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Introduction

Kelly Tremblay and Robert Burkard

WHY ANOTHER HEARING SCIENCE BOOK?

The term “hearing science” has come to mean many different things. Virtually anything related to hearing that has a scientific basis could be included in a book so labeled, so the term “translational” in the title might help clarify what we intended to include. In the editors’ opinion, “translational research” was a term coined to give underrepresented clinical research a chance to develop in a research world that is dominated by two ends of the research continuum: cellular and molecular experiments (i.e., reductionistic work) and (on the other end of the continuum) clinical trials. Our definition hints at the disconnect between basic and clinical scientists that has become a topic of discussion in scientific (Declan, 2008) as well as mainstream media (*Newsweek*, 2010). Despite a common mission to improve hearing health care, basic and clinical scientists ask very different questions, use very different approaches, and belong to very different cultures (Figure 1–1). Moreover, even though evidence at the cellular or molecular end could manifest itself into rehabilitation treatments, and observed clinical behaviors could better define biological processes, information can get lost when there is no translation.

This book addresses a mission to improve dialogue between the two cultures of science so that health-related science can translate in many directions: from bench to bedside and vice versa. The editors of this book are two examples of people who have managed to straddle the chasm illustrated in Figure 1–1, but not without struggle. We are clini-

cal audiologists as well as classically trained hearing scientists, who, putting politics aside for a moment, are committed to the advancement of “translational research.” To do this we approached colleagues who work along each step of the scientific continuum, from basic to applied, and asked them to provide information that was theoretically deep, but contextually

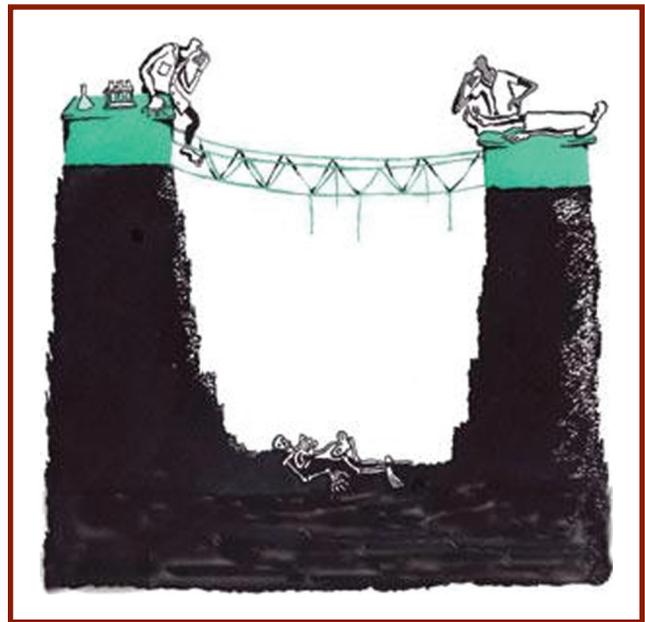


Figure 1–1. Translational research: Crossing the valley of death—A chasm has opened up between biomedical researchers and the patients who need their discoveries. *Source:* From B. Declan, 2008, “Translational Research: Crossing the Valley of Death,” *Nature*, 453, 840–842. Reprinted with permission from *Nature*.

broad. In some instances this meant pairing authors who normally would not write together and asking them to co-author chapters. We also included a diverse group of students, postdoctoral researchers, and scientists to interact with the authors by asking questions and infusing comments during the review process. This process ensured that both basic and applied material would be integrated. One example is the final chapter in the third book in this series, on auditory plasticity and auditory training. Rather than simply review evidence of experience-related physiologic changes documented in animal models, the authors chose to address the functional significance of “auditory plasticity” as it pertains to “auditory learning.” By simply revisiting the concepts of “plasticity” in relation to “learning” there has been a resurgence of interest in the area as it pertains to auditory rehabilitation. For those of us who are monists philosophically, brain function must underlie all behavioral changes, and hence there is no surprise that as long as we can learn, and adapt our behavioral responses, then of course the brain is somehow changing (and hence is “plastic”). So here the challenge was to present the literature in a way that allowed us to ask the tough questions like, “Does a statistically significant change in perception (or biology) necessarily constitute a functionally relevant change in behavior?” More importantly, “Do the observed changes impact a person’s ability to communicate? And does it impact their quality of life?”

This compendium is a three-book series. We begin the first book, *Normal Aspects of Hearing*, with a chapter in acoustics because we need to provide an acoustic (or similar) stimulus in order to study the physiologic or perceptual response. Describing a response in the absence of a complete and unambiguous description of the stimulus makes it impossible to interpret the response. The next nine chapters in the first book describe the anatomy and physiology of the peripheral and central auditory systems in a rather traditional manner: from caudal through rostral levels, ending with the descending auditory system. Note that these chapters, for the most part, review topic areas that are best considered basic research. However, the final section of *Normal Aspects of Hearing* is an attempt to tie perception to the underlying physiologic responses, and chapters are parsed into stimulus factors (such as

intensity, frequency, binaural stimulation, and complex sounds). We are reminded that the mind-body problem is a formidable obstacle to relating what we know about brain activity to what we know about human perception.

The second book, *Hearing Across the Life Span—Assessment and Disorders*, reviews what we know about the developing auditory system, what happens as we age, as well as a brief synopsis of the disordered auditory system. These aspects of human perception are then extended by the discussion of state of the art noninvasive physiologic measures of hearing. Many of these measures are tools used to assay the auditory system in applied research studies, as well as used in the clinical evaluation of subjects.

The third book, *Special Topics*, interweaves both basic and applied research, and hence provides “translational” perspectives on “hot topics” in hearing science.

WHO ARE THESE BOOKS FOR?

Perhaps you are thumbing through this book series, trying to figure out if you should buy it. Is this book for you? Should you use it to teach a class on the anatomy/physiology of hearing? The answer rests, in part, with who you are. If you are already a neuroscientist or clinician scientist and interested in cross-training, then these books are for you. The series should serve as a source of knowledge that is both deep and broad, presenting current theory within a clinical context so one can learn to appreciate what rests on the other side of “death valley.” If you are a neuroscientist teaching in a neuroscience program, and planning on teaching a course on hearing, the first book in the series may not be appropriate for you. The spirit of the book was to move beyond reductionism (i.e., the molecular and cellular level) so your students will need to acquire their basic biochemistry, molecular genetics, ionic bases of excitation, as well as general anatomy/physiology, from other sources. Once that foundation is in place, students can expand their understanding by going through the first book in the series. If you are teaching audiology students, then the first book in the

series could serve as a course on the anatomy and physiology of the auditory nervous system. Generally speaking, audiology students usually have a course on acoustics/instrumentation, and the anatomy of the auditory periphery is usually considered in a basic audiology site-of-lesion course. Hence, Chapters 4 through 11 in *Normal Aspects of Hearing* would serve as a good basis for such a course. Although there are other sources of reviews of the central auditory nervous system, we have attempted to make these chapters understandable to those with limited neuroscience background, while making them accurate and reasonably up to date. *Hearing Across the Life Span—Assessment and Disorders* and *Special Topics* are intended to relate the more basic scientific knowledge about the auditory system to more clinical aspects of the discipline. These books should be used as the basis for detailed class discussions. They should be thought provoking, and, in some instances, controversial. They should serve as a catalyst for term papers, updated literature reviews, and research projects. As these fields mature, no doubt some controversial statements will be proven true or false, or even rendered irrelevant, as the purpose of science is to continually update our current state of knowledge.

Some of the “translational” chapters in *Hearing Across the Life Span—Assessment and Disorders* and *Special Topics* at least briefly extend into the realm of clinical practice. Students from clinical disciplines will note that there is often a dearth of experimental evidence that a specific therapeutic approach actually leads to improved function for a given clinical

population. We hope that such gaps in knowledge will be addressed in your future clinical research efforts. The results of these future research efforts will form the basis of truly evidence-based practice in our clinical professions.

Acknowledgments. A few words of thanks are in order. These books reflect the collective wisdom (and writing skills) of the many authors who contributed to the various chapters. Although textbooks typically are poor in character development, it is the efforts of these authors that make these book useful (or not) to educate and, one hopes, inspire those students who read these books.

Several students, post-docs, clinicians, and scientists at the University of Washington read the various chapters, offered editorial comment, and crafted many of the questions posed to the authors at the end of each chapter. A special thanks to Hannah Martin who assisted with copy editing, and Lindsay DeVries who provided editorial comments as well as managed many of the administrative duties that are involved with producing a book. We would also like to say a special thanks to Kristin Swenson-Lintualt for creating the cover artwork used in this book.

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