Research Paper Education

What is Meta-Analysis?

* Marzieh Ghobadi Pour

* Research scholar, the University of Mysore, Mysore

ABSTRACT

This article has indicated briefly about meta-analysis. As one of quantitative researches, meta-analysis is a method for systematic literature reviews on a certain substantive question of interest. It is a general set of procedures for combining the results of many individual research studies addressing a single question and has a lot of debates around itself.

Keywords: meta-analysis, quantity research

Introduction

Mahoney (1985) announced that research literature, it is often pointed out, is growing at an exponential rate. One study estimated that there are 40,000 journals for the sciences, and that researchers are filling those journals at the rate of one article every 30 seconds, 24 hours a day, and seven days a week (cited in The Meta Analysis of Research Studies n.d). No matter what the topic—from computer-aided instruction to sex differences to the effects of medication on hyperactivity—researchers can, in just a few years, add dozens and even hundreds of studies to the literature. As research results accumulate, it becomes increasingly difficult to understand what they tell us. It becomes increasingly difficult to find the knowledge in this flood of information. The human mind is not equipped to consider simultaneously a large number of alternatives. Unable to deal with the large number of studies on a topic, reviewers focus on a small subset of studies, often without describing how the subset was selected. Reviewers often cite the conclusions of previous reviews without examining those reviews critically. Reviewers are usually active and prominent in the field under review. Therefore, they might not be inclined to give full weight to evidence that is contrary to their own positions (Lyons, 1998 cited in The Meta Analysis of Research Studies n.d).

In 1976, Gene Glass proposed a method to integrate and summarize the findings from a body of research. He called the method meta-analysis. Meta-analysis is the statistical analysis of a collection of individual studies. Glass (1976) said "Meta-analysis refers to the analysis of analyses. I use it to refer to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies which typify our attempts to make sense of the rapidly expanding research literature."

In a meta-analysis, research studies are collected, coded, and interpreted using statistical methods similar to those used in primary data analysis. The result is an integrated review of findings that is more objective and exact than a narrative review.

The typical review concludes that the research is in horrible shape; sometimes one gets results, sometimes one doesn't. Then the call is sounded for better research designs, better measures, and better statistical methods—in short, a plaintive wish that things were not as complicated as they are (Glass, 1976).

Meta-analysis is the statistical synthesis of the data from a set of comparable studies of a problem, and it yields a quantitative summary of the pooled results. It is the process of aggregating the data and results of a set of studies, preferably as many as possible that have used the same or similar methods and procedures; reanalyzing the data from all these combined studies; and thereby generating larger numbers and more stable rates and proportions for statistical analysis and significance testing than can be achieved by any single study. In these applications, meta-analysis is defined as the systematic, organized, and structured evaluation of a problem of interest. The essence of the process is the use of statistical tables or similar data from previously published peer-reviewed and independently conducted studies of a particular problem. It is most commonly used to assemble the findings from a series of randomized controlled trials, none of which on its own would necessarily have sufficient statistical power to demonstrate statistically significant findings. The aggregated results, however, are capable of generating meaningful and statistically significant results (Dickerson & Berlin, 1992).

Meta-analysis leads to a shift of emphasis from single studies to multiple studies. Modern statistical meta-analysis does more than just combine the effect sizes of a set of studies. It can test if the outcomes of studies show more variation than the variation that is expected because of sampling different research participants. If that is the case, study characteristics such as measurement instrument used, population sampled, or aspects of the studies' design are coded. These characteristics are then used as predictor variables to analyze the excess variation in the effect sizes. Some methodological weaknesses in studies can be corrected statistically. For example, it is possible to correct effect sizes or correlations for the downward bias due to measurement error or restriction on score ranges.

Meta-analysis can be done with single-subject design as well as group research designs. This is important because much of the research on low incidents populations has been done with single-subject research designs. Considerable dispute exists for the most appropriate meta-analytic technique for single subject research (Van den Noortgate & Onghena, 2007).

Meta-analysis may be broadly defined as the quantitative review and synthesis of the results of related but independent studies. The objectives of a meta-analysis can be severalfold. By combining information over different studies, an integrated analysis will have more statistical power to detect a treatment effect than an analysis based on only one study.

The objectives of a meta-analysis include increasing power to detect an overall treatment effect, estimation of the degree of benefit associated with a particular study treatment, assessment of the amount of variability between studies, or identification of study characteristics associated with particularly effective treatments. Meta-Analysis is applied and basic research. Meta analysis is also widely used in basic research to evaluate the evidence in areas as diverse as sociology, social psychology, sex differences, finance and economics, political science, marketing, ecology and genetics, among others. As in primary research, a meta-analysis begins with a well-formulated question and design. What are the study objectives? Is the objective of the study to validate results in a broader population?

An often- recommended technique is the use of effect sizes to describe the practical significance of a statistical test result (Vaske , Gliner & Morgan , 2002). When the treatment effect (or effect size) is consistent from one study to the next, meta-analysis can be used to identify this common effect. The effect size, a value which reflects the magnitude of the treatment effect or (more generally) the strength of a relationship between two variables, is the unit of currency in a meta-analysis. When the effect varies from one study to the next, meta-analysis may be used to identify the reason for the variation. Meta-analysis reviews show a strong, dramatic pattern of positive overall effects that cannot readily be explained as artifacts of meta-analytic technique or generalized placebo effects. Moreover, the effects are not so small that they can be dismissed as lacking practical or clinical significance. Although meta-analysis has limitations, there are good reasons to believe that its results are more credible than those of conventional reviews and to conclude that well-developed psychological, educational, and behavioural treatment is generally efficacious (PsyclNFO Database Record (c) 2010 APA).

The measures for effect size are Cohen's d, the Pearson correlation coefficient r, odds ratios or risk rates. Typically, the choice of measure depends on the conventions of the research discipline and is not based on statistical reasoning. For example, the correlation coefficient is typically chosen to represent the size of a relationship and Cohen's d is used to quantify the degree of difference between group means; however, the correlation coefficient, Pearson's r, can be used to quantify differences between means (Rosenthal, 1991; Field & Hole, 2003). All effect size estimates represent a standardized form of the size of the observed effect, and most can be easily transformed into a different metric and back again (Rosenthal, 1991)

The first step in meta-analysis is to express the effect in each study in a uniform way. So, if we decide to use r as our effect size measure, we would need to look at each study and use the data to calculate the value of r (Field, 2000). Effect sizes are influenced by the quality of the research. In its simplest form, meta-analysis doesn't take account of the measurement reliability, range differences, or the general quality of research. Hunter and Schmidt (1990) have suggested statistical techniques for correcting for measurement error and range variation.

Meta- analysis methods fall into three broad categories.

1- The purely descriptive methods (the Glass methods and study effects meta-analysis methods) paint a descriptive picture of what is in the research literature
2- Tests of homogeneity: that addresses only the artifact of sampling error. These include the homogeneity test- based methods of Hedges and Olkin (1985) and Rosenthal, Rubin and Rosnow (1982).These methods do not address the effects of artifacts other than sampling error. In particular, they do not address measurement error.
3- Psychometric meta-analysis: Finally, there are meta-analysis methods that address and correct for the effects of not only sampling error but also a variety of other artifacts that distort study results. These methods estimate the results that would have been obtained had all the studies been conducted in a methodological unflawed manner. These methods called psychometric meta-analysis methods. Hunter& Schmidt (1990); Callender & Osburn (1980) method, & Raju & Drasgow (2003) have made important contributionin psychometric methods. All the methods have now been labled "meta-analysis" but each method has its own specific idiosyncrasy.

Conclusion

Reviews of research have been valuable to many fields, but when presented and described only qualitatively, the results of conflicting studies can be confusing (SLUB Dresden, 2007). The quantitative procedures of meta-analysis help to address some of the challenges introduced by the existence of multiple answers to a given research question. Meta analysis allows the combining of numerical results from a few or many studies, the accurate estimate of descriptive statistics (Rosenthal, 1978) and the explanation of inconsistencies as well as the discovery of moderators and mediators in bodies of research findings.

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