation and in particular the emotions evoked by arts, leading to the emergence of the field of neuroaesthetics (Di Dio and Gallese 2009). This research indicates that a network of brain structures involved in emotional processing is also associated with artistic appreciation (see Figure 3.1). These regions include the left anterior cingulate sulcus (see Devinsky et al. 1995 for a review), the insula and the amygdala (Phelps and

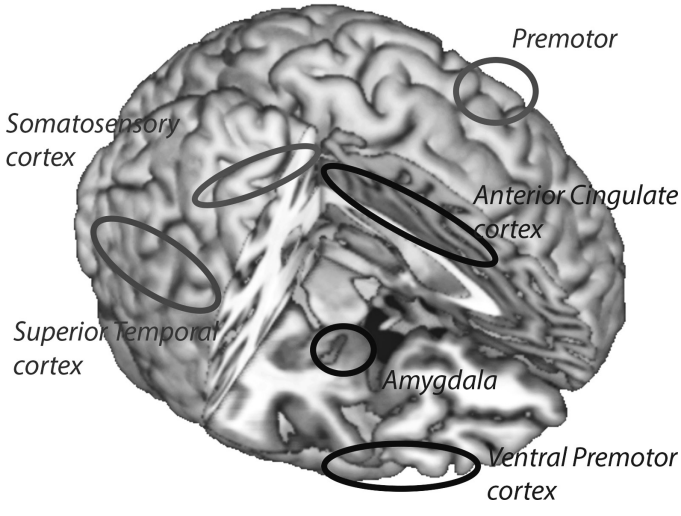


FIGURE 3.1. The network of brain structures involved in emotional processing and artistic appreciation. In black, regions commonly involved in emotion processing; in grey, regions commonly involved in person perception.

LeDoux 2005; Cupchik et al. 2009; also see Di Dio and Gallese 2009 as a review), the ventromedial frontal cortex (Calvo-Merino et al. 2005). Theses regions are activated in addition to regions involved in object or person perception in visual and premotor cortices (Calvo-Merino et al. 2006).

Empirical and theoretical work from all these fields of research (psychology, neuroscience, and qualitative audience research) support the idea that aesthetic experience is a complicated psychological state that involves multiple cognitive approaches, while emotional responses evoked from the experience are especially apparent and intermingled with different cognitive processes. In this context, the present study aims to provide a multidisciplinary account of the emotional response to dance. To this end we combine psychophysics, brain measures, and qualitative research to study the subjective emotions induced by watching dance. The originality of this approach offers a unique view of emotional engagement with dance, which could form the base for more applied research on dance as a mean of regulating emotions. Part of the data on which this paper is based has been published as a scientific report (Grosbras et al. 2012).

Dance is an art form that uses the dancer's body as a means to induce affective and aesthetic experience in the observers. It has been used in the field of qualitative audience research but also in psychology and cognitive neuroscience as a form of stimulus to study emotion perception (see also Blasing's chapter in this volume). Macfarlane, Kulka, and Pollick (2004) asked subjects to rate emotional valence after watching ten pieces of dance with different affects, and found that subjects were able to distinguish accurately the emotion portrayed by the dancers. This study, however, involved segments of dance, each 15 seconds long, with judgements of affective similarity made *after* the presentation of the videos. Yet emotional response to dance occurs in the immediacy and evolves as the dance performance unfolds (Jola et al. 2012). Thus in the present study we collected continuous ratings on a linear visual scale. Participants watched a 4-minute video constructed from the filming of a piece of contemporary dance choreographed for the purpose of the research project (Watching Dance n.d.), involving two dancers and three different music segments. They were asked to use a computer mouse to move a slider on a screen upwards when they felt positively aroused, and downwards when they felt a negative emotion. This provided us with a continuous rating of their subjective emotional response. We chose to focus only on valence and intensity rather than categorization of individual emotions (e.g. sadness, joy, fear, and so on) as those dimensions capture most of the experience of emotion and are less sensitive to interindividual differences in labelling feelings and emotions. Indeed, based on the circumplex model of affective experience—one of the most influential models in the field of emotion research (Russell 1980)—each emotion can be placed on a plan with the two bipolar dimensions representing valence (or pleasantness: positive or negative) and arousal (or activation, low or high). Importantly, both dimensions are independent and correspond well to the conscious experience or

perception of emotion (Pollick et al. 2001). While previous studies have collected only self-reported positive emotion responses to dance, in reference to this model we felt that using a bipolar slider—measuring not only positive but also negative emotional changes—was pivotal. Similar ratings of the aesthetic response were also obtained in order to test the relationship between affective and aesthetic impressions during the continuous watching.

We used these ratings to investigate how the subjective judgement of the emotion induced by the dance modulates the brain response to the dance. To this end we used functional magnetic resonance imaging (fMRI)—a technique that provides us with an indirect measure of brain regional activity, exploiting the fact that brain regions that are active receive an increased afflux of oxygenated blood, which in turn changes the magnetic signal in a way that can be measured. We relied on a parametric approach (Buchel, Morris, and Dolan 1998) to map the impact of emotion on the regional neuronal activity.

This experiment was complemented by two lines of investigation. First, in order to draw causal links between the identified functional brain regions and emotional appraisal, we conducted a non-invasive brain interference study using Transcranial Magnetic Stimulation (TMS). Indeed, fMRI shows where in the brain the activity is *correlated* with the perception of dance while subjects are watching the video. It does not tell us anything about the causal nature of this relationship. TMS is a technique that allows us to transiently and non-invasively perturb local brain activity (reviewed in Walsh and Rushworth 1999). If as a result we observe a change in behaviour, then we can infer that the brain region targeted with TMS is causally involved in the behaviour under investigation, and not just incidentally activated. It works by applying a rapidly changing focal magnetic field near the scalp of the participants, which depolarizes the nearby neuronal populations and thereby interferes with their activity. If applied repeatedly during several minutes the effect of altered activity can outlast the stimulation by 10–15 minutes. In this study we used TMS to ask whether a small and transient manipulation of the regions identified in fMRI could modify the emotional appreciation of dance. We then conducted a qualitative investigation probing participants' subjective reflections on their reaction to the dance, in order to obtain further insight into the meaning of their responses during the experiments.

In summary, the aim of this project was to investigate the neural correlates of the subjective emotional reaction to dance, using functional brain imaging and non-invasive brain interference to investigate a causal link between regional brain activity and the subjective emotional response. This was complemented by structured interviews prompting the participants to reflect on their ratings. This chapter will present and discuss some of these findings with regards to their relevance for understanding the links between emotion and cognition. In doing so we will draw a link with wellbeing. For the purpose of this chapter, wellbeing will be seen as a state of health and positive functioning, and we will argue that it is strongly dependent upon the harmonious integration between cognitive and affective processing at the brain level. We will speculate about how considering dance perception in this framework could offer new research avenues for interventions promoting wellbeing.