

# **Preface**

## **The Purpose of This Book**

Children in Africa face an astounding array of risk factors in their development, stemming from grinding poverty and from the myriad public health and educational challenges afflicting most of the continent. Because the developmental milieu for African children can vary so dramatically, this population provides fertile ground for the study of how brain/behavior development reflects both vulnerability and resilience in the face of impoverishment, war and displacement, and disease. Therefore, cross-cultural neuropsychology as applied to brain/behavior development in African children provides an excellent opportunity to further the frontiers of neurocognitive science in understanding how the human brain copes with pervasive developmental deprivation and stress within an ecosystem. This is the principal reason for this book.

This book is also very much needed for humanitarian reasons. It is only with advances in the field of cross-cultural neuropsychology with African children that biomedical science can discover evidence-based, effective, and sustainable ways of better protecting these children from significant brain/behavior injury. Cross-cultural neuropsychology will also provide the foundation for effective rehabilitation when such injury does occur. Of course, such advances will benefit not only African children but also children everywhere.

## **The Professional Pilgrimage Leading to the Inception of This Book**

Working as a graduate student “rat-runner” in a behavioral biopsychology laboratory in 1976, I (mjb) would never have anticipated a career someday as a fulltime researcher with African children in the public health domain. That pilgrimage began

that same year when I met my future wife, Grace, who was living in the USA and had planned to return to Africa with the Peace Corps after finishing university. Grace had grown up in the DR Congo where her father served for 35 years as a medical missionary and her mother as a school teacher. Through our courtship and marriage, Grace's upbringing in the Congo was an intriguing part of her past, but not relevant to my scientific and professional career goals at that time. Her Peace Corps volunteer plans evaporated as we married and began a family and as I settled into a career as a university psychology professor.

Ten years into our marriage and four children later, Grace's Africa past suddenly came to the forefront of our family life. She wanted to return as a family to Africa so that we could see her childhood "home" and the legacy of her parent's lifelong service before they retired from the mission field that following year. I did not want to travel to the DR Congo with our four young children, fearing for our health and safety. However, because of the support of a small overseas research grant from my university, and the generosity of Grace's parents, we were able to travel as a family to the Congo for a month-long stay at a small remote medical mission where Grace's parents lived, several hundred kilometers east of Kinshasa.

That month at this remote medical mission changed my life. My wife and I and our four small children spent that month with her parents at the medical mission of Moanza on the Inzia River in Bandundu Province, Zaire. While traveling that month to public health outposts with Grace's father and to villages with clean water due to the efforts of a newfound Peace Corps volunteer friend, David Anderson, I saw and felt a level of human need and suffering that I could never have imagined. It was then that I proposed to use whatever tools or skills I had to offer in brain/behavior science, to trying to make a difference in addressing that need.

It challenged me to find a way to make my scientific passion relevant to the needs of these children and led to my returning to the DR Congo a year later on a Fulbright research award to investigate the neuropsychological outcomes of various public health risk factors and interventions in the northern Bandundu Province. That year at the small medical mission of Kikongo in northern Bandundu Province solidified my commitment to finding ways to making neuropsychological science relevant to the public health needs of African children in low-resource settings. At the end of that Fulbright research year in August 1991, we left the country only weeks before Mobutu's army units began widespread looting in major cities, eventual anarchy and civil war, an invasion from Rwanda, and the ultimate collapse of the government of Sese Seko Mobutu.

This was the first of two Fulbright fellowships to Africa (Zaire 1990; Uganda 2003), a West African Research Association Fellowship (Senegal 1997), and as a PI on 6 NIH-sponsored research grants to Uganda. These activities eventually positioned Bruno Giordani and me to consider a book that could provide an overview of the research taking place on the neurodevelopment and neuropsychology of African children in low-resource settings.

## **Influences Shaping the Public Health Emphasis in the Neuropsychology of African Children**

Following my Fulbright year in the DR Congo, I pursued a master's degree in public health at the University of Michigan while continuing to teach fulltime in psychology at my home university. The plan was to return to Africa and to pursue a fulltime vocation in public health work with African children. As I pursued my M.P.H. degree following my Fulbright year in the DR Congo, my training and passion for brain/behavior science shifted fully towards a global health emphasis. My thesis topic was on the neuromotor disease called konzo, a disease in the DR Congo for insufficiently processed toxic cassava (Boivin 1997). In September 2011, I returned to the DR Congo after 20 years to begin a neuropsychological investigation of konzo, with the support of an NIH grant to Dr. Tshala-Katumbay, a neurologist from the DRC who is now at Oregon Health and Sciences University (see <https://vimeo.com/42317386> for a video overview of this study).

Working with my mentor in neuropsychology, Dr. Bruno Giordani, we evidenced this newfound professional trajectory with publications from my summer research experience in the DR Congo in 1989 (Boivin 1991) and from the year-long Fulbright award the following year (1990–1991) (Boivin and Giordani 1993; Boivin et al. 1993, 1995a, b, 1996; Giordani et al. 1996).

Following my MPH degree, I consulted with Penny Holding on her Kenyan-based study on the neuropsychology of cerebral malaria (Holding et al. 1999), and I returned to Africa for 2 months for a neuropsychology of cerebral malaria in Senegal in 1997 (as a West African Research Association fellow) (Boivin 2002, 2006). Dr. Holding has a chapter in this book on cerebral malaria, as does one of her former students (Dr. Abubakar) on malnutrition. Then in 2003, I received my second Fulbright research award, which allowed me to complete a year-long study on the neuropsychology and immunopathogenesis of cerebral malaria at Makerere Medical School/Mulago Hospital in Kampala, Uganda.

During that year, a partnership was formed among a core team of Ugandan and American researchers. This collaboration has been sustained to this day with the support of NIH grants. I acknowledge the dedication and support of Dr. Chandy John at the University of Minnesota; Drs. Paul Bangirana, Robert Opika Opoka, Noline Nakasujja, and Justus Byarugaba at Makerere University; and Ms. Esther Ssebyala at Global Health Uganda. Without their dedication and support, my second Fulbright year could never have succeeded, and our research program today could never have been realized. It is because of their friendship and support that my colleague and friend, Bruno Giordani, was able to be directly involved as a coinvestigator in our NIH-sponsored work in Uganda and that the dream for this book could be realized. Our Fulbright experience as a family in 2003–2004 in Uganda is available on the Fulbright website at [http://www.cies.org/stories/s\\_mboivin.htm](http://www.cies.org/stories/s_mboivin.htm).

Paul Bangirana, who was my first research assistant during that Fulbright year in Uganda, eventually went on to earn his Ph.D. in neuropsychology (Uganda's first) and has a chapter in this book as well. Thanks to a recent NIH D43 training grant

embedded within our malaria research program at Makerere/Mulago, we now have support for the Ph.D. training in neuropsychology for two more Ugandans, and this book will be one of the resources for their training.

Because of this Fulbright research award (Uganda, 2003–2004) as well as an NIH/Fogarty R21 grant (PI: John), we were able to publish pioneering research in the neuropsychology and immunopathogenesis of cerebral malaria (Boivin et al. 2007; John et al. 2008a, b). The role these colleagues played in eventually making possible this book is also evidenced by the cerebral malaria publications of our research group in leading journals and our presentations at many international and national meetings (Bangirana et al. 2009; Bangirana et al. 2006; Boivin et al. 2007, 2008; John et al. 2006, 2008a, b, c).

## **Student Collaborators and the Further Formation of This Book**

Since my coming to Michigan State University in 2006, Bruno Giordani and I have had the opportunity to bring graduate and medical students from our respective universities to Uganda for summer research internships. The Ugandan-based research efforts of those students in our NIMH-sponsored pediatric HIV research programs have blossomed into several chapters in this book (Chaps. 5 and 6 by Dr. Rachelle Busman; Chap. 7 by Erin Lorencz). Other significant presentations and publications have come out of their work (Boivin et al. 2008; Boivin et al. 2010a, b). Her doctoral dissertation work with HIV orphans in Malawi is represented in Kim Ferguson's chapter, and other chapters represent joint authorship and collaboration between senior scholars and their students (e.g., Chaps. 3, 8, 10, and 15). This volume represents an excellent balance among more established senior investigators who pioneered neurodevelopmental research in African children (e.g., Dr. Jane Kvalsvig) and some of the best and brightest of a new generation of African child development scholars and researchers who have taken the lead in their own chapter contributions (e.g., Drs. Abubakar, Kihara, Bangirana, and Ferguson).

Because of the pandemic of HIV disease and severe malaria across the sub-Saharan of Africa, neuropsychological studies of affected children have multiplied over the past two decades especially. The scientific literature related to the developmental effects of these and other tropical diseases has blossomed to the point where a book is very much needed to organize and interpret the state of the science. This book fills this gap in the scientific literature by providing a review of the neuropsychological research literature in African children as affected by major diseases such as HIV and severe malaria, malnutrition, sickle-cell disease, and other pervasive medical and social risk factors. Our book provides a hopeful dimension by providing evidence of the neuropsychological benefit of public health therapeutic interventions that have occurred in response to these developmental threats.

## **Biocultural Co-constructivism as the Organizing Framework for This Book**

As we interpret the various chapters related to the neuropsychological effects of disease and deprivation on brain/behavior development of African children, we will use the “co-constructive” paradigm (Li 2003). This paradigmatic approach was applied to a review of portions of the pediatric neuropsychology literature related to HIV and to severe malaria in a recent chapter by Boivin and Giordani (2009). This chapter provides the framework for the present book proposal. Cross-level dynamic biocultural co-constructivism is a holistic multidimensional approach that emphasizes reciprocal biocultural influences across the life span. It also emphasizes the reciprocal interaction of culture and the genome in shaping brain/mind at multiple levels: neurobiological, cognitive, behavioral, and sociocultural (Li 2003). The successive chapters and sections of our book address each of these levels in practical and innovative ways.

The concept of neuroplasticity in human development is central to the dynamic biocultural co-constructivist paradigm, and this concept will drive our understanding of how risk, resilience, and rehabilitation occur for African children. These constructs are particularly relevant when considering the array of ecological stressors of pervasive disease and deprivation encompassed within this book. The book addresses how cross-cultural neuropsychology in healthy and diseased brains, brain imaging technologies, and genomic research can triangulate the manner in which a universal brain/behavior omnibus drives plasticity across the life span. As such, the further scientific characterization of the brain/behavior development of African children can provide a vital lynchpin between biology and culture in Li’s co-constructive paradigm. Ultimately, this has the potential of revolutionizing our understanding of neurocognitive development and culture.

This volume was inspired by a conceptual overview of our African-based neuropsychological assessment work in severe malaria and in HIV (Boivin and Giordani 2009). The chapter was entitled “Neuropsychological Assessment of African Children: Evidence for a Universal Brain/Behavior Omnibus Within a Co-constructivist Paradigm.” It was published in an edited volume of *Progress in Brain Research* dedicated to the theme of cross-cultural cognitive neuroscience (J.Y. Chiao, Ed.). Our chapter was the only one that focused on African children.

At that point, we decided that a book was needed that would compile and organize a sample of the immense wealth of neurodevelopmental/neuropsychological research emerging from this continent. This book is the first of its kind, providing an integrated conceptual overview and interpretation of what we consider to be some of the best of what this emerging field has to offer, contributed by an all-star cast of its leading scientists and scholars. Dr. Elaine Fletcher-Janzen, the editor for the Springer Publishers Series in cross-cultural neuropsychology, believes that this book will be a “seminal” work for developmental brain/behavior science in general. We agree with this assessment, not because of our efforts but because of the outstanding contributions from the chapter authors who represent the leading scientists and scholars in the field of the neurodevelopment of African children. They present

their work with clarity, rigor, innovation, and humanitarian concern for the well-being of African children.

The foundational premise of this book is that neuropsychology has the tools to provide a sensitive, sensible, and consistent methodology for characterizing patterns of risk and resilience in the brain/behavior development of African children. This premise is borne out evidentially in successive chapters as neurodevelopmental and neurocognitive performance is evaluated for children at risk from HIV, malaria, malnutrition, sickle-cell disease, and other public health risk factors. These brain-behavior disease processes are also modified in a consistent manner cross-culturally by quality of developmental milieu and caregiving. Later chapters present findings from the pioneering use of computerized cognitive rehabilitation therapy (CCRT) with Ugandan children surviving CM and with HIV. This neuropsychological evidence that CCRT enhances positive brain plasticity in a consistent manner across cultures supports the “co-constructive” paradigm (Li 2003), since plasticity across the life span is the hallmark of this approach.

In the final chapter, we summarize and interpret the principal scientific and theoretical contributions of the chapters using the concept of a brain/behavior omnibus. This metaphor is proposed as a way to conceptually interface foundational neuropsychological functions consistent across cultures, with cognitive tendencies and abilities more readily shaped by ecological necessity and cultural experience. We also believe that future cross-cultural neuropsychological research will describe and substantiate the explanatory power of the construct of a universal brain/behavior omnibus.

In conclusion, we posit that it is critical that any neuropsychological assessments applied across cultures be based on the latest cognitive neuroscience and neuroimaging research. This is because the cross-cultural application of neuropsychology assessments has provided a means of methodologically triangulating the omnibus. It does so by using more dynamic assessments across various cultural groups, along with neuroimaging and genomic technologies in both impoverished and resource-rich settings. Cross-cultural neuropsychology, brain imaging, and genomic technologies together can elucidate a brain/behavior omnibus foundational to human plasticity across the life span. The integration of these approaches can provide a powerful new paradigm in understanding the relationship between the developing brain, culture, and cognitive ability. Such a paradigm can help us better understand how, across the life span, ecological necessity sculpts culturally specific cognitive ability profiles, doing so upon a universal brain/behavior omnibus.

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