Synthesis and Computation of Precise Effects: A Meta-Analytical Approach

Peng Lu
979-845-2953
Peng.lu@ag.tamu.edu

Alexis Zickafoose
937-509-1768
alexis.zickafoose@ag.tamu.edu

Jean Parrella
979-845-2954
jparrella@tamu.edu

Matt Baker
979-845-6944
mathew.baker@ag.tamu.edu

Amber Chambers
979-458-2304
amberchambers@tamu.edu

Jaehyun Ahn
979-458-0193
hyun81219@tamu.edu

Holly Leggette
979-458-3039
holli.leggette@ag.tamu.edu

Department of Agricultural Leadership, Education & Communications
Texas A&M University
600 John Kimbrough Blvd
2116 TAMU
College Station, TX 77843

Synthesis and Computation of Precise Effects: A Meta-Analytical Approach

Introduction/Need for Innovation

Conflicting findings reported in quantitative studies propose a challenge for researchers to generate a precise full estimate of interventions or relationships regarding studied phenomena. "At present, too many research results in education are blatantly described as significant, when they are in fact trivially small and unimportant" (Carver, 1993, p. 287). Also, statistical significance only provides a partial interpretation of effect and is influenced by sample size (Kirk, 1996). Meta-analysis is a quantitative approach that aims to synthesize preexisting studies and compute a generalizable and precise effect (Lipsey & Wilson, 2001). Also, meta-analysis can "allow us to diminish our reliance on statistical tests from individual studies" (Newton & Rudestam, 1999, p. 281).

Meta-analysis computes a value as effect size to overcome the biases of narrative reviews (Lovell & Kosten, 2000). Performing meta-analysis is based on mathematic and statistical rules, so conclusions are drawn transparently and less influenced by authors' implicit bias (Borenstein et al., 2009). In addition, integrating a multitude of quantitative evidence to generate an objective measure can help researchers discern existing contradictory results (Borenstein et al., 2009). Glass et al. (1981) indicated, "A meta-analysis seeks a full, meaningful statistical description of the findings of a collection of studies, and this goal typically entails not only a description of the findings in general but also a description of how the findings vary from one type of study to the next" (p. 79). This methodological approach is an accepted form of secondary data analysis in the social sciences which provides the highest level of accurate evidence (Cook, 1974, 1992; Glass, 1976, 1981; Hedges & Olkin, 1985).

How It Works/Methodology/Steps

In this research approach, meta-analysis is comprised of identifying and screening numerous studies to conduct a computation that demonstrates the summative effect size between the research variables (e.g., standardized mean difference, odds ratio, correlation) (Borenstein et al., 2009). Sets of keywords are identified to find relevant studies conducted that focus on the research objectives. Combinations of these keywords are inputted into relevant databases. The studies are then screened based on inclusion and exclusion criteria (e.g., topic relevance, research design, publication type, language). Qualitative research is excluded due to the inability to extract effect sizes. An instrument should be developed to appraise each study on their validity and impact of bias (Petticrew & Roberts, 2008). Two independent reviewers screen and extract the study characteristics and relevant data (e.g. effect sizes). After extraction of the effect size from each study, a random-effect meta-analysis is conducted using *RStudio* software. Assigning weights based on sample sizes increases the precision of the summative effect size. The random-effect model assumes that the included studies are from different populations in which the effect size varies randomly across studies (Field & Gillett, 2012; Quintana, 2015) and allows the inferences to be generalized beyond the included population (Field & Gillett, 2015). Interpret effect size homogeneity with Cochran's Q statistic and the I^2 index (Higgins et al., 2003).

Results to Date/Implications

The authors performed a meta-analysis to further understand the relationship between consumers' level of knowledge and their acceptance of functional foods. Functional foods are

designed to reduce the risk of chronic disease and promote consumer well-being (LaBarbera et al., 2016). Three sets of keywords were used to screen and identify 1,050 studies from three databases: CAB Abstracts, Web of Science, and Food Science and Technology Abstracts. Eighteen studies were deemed appropriate to extract the effect size (i.e., correlation coefficients (*r*). This meta-analysis generates a positive relationship ($r = 0.14$, 95% CI [0.05;0.23]) between the two variables. The positive relationship emphasized the important role of consumers' knowledge in their acceptance of food health innovations. In other words, consumers who have a high level of health-related knowledge are likely to accept functional foods. Findings from this meta-analysis provided useful insights into the literature regarding the effect of consumers' knowledge on their behavior toward food innovations. The study highlights the necessity to increase consumers' knowledge of food health innovations and their health benefits for the public to adopt innovations. Therefore, efforts to educate consumers, such as food health campaigns and events, should be made with the intent to increase consumers' knowledge of the innovations and their health benefits. In addition, the meta-analysis approach can be effective in understanding other consumer psychological factors (e.g. attitude, beliefs, and perception) influencing consumer food innovation acceptance.

Future Plans/Advice to Others

Based on the results, social media, or other web-based interventions could be an efficient way of disseminating targeted messaging to increase consumers' knowledge about food innovations. Educators, communicators, and policy makers can use this study and approach to better influence consumers' healthful practices. In addition, future researchers should encourage consumer engagement in social media's public health domain to facilitate their behavior change toward food health innovations. In order to improve dissemination, creating educational materials on functional foods should emphasize their health benefits and advancements. Information designers can use this methodology to better connect with their audience and increase scientific information diffusion.

Cost/Resources Needed

Meta-analysis can be performed numerous ways, but researchers need tools to ensure that the study is done properly. Having resources familiar with databases, like librarians or other researchers is vital to ensuring a wide breadth of studies are able to be considered. For screening, using two independent reviewers reduces bias. Software is needed to do the computations; *RStudio* is free and available online, but fee-based software like *Comprehensive Meta-Analysis Software (CMA)* and *RevMan* are commonly used to conduct the computations in meta-analysis. As effect sizes are needed in the studies, researchers themselves must have a basic statistical foundation on effect sizes for both conducting the meta-analysis and the study being analyzed.

References

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. John Wiley & Sons.

Carver, R. P. (1993). The case against statistical significance testing revisited. *Journal of Experimental Education, 61*, 287–292.

Cook, T. (1974). *The potential and limitations of secondary evaluations. In M. Apple, (Ed.), Educational evaluation: Analysis and responsibilities.* McCutchan

Cook, T. (1992). *Mets-analysis for explanation: A casebook.* New York Sage.

Field, A. P., & Gillett, R. (2010). How to do a meta-analysis. *British Journal of Mathematical and Statistical Psychology*, *63*(3), 665–694. https://doi.org/10.1348/000711010X502733

Glass, G. (1976). Primary, secondary and meta-analysis of research. *Educational Research,5* (10), 3-8.

Glass, G. (1981). Mets-analysis in social research. Beverly Hills, CA Sage.

Hedges, L., & Olkin, I. (1985). *Statistical methods for meta-analysis.* Academic Press.

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, *327*(7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557

Kirk, R. E. (1996). Practical significance: A concept whose time has come. *Educational and Psychological Measurement, 56*, 746–759.

La Barbera, F., Amato, M., & Sannino, G. (2016). Understanding consumers' intention and behavior towards functionalized food. *British Food Journal*, *118*(4), 885–895. https://doi.org/10.1108/BFJ-10-2015-0354

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. SAGE publications.

Lovell, C. D., & Kosten, L. A. (2000). Skills, knowledge, and personal traits necessary for success as a student affairs administrator: A meta-analysis of thirty years of research. *NASPA journal*, *37*(4), 553-572.

Newton, R. R., & Rudestam, K. E. (1999). *Your statistical consultant.* Sage.

Petticrew, M., & Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons.

Quintana, D. S. (2015). From pre-registration to publication: a non-technical primer for conducting a meta-analysis to synthesize correlational data. *Frontiers in Psychology*, *6*, 1549. https://doi.org/10.3389/fpsyg.2015.01549