To Mr Mallenson, who lent me Magee's "Popper" when I was in Imberhorne's Sixth Form, and to Jonck, whose witty and profound comments on this manuscript I could sadly never hear.

Preface

The aim of the book is to address those issues in the philosophy of science, including the conceptual basis of statistical inference, that have a direct bearing on the practice of psychological research. The book will enable lecturers teaching critical thinking, research methods, or the new British Psychological Society's core area 'conceptual and historical issues' to cover material that every psychology undergraduate should know, but does not. The book will also be valuable for masters students, PhD students, and experienced researchers.

The book is organized around influential thinkers whose admonitions and urgings are heard in the head of every research psychologist. The core arguments surrounding Popper, Kuhn, Lakatos, Fisher, Neyman and Pearson and Bayes are still live, heated, important and potentially within the grasp of every psychology undergraduate. Further, key points of the Neyman-Pearson approach are deeply misunderstood even by seasoned researchers in ways that can reflect badly on their research decisions. The best place to uproot these misconceptions is right at the undergraduate level, but I found no other existing book suitable for this purpose. Further, there is a live debate on whether psychologists even should be following the orthodoxy of Neyman-Pearson. Few psychologists have an opinion on this matter (which has important consequences for how research is conducted and evaluated) because they have not been exposed to the issues (and mostly do not realize there are any issues). There is a large and growing literature on the confusions and misuse of orthodox statistics, and what the alternatives might be. But the clarifications have not percolated through to ground level. The reason is that the literature is largely technical and read only by the aficionado. The very people who need to know it are just the people who don't read it. What has been missing is a simple (though not simplistic) introduction showing conceptually how the characteristics of the different approaches arise from first principles. There has been a gap in our education that has existed far too long. To paraphrase Phil Johnson Laird's famous quip, I hope the current book helps fill this much unwanted gap. (I leave the task of my writing books filling much *needed gaps* to other occasions.) In any case, if my role in all this is to start corrupting undergraduates at a young age, the cat will be let out of the bag. I think the sooner the conceptual issues underlying inference form a part of the undergraduate's education in research methodology, the better.

The first two chapters cover classic philosophy of science (Popper, Kuhn, Lakatos) in a way accessible to psychologists while avoiding the normal textbook caricatures. The aim is to appreciate the depth of these authors so their ideas provide real tools for thinking about research. Examples are drawn from psychology and practical advice given.

The next three chapters motivate the reasoning behind statistical thinking. Chapter three covers the Neyman Pearson approach, i.e. the logic meant to underlie the statistics in every textbook for psychology students. It is a sad fact – indeed, a scandal - that few undergraduates, PhD students or lecturers actually understand the logic of hypothesis testing (with or without Fisherian

twists). The Neyman Pearson logic will not be fully grasped until alternatives are also presented. Many people instinctively believe they are getting Bayesian or likelihood answers to Neyman Pearson statistics. This basic confusion more than any other probably underlies the widespread misuse of significance testing. So chapter four shows the logic of Bayesian inference, the opposite of Neyman Pearson in fundamental ways. The book's website (http://www.lifesci.sussex.ac.uk/home/Zoltan_Dienes/inference/) includes a program that can be used for analyzing data in a Bayesian way. Finally, the logic of the third major school of statistical inference, likelihood inference, is presented and motivated in chapter five. Chapter five shows how to use likelihood inference in practice and how it leads to different research decisions than the other schools. The book's website also includes programs for conducting likelihood analyses.

None of the chapters on statistics assume mathematics beyond that necessary for an undergraduate course in statistics as run in an average psychology department. The chapters aim only to provide foundational concepts and link them to practical research decisions. The arguments for each school are presented conceptually so for the first time the average user of statistics can start making informed decisions – and accept or reject orthodoxy on a rational basis.

I wish to warn the psychology undergraduate reader that the material may at first appear daunting as it will require thinking in new ways. Persistence will bring reward. Do not deride your own intellectual reactions; the interesting thing about philosophy is that whatever view you hold on a topic, there is bound to be some very eminent philosopher who holds a similar view. In many cases, I am not giving you settled answers. Be confident in thinking through your own arguments. However, the multiplicity of views does not mean nothing has been achieved in philosophy nor that all views are acceptable. On the contrary, having understood the issues discussed in this book you will evaluate and practice research in ways you could not have done before. Whatever decisions you come to on the open issues, you will become a far better researcher and evaluator of research having thought about the issues in this book.

If in reading this book you feel confused at times, that is a very good sign. Confusion means you have found a way to arrive at a deeper understanding. Value that feeling. Confusion is not the end goal of course, it is a sign post for what to think about and a spur to think it through now because your mind is ripe. While I hope to confuse you, I also hope I have given you what you need to subsequently gain clarity. Any confusion caused by errors or omissions on my part is not good, and I will endeavor to correct them in any future editions. You can contact me on dienes+inference@sussex.ac.uk.

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Zoltán Dienes
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