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Advances in Meta-Analysis

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Advances in Meta-Analysis

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To Jenny and Alison,
who make it all worthwhile.

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Chicago, IL, USA Terri D. Pigott

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Chapter 1
Introduction

Abstract This chapter introduces the topics that are covered in this book. The goal of the book is to provide reviewers with advanced strategies for strengthening the planning, conduct and interpretations of meta-analyses. The topics covered include planning a meta-analysis, computing power for tests in meta-analysis, handling missing data in meta-analysis, including individual level data in a traditional meta-analysis, and generalizations from a meta-analysis. Readers of this text will need to understand the basics of meta-analysis, and have access to computer programs such as Excel and SPSS. Later chapters will require more advanced computer programs such as SAS and R, and some advanced statistical theory.

1.1 Background

The past few years have seen a large increase in the use of systematic reviews in both medicine and the social sciences. The focus on evidence-based practice in many professions has spurred interest in understanding what is both known and unknown about important interventions and clinical practices. Systematic reviews have promised a transparent and replicable method for summarizing the literature to improve both policy decisions, and the design of new studies. While I believe in the potential of systematic reviews, I have also seen this potential compromised by inadequate methods and misinterpretations of results.

This book is my attempt at providing strategies for strengthening the planning, conduct and interpretation of systematic reviews that include meta-analysis. Given the amount of research that exists in medicine and the social sciences, policy-makers, researchers and consumers need ways to organize information to avoid drawing conclusions from a single study or anecdote. One way to improve the decisions made from a body of evidence is to improve the ways we synthesize research studies.

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Much of the impetus for this work derives from my experience with the Campbell Collaboration, where I have served as the co-chair of the Campbell Methods group, Methods editor, and teacher of systematic research synthesis. Two different issues have inspired this book. As Rothstein (2011) has noted, there are a number of questions always asked by research reviewers. These questions include: how many studies do I need to do a meta-analysis? Should I use random effects or fixed effects models (and by the way, what are these anyway)? How much is too much heterogeneity, and what do I do about it? I would add to this list questions about how to handle missing data, what to do with more complex studies such as those that report regression coefficients, and how to draw inferences from a research synthesis. These common questions are not yet addressed clearly in the literature, and I hope that this book can provide some preliminary strategies for handling these issues.

My second motivation for writing this book is to increase the quality of the inferences we can make from a research synthesis. One way to achieve this goal is to improve both the methods used in the review, and the interpretation of those results. Anyone who has conducted a systematic review knows the effort involved. Aside from all of the decisions that a reviewer makes throughout the process, there is the inevitable question posed by the consumers of the review: what does this all mean? What decisions are warranted by the results of this review? I hope the methods discussed in this book will help research reviewers to conduct more thorough and thoughtful analyses of the data collected in a systematic review leading to a better understanding of a given literature.

The book is organized into three sections, roughly corresponding to the stages of systematic reviews as outlined by Cooper (2009). These sections are planning a meta-analysis, analyzing complex data from a meta-analysis, and interpreting meta-analysis results. Each of these sections are outlined below.

1.2 Planning a Systematic Review

One of the most important aspects of planning a systematic review involves formulating a research question. As I teach in my courses on research synthesis, the research question guides every aspect of a synthesis from data collection through reporting of results. There are three general forms of research questions that can guide a synthesis. The most common are questions about the effectiveness of a given intervention or treatment. Many of the reviews in the Cochrane and Campbell libraries are of this form: How effective is a given treatment in addressing a given condition or problem? A second type of question examines the associations between two different constructs or conditions. For example, Sirin's (2005) work examines the strength of the correlation between different measures of socio-economic status (such as mother's education level, income, or eligibility for free school lunches) and various measures of academic achievement. Another emerging area of synthesis involves synthesizing information on the specificity and sensitivity of diagnostic tests.