



Comprehensive Meta-Analysis (CMA) 3.0: a software review

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Abstract

Comparative analyses of different publications on the same topic are becoming increasingly popular in several areas of marketing research. Especially in research strands with many different empirical studies, there is a strong need for a systematic method to verify the multitude of results. Meta-analysis is such a method to empirically synthesize multiple research results. This software review examines probably the most popular software for the implementation of meta-analyses: Comprehensive Meta-Analysis (CMA) 3.0 (<https://www.meta-analysis.com/>).

Keywords Meta-analysis · Comprehensive Meta-Analysis 3.0 · CMA 3.0 · Software review

Introduction

The use of software for meta-analysis is beneficial when there are numerous empirical research projects but no clear overall picture of these publications. The meta-analysis method can be used for the synthesized analysis of many studies or only a few studies (Crocetti 2016). According to Hansen et al. (2022), research questions about relationships among variables or treatment effects are predisposed to run a meta-analysis. As it becomes especially in the field of marketing analytics more and more important to verify empirical results by analyzing them jointly (e.g., Bijmolt et al. 2005; Franke and Park 2006; Wang et al. 2014; Edeling and Himme 2018), this software review focusses on one of the most used software to proceed meta-analysis: Comprehensive Meta-Analysis (CMA) 3.0 (<https://www.meta-analysis.com/>).

We provide an overview of CMA 3.0 and explain how it can be used. This software review aims to assist researchers by pointing out the advantages of *CMA 3.0*, especially with a view on marketing analytics. Before we detail the essential

characteristics of this software solution, we briefly introduce the meta-analysis approach.

Meta-analysis

Meta-analysis is used to aggregate effect relationships from multiple studies. According to Paul and Barari (2022, p. 1099), “meta-analysis is a research method for systematically combining and synthesizing findings from multiple quantitative studies in a research domain.” The purpose is to determine whether effect relationships are consistent across this research. Moreover, complex decisions can be supported by a robust meta-analytic technique (Jager et al. 2022). In recent years, numerous research studies have been published on the merits and best practices in a wide range of disciplines, including marketing, psychology, education, medicine, and social sciences (Wampold et al. 2000; Rana and Paul 2020; Paul and Barari 2022). “Meta-analysis allows the researcher to compare the treatment effect in different subgroups, even if these subgroups appear in separate studies” (Borenstein and Higgins 2013, p. 134). Consequently, this method has been progressively developed recently (Paul and Barari 2022).

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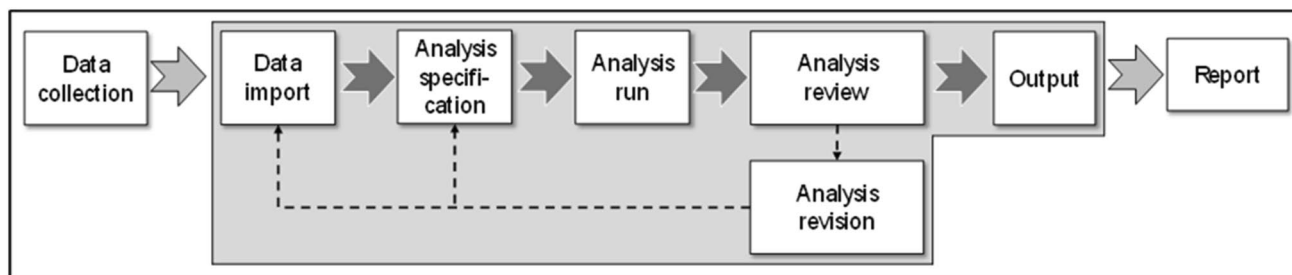


Fig. 1 Procedure for performing a meta-analysis with CMA 3.0

The CMA 3.0 software

Overview

CMA 3.0 is funded by the *U.S. National Institutes of Health*.¹ While the software was developed for the health care sector, it is now used in many other research areas. According to Rana and Paul (2022), *CMA 3.0* is the most preferred software for conducting meta-analysis for business management research. According to Bax et al. (2007), *CMA 3.0* is the most user-friendly and adaptable meta-analysis tool. The authors highlight the wide range of choices for analyzing different forms of data (Bax et al. 2007). This software helps to find overarching results based on several studies. These new or even generally valid results can then be used, e.g., for future research directions (Pang et al. 2021). The software supports the user with different illustrations, e.g., how to perform an analysis after data entry and get detailed results with additional statistical measurements. In addition, several tutorials for different meta-analyses are available on the *CMA 3.0* homepage.²

As mentioned earlier, the purpose of meta-analysis is to combine and empirically analyze multiple studies on the same topic to discover overarching results. A major strength of *CMA 3.0* is that it supports over 100 different data formats. These data formats are listed on the software provider's homepage.³ Thus, *CMA 3.0* can be used to analyze studies with heterogeneous data sets systematically.

In addition to the statistical analysis, it is possible to use visual data mining to identify different patterns. Thus, the *CMA 3.0* software is an appropriate tool, especially for the following uses (Leontyev et al. 2017; Borenstein 2022):

- estimate effect sizes,
- construct forest plots as well as high-resolution plots,
- plot the distribution of the true effects,

- compare effect sizes of different subgroups,
- run meta-regression,
- run moderator analyses,
- detect the presence of bias in research directions

CMA 3.0 can be used to verify the results from various publications. For this purpose, the so-called Hedges' g is used to indicate the effect size of the meta-analysis. Overall, we recommend this approach because of its user-friendliness and the possibility of considering and systematically evaluate numerous variables. Besides, the possibility to process data in different formats is another advantage of the software. *CMA 3.0* supports both fixed and random effect measures. In addition, many other computational models are provided, such as Schmidt and Hunter, Mantel–Haenszel, and the inverse variance model. Furthermore, this software solution can process a range of different categories of inputs (Beaubien 2003).

Meta-analysis with CMA 3.0

Figure 1 summarizes the essential steps for running a meta-analysis with *CMA 3.0*. In preparation, it is necessary to collect the data to be analyzed. Then, the user must insert the data into the software. The columns inserted must then be specified (study name, effect size data, data format). After that, *CMA 3.0* generates initial results with just one click on “Run analyses.” These results need to be reviewed and possibly revised by the user. When all necessary adjustments are done (e.g., regarding data formats and analyses methods), the output can be reported, e.g., to Microsoft PowerPoint, Microsoft Word or LaTeX. Please note that Fig. 1 shows only a schematic summary to illustrate the procedure with *CMA 3.0*. For a detailed description of the procedure for meta-analyses, see Paul and Barari (2022).

The interpretive analysis provides in-depth results for studying the specified context, including several illustration possibilities. The tabular presentation in Fig. 2 includes mean effect sizes, confidence intervals,

¹ see https://www.meta-analysis.com/pages/about_us.php?cart.

² see <https://www.meta-analysis.com/pages/tutorials.php>.

³ see <https://www.meta-analysis.com/pages/formats.php>.



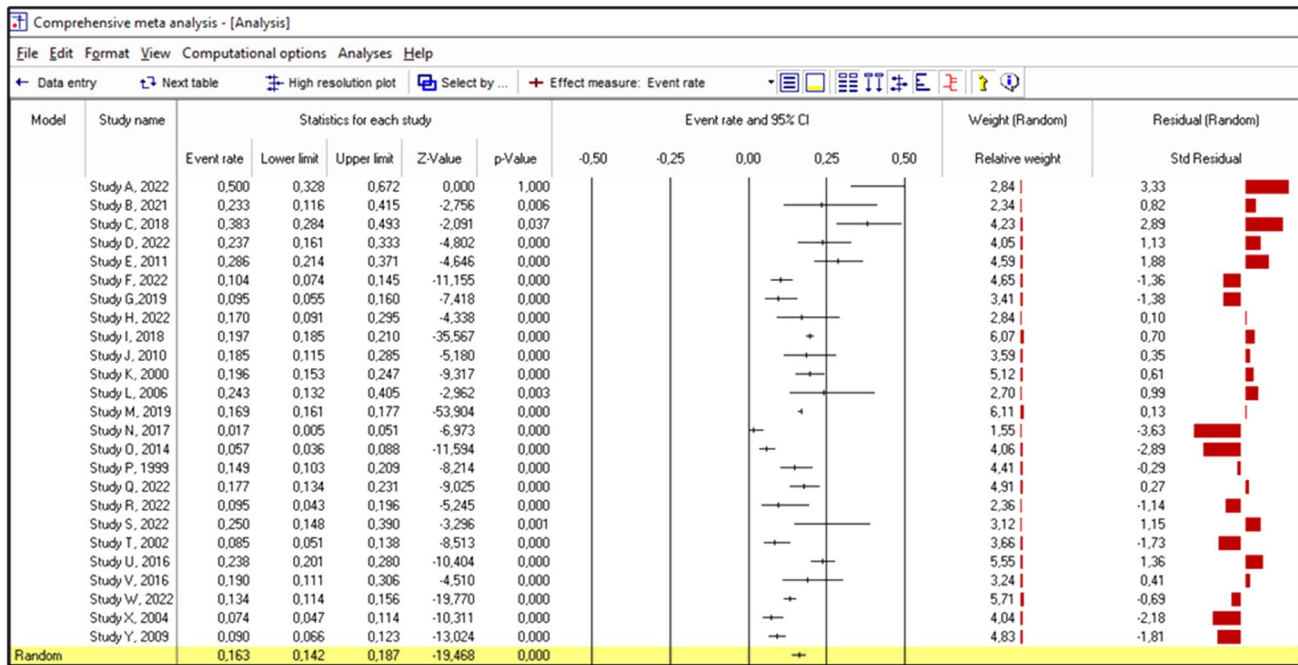


Fig. 2 Example of data analysis with random effects

standard errors, and other test statistics. The forest plot on the right shows both effect sizes and precision for each study as well as combined effects (Hansen et al. 2022). The bottom line shows the result of the aggregated analysis. As shown in Fig. 1, the initial results need to be reviewed and perhaps adjusted, e.g., by specifying data formats or analysis methods. A strength of *CMA 3.0* is the formatting possibilities of the output. As shown in Fig. 3, the software provides some convenient options to include the results into text processing programs or presentations.

Additionally, this software can divide the mean effect among different groups by performing a so-called subgroup analysis. Another advantage of this software is that there are many subgroup options (Suurmond et al. 2017). This can reveal, for example, differences between countries or continents in the literature analyzed. Another advantage of *CMA 3.0* is that moderation effects can also be considered when calculating meta regressions (Borenstein 2022). This method can be used to find out whether the results of the meta-analysis are strengthened or weakened by another variable. For example, it could be investigated whether the year of publication as a moderating variable has an influence on the effect size of the meta-analysis (Suurmond et al. 2017).

Conclusion

We urge that researchers fully utilize the *CMA 3.0*-based meta-analytic technique to acquire the most significant insights about aggregate studies that a single primary study cannot deliver. As the volume of data and empirical research grows, this is especially important for meta-analysis in marketing analytics. In addition, there are numerous constructs in the field of marketing that are very commonly replicated in many research papers. This is where the synthesized investigation of meta-analyses with *CMA 3.0* is highly appropriate.

CMA 3.0 is quite beneficial for meta-analysis, particularly because the analytic options are extensive and the interface is simple. As a result, we propose that researchers who intend to do a meta-analysis apply *CMA 3.0*. This technique may be quite valuable, particularly in marketing and marketing analytics, in systematically evaluating a large number of analytical studies to verify findings or reveal new research requirements. For instance, a meta-analysis with *CMA 3.0* can be used to synthesize previous research on the acceptance and use of the metaverse. Similarly, analyzing previous literature on the budget allocation of online advertising could be another meaningful subject for future meta-analyses. Similarly, the numerous studies on retail analytics can be used to summarize the results of these studies systematically.



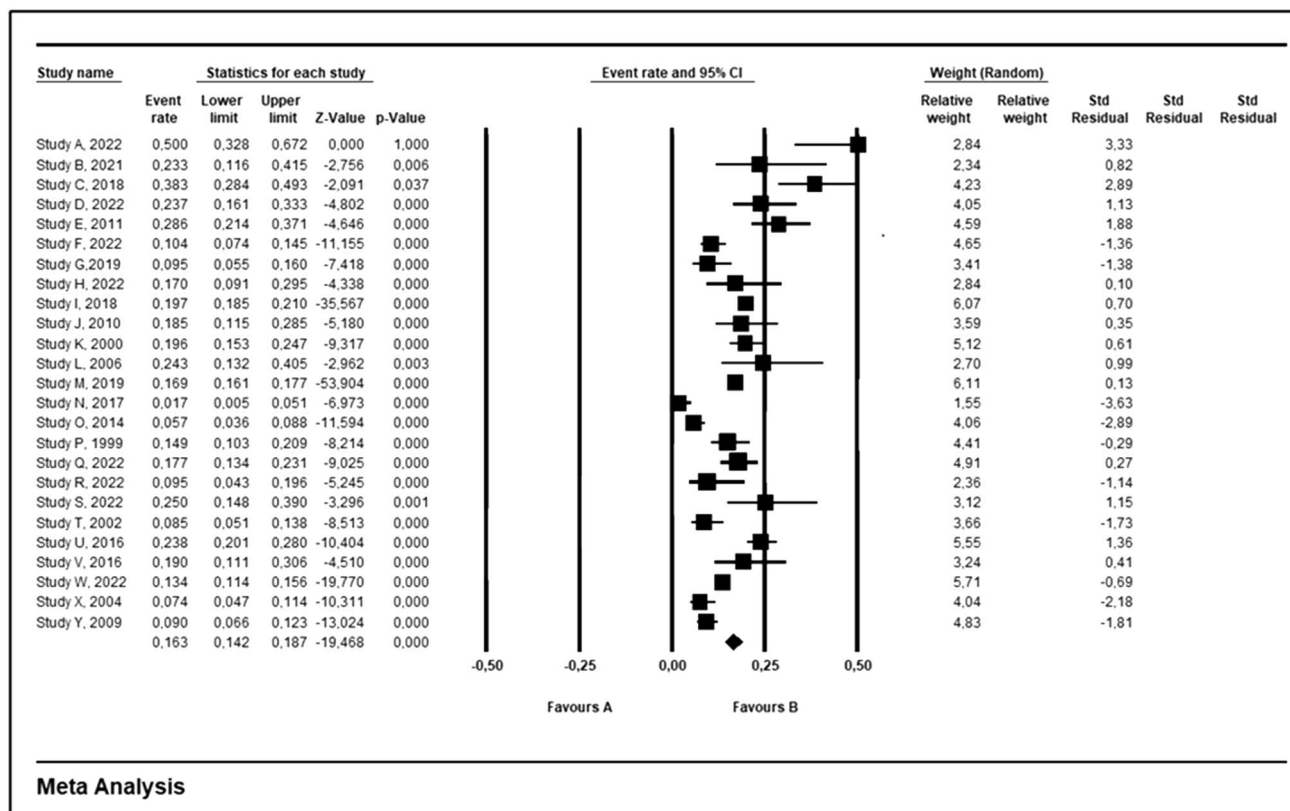


Fig. 3 Example of output presentation

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