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META-ANALYSIS IN MARKETING

ABSTRACT

Meta-analysis is a method that seeks to aggregate, integrate, and adjust results from previous studies, while considering the different conditions in which the original studies were investigated. The expected benefit is demonstration of the association between one or more variables, and generation of a systematic review and integration of studies. Hence, in the meta-analysis, the researcher can present broad evidence for or against a given theory. This study discusses the methodological and structural aspects of the organization of meta-analytical investigations in marketing. In addition, this paper suggests eight steps to organize the data and interpret the results. Lastly, we discuss the implications of the formulas and the corrections of the effects, as well as proposing paths for investigations that use meta-analysis in marketing.

Keywords: Meta-Analysis; Marketing; Investigation; Method.

META-ANÁLISE EM MARKETING

RESUMO

A meta-análise é um método que procura agregar resultados de pesquisas anteriores, integrando-os e ajustando-os, levando-se em consideração as diferentes condições nas quais as pesquisas originais foram investigadas. O resultado esperado é um valor que represente a força da associação entre uma ou mais variáveis estudadas, gerando uma resposta padrão generalizável. Com isso o pesquisador pode concluir contra ou a favor de uma dada teoria e/ou ter facilitada uma tomada de decisão. Este trabalho discute os aspectos metodológicos e estruturais da organização de investigações meta-analíticas em marketing, sugerindo oito passos para organização dos dados e interpretação dos resultados. Ao final, são discutidas as implicações das fórmulas e correções dos efeitos, bem como propostos caminhos de investigações que utilizem a meta-análise em marketing.

Palavras-chave: Meta-Análise; Marketing; Pesquisa; Método.

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1 INTRODUCTION

Historically, periodicals with a high impact factor[1] typically published four volumes per year, each with approximately seven articles per issue. The result, therefore, was the publication of an average of 28 articles per year. With the advent of the Internet, the growing number of its users, the increase of the diffusion of media, a greater number of researchers, and more financial resources from agencies that foster and increase the velocity of scientific discoveries, it has become quite common for important scientific periodicals to publish much more than four volumes per year. For example, some of the journals – such as *Nature* and *Science* – publish 50 or more volumes per year (see Table 1), publishing at an average more than 30 articles per issue, totaling at least 1,500 articles/year.

Table 1 - Principal 20 periodicals by ranking of the impact factor in 2013 (based on 2012).

Rank	Name of Journal	Number of issues in 2013	Total Citations	Impact Factor
1	Cancer Journal of Clinicians	6	10,976	101.78
2	New England J. of Medicine	52	232,068	53.30
3	Annual Review of Immunology	1	15,990	52.76
4	Reviews of Modern Physics	4	31,368	43.93
5	Chemical Reviews	12	103,702	40.20
6	Nature Review Mol. Cell Biology	12	29,222	39.12
7	Lancet	52	158,906	38.28
8	Nature Reviews Genetics	12	20,384	38.08
9	Nature Reviews Cancer	12	28,602	37.55
10	Advances in Physics	4	4,400	37.00
11	Nature	61	526,505	36.28
12	Nature Genetics	12	76,456	35.53
13	Annual Review of Biochemistry	1	18,684	34.32
14	Nature Reviews Immunology	12	22,613	33.29
15	Nature Reviews Drug Discovery	12	19,470	33.07
16	Nature Biotechnology	12	38,728	32.43
17	Cell	7	178,762	31.96
18	Nature Reviews Neuroscience	12	26,938	31.67
19	Nature Nanotechnology	12	21,920	31.17
20	Science	50	508,489	31.03

Source: Thomas Reuter 2013 Journal Citation Reports (http://thomsonreuters.com/).

[1]The impact factor (IF) of a periodical is, traditionally, calculated from the ratio between two elements, citations (C) and published articles (N), for a temporal window of two years, according to the formula IF=C/N. Thus, the calculation of the impact factor of a periodical for the year 2007, for example, considers in the numerator the volume of citations in the current year for any item published in the two previous years, while the denominator is the number of articles published by the periodical during these same two years (Garfield, 1972).

Considering data from the *Scopus* database, there are 20,544 scientific periodicals in diverse areas of knowledge (SCHIMAGOJR, 2014), verifying an increase in the publication and the diffusion of the scientific work published on numerous continents (see Figure 1). With such a large number of scientific publications, it is common for researchers, professors, students, managers, doctors, and other professionals to lose track of a determinate theme in the midst of so many articles published over just a few years about the same subject.

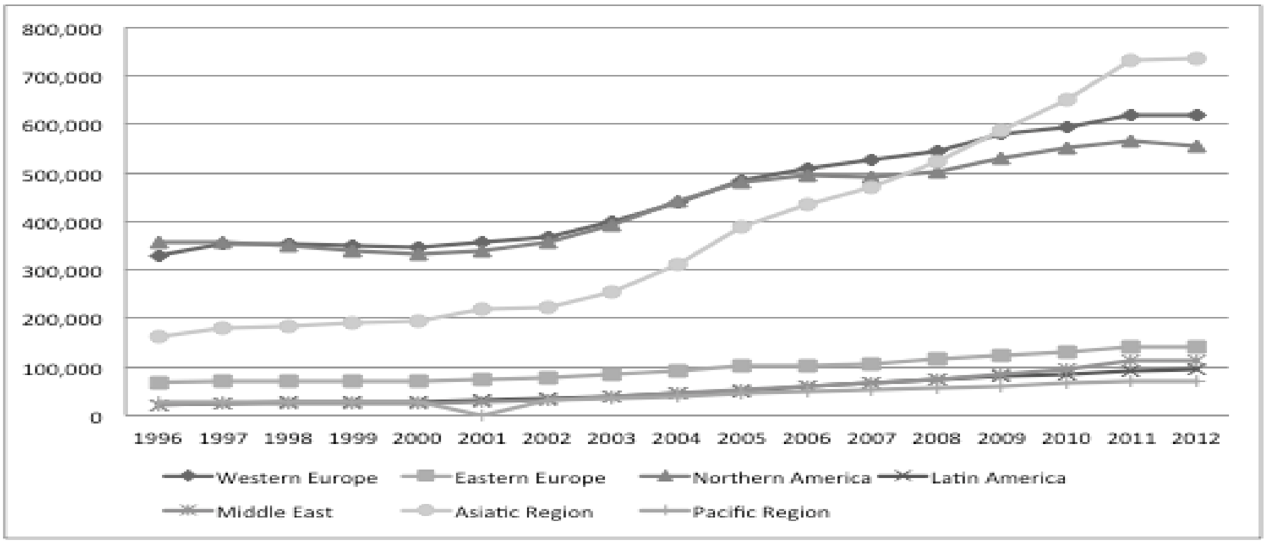

Figure 1 - Number of scientific articles published by continent/region between 1996 and 2012
Source: SCImago Journal & Country Rank. http://www.scimagojr.com (2014).

Specifically considering the area of marketing, it is possible to verify that there is a similar profusion of articles. Despite not publishing as many volumes per year as *Nature* and *Science*, the principal periodicals of the marketing area, such as the *Journal of Marketing (JM), Journal of Marketing Research (JMR), Marketing Science (MS),* and *Journal of Consumer Research (JCR)* publish four to six volumes per year. Considering that each volume contains seven to fourteen articles, depending on the journal, we can easily arrive at more than 200 articles per year, without counting the special editions.

In other words, to keep oneself up-to-date on marketing publications, only from 2013, a researcher would have to read at least 200 articles from the principal periodicals of the field. This is without considering the articles published in the other 97 marketing journals available in the Scopus database (SCHIMAGOJR, 2014).

The problem with the number of periodicals and the publications available goes beyond the ability to locate and read important articles. Considering that there is more to read, it is also expected that there are more positive, negative, or null results. The number of distinct results, sometimes contradictory, can generate doubts for the person interested in which decision to make. In this article we talk about one of the ways to settle this problem: the realization of meta-analyses.

A **meta-analysis** is a study that seeks to aggregate previous results, integrating them and adjusting them, taking into consideration the different considerations under which the original studies were investigated. The expected result of the meta-analysis is a value that represents the strength of the association between one or more variables studied. This finding generates a generalizable standard, a fact that assists the researcher in concluding for or against a given theory or to make a determinant decision.

Meta-analysis is useful for numerous areas of knowledge, including marketing. In this article, we seek to introduce a systematic view of what meta-analysis is and how to use meta-analysis in marketing. For this, we present a historical review of the method, of its definition, and its aim. Next, we discuss the situations in which meta-analysis is indicated and we suggest steps for it to be applied, as well as a summary of the principal formulas for the calculations and transformations of the effects. Finally, we analyze the use of this method in the area of marketing, pointing out suggestions for future studies.

2 A BRIEF HISTORY OF META-ANALYSIS

Meta-analysis was developed in the beginning of the 1970's in the field of Psychology and Psychotherapy (LIPSEY; WILSON, 2001; HUNTER; SCHMIDT, 2004). The initial reasoning for its development was the discussion about the efficacy of psychotherapy, being that hundreds of studies and applications had generated heterogeneous results. Motivated by summarizing the results of the 375 studies about Psychotherapy published until then, Gene V. Glass developed a method that he called "*meta-analysis*" (LIPSEY; WILSON, 2001). This method involved statistical standardization of the difference between the treatment group and the control group and then accumulation and production of an average effect. Developed initially to analyze studies with an experimental approach, the results indicated that psychotherapy was, in fact, efficient. The proposal of the method and its results were published in a text that had become classic in the literature of systematic review (SMITH; GLASS, 1977). These authors defined meta-analysis as the statistical analysis of a large group of results with the aim of integrating the results.

Other authors also contributed to the development of meta-analysis. Hunter and Schmidt (2004), for example, stated that the first article published about meta-analysis was that of Glass (1976), but that she and Smith proposed the method in 1975 and applied to the studies about personnel selection already in that year. Nonetheless, instead of submitting for direct publication in a journal, contended Hunter and Schmidt (2004), they had participated and had won a competition in the American Psychological Association, in 1976.

However, the article was not published until 1977 (SCHMIDT; HUNTER, 1977). In all respects, they recognize the work of Glass (1976), not only as the pioneer because it was published, but also as the first to emphasize meta-analysis as a method. This is because it has to do with a general group of procedures that can be applied to the integration of the results of studies in any area of knowledge.

Despite the critics that considered the procedures suggested by Smith and Glass (1977) as a silly exercise (EYSENCK, 1987), Lipsey and Wilson (2001) show that the method was not abandoned. Quite the opposite, its use grew and extended to other areas besides the social and behavioral sciences. For example, a search for the word meta-analysis in the title of articles in the EBSCO database, on March 7 of 2014 resulted in 62,264 articles (10,817 in the Proquest database). If we consider only the academic journals, the number is 61,439 (8,941 articles in Proquest). Filtering by the words "management" or "business "in the subject line, the number of studies we obtain is 912 (532 on the Proquest database).

The search for the title "meta-analysis" and the subject "marketing" resulted in 68 articles on the EBSCO database and 100 articles, approximately 1% of the total of meta-analyses already published, on Proquest. EBSCO shows that the first article published in marketing journals with the term "meta-analysis" in the title was that by Assmus et al. (1984)[2], and the evolution throughout the years can be seen in Figure 2.

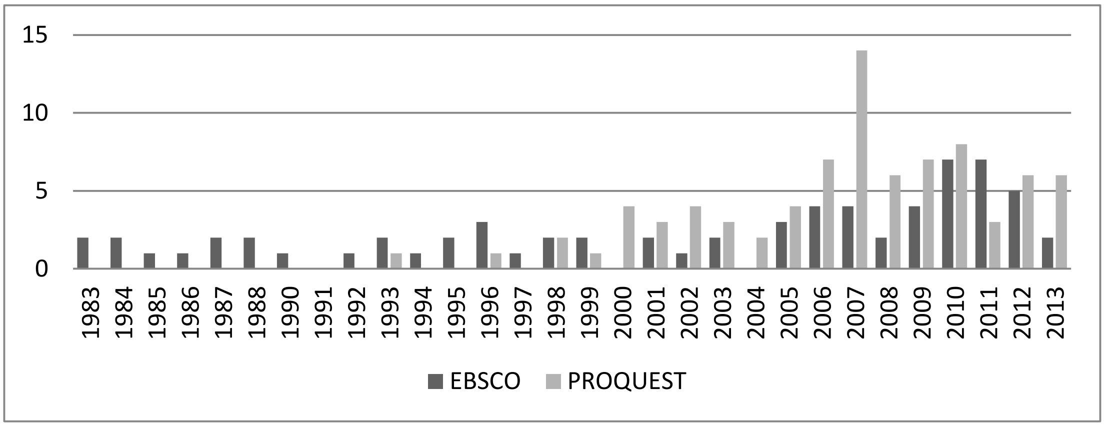

Figure 2 - The number of meta-analyses with the subject "marketing" published per year, according to the EBSCO and Proquest databases (2014).

[2] Considering as well the articles in congress annals, Houston et al. (1983) can be considered as the pioneers, since they published an article about meta-analysis in the consumer study in Advances in Consumer Research.

There are a variety of subjects that have already been analyzed in meta-analyses in the marketing field. For example, in the EBSCO database, there are meta-analytical studies about social marketing (6), use of preservatives (3), community health services (2), and the promotion of health (2), among others. In the Proquest database the subjects most cited were relatively generic such as marketing (25 articles), mathematic models (18), management (17), methodology (16), empirical analyses (14), production design (11), and moderators (11), among others. To summarize, there is a growing and diversified use of meta-analysis in marketing. However, there is still not a consensual vision regarding its definition and use. Following we will discuss the definition of meta-analysis.

3 DEFINITION AND AIM OF META-ANALYSIS

Meta-analysis is a strictly **quantitative** methodology, referring to a statistical analysis of a large group of results of individual studies with the objective of integrating the conclusions (ROSENTHAL, 1991). It is a statistical technique especially developed to integrate the findings of two or more studies, regarding one research question, in such a way as to systemically review the literature. Glass (1976, p. 3) defines it as an "...analysis of the analyses [...of] the statistical analysis of a large group of results of individual studies with the purpose of integrating the results. It is a rigorous alternative to the narrative and casual discussion of the literature..."

Common to all of the discussions of meta-analysis is the negation of the literature review that is merely "narrative", where the researcher reports the studies that s/he found and narrates to the reader how each one of them approaches the matter of interest, without presenting a quantitative summary of the different studies. The realization of "subjective narrative reviews" becomes an almost impossible task in fields where there are a large number of studies published, with conflicting results (HUNTER; SCHMIDT, 2004).

Even if this summary were possible, it would have to be taken into consideration that, as good as it might be, all studies present imperfections or limitations. There will always be different factors distorting the results on different levels, such as systematic and random errors. For this reason, there is not one study in particular or subgroup of studies that can supply a secure base to generate scientific conclusions about the accumulated knowledge. Therefore, reliability in the "best" studies does not supply a solution for the problem of conflicting results, because different researchers choose a different subgroup of the "best" studies, in such a manner that the "disagreement between results in the literature become disagreements between researchers" (HUNTER; SCHMIDT, 2004, p.18).

Therefore, meta-analysis is presented, not only as a method that allows for a more rigorous review of the literature, but also able to "...discover new knowledge that would not be inferable from any of the studies taken individually; it is also able to propose or answer questions that were never addressed in any of the individual studies included in the meta-analysis" (HUNTER; SCHMIDT, 2004, p.26).

Meta-analysis, therefore, consists of a quantitative systematic review and integration of the results of distinct studies, which are related in terms of theme and principal objectives (GLASS, 1976). The overall effect produced by meta-analysis is weighed (i.e., adjusted), attributing a different weight to each study, making it possible that each investigation contributes in a coherent and valid manner to the final conclusion. The statistical methods used in meta-analysis allow the researcher to obtain a combined and precise estimate. This is from the increase of the number of observations, increase in the statistical strength, and the ability to examine the variability among the studies (FAGARD et al., 1996). Thus, the general result tends to be more reliable.

Meta-analysis can be used for different purposes. Rosenthal (1991 and 1979) summarizes the main ones:

(1) Generation of a summary of the evidence that emerges from numerous studies, where there is a relationship between two or more variables,

(2) Isolation of a group of moderated variables, verifying in detail their impact on the relationship that is being studied, and

(3) Development of hypotheses by grouping studies on variables not directly observed or measured in the study.

In summary, meta-analysis has many advantages for science to the degree that it is an explicit and systematic method that summarizes the more recent evidence of the effectiveness of the relationship between variables presenting a global quantitative estimate derived from individual studies and, principally, avoiding unnecessary studies about themes that have already matured. Following, we will talk about how meta-analysis should be applied.

4 SITUATONS FOR WHICH META-ANALYSIS IS INDICATED

Given that meta-analysis is a method of summarizing results, it has its own limitations. To be executed correctly, there are some necessary conditions (LIPSEY; WILSON, 2001):

a) It can be applied only in empirical studies, such that it cannot be applied to summarize theoretical or qualitative studies, research projects, etc.;

b) It can be used only in quantitative studies that use measuring variables and present specific statistics (e.g. correlations);

c) It can be used only with statistics possible to be transformed, such as: correlation, r, F test, t test, noticing that there is no access to the original data that generated the statistics (if there were such access, it would be preferable to reanalyze the original data);

d) Studies need to be conceptually comparable, that is, to deal with the same constructs and relationships;

e) Studies using different methods of research (example: experiments and surveys) can be included in the meta-analysis as long as one variable is created to consider this information. For example, you can investigate the differences among groups of studies that used surveys and that used experiments, aiming to test if the results varied by function of the study design.

In addition to these considerations, the researcher should be clear about the theme of interest. The more exact a studied relation is and the clearer the inclusion/exclusion criteria of the studies in meta-analysis, the greater the chance of success. However, a simple explanation of the criteria is no guarantee of relevance of the meta-analysis, as the criteria for inclusion must pass the scrutiny of the research reviewers (LIPSEY; WILSON, 2001). Therefore, necessary care should be taken in applying a meta-analysis. Following, we will talk about the procedures in each step.

5 STEPS OF META-ANALYSIS

There is some uniformity with respect to the steps that should be followed to carry out a meta-analysis. Irwig et al. (1994) and Dinnes et al. (2005) suggested some necessary steps, represented in Figure 3:

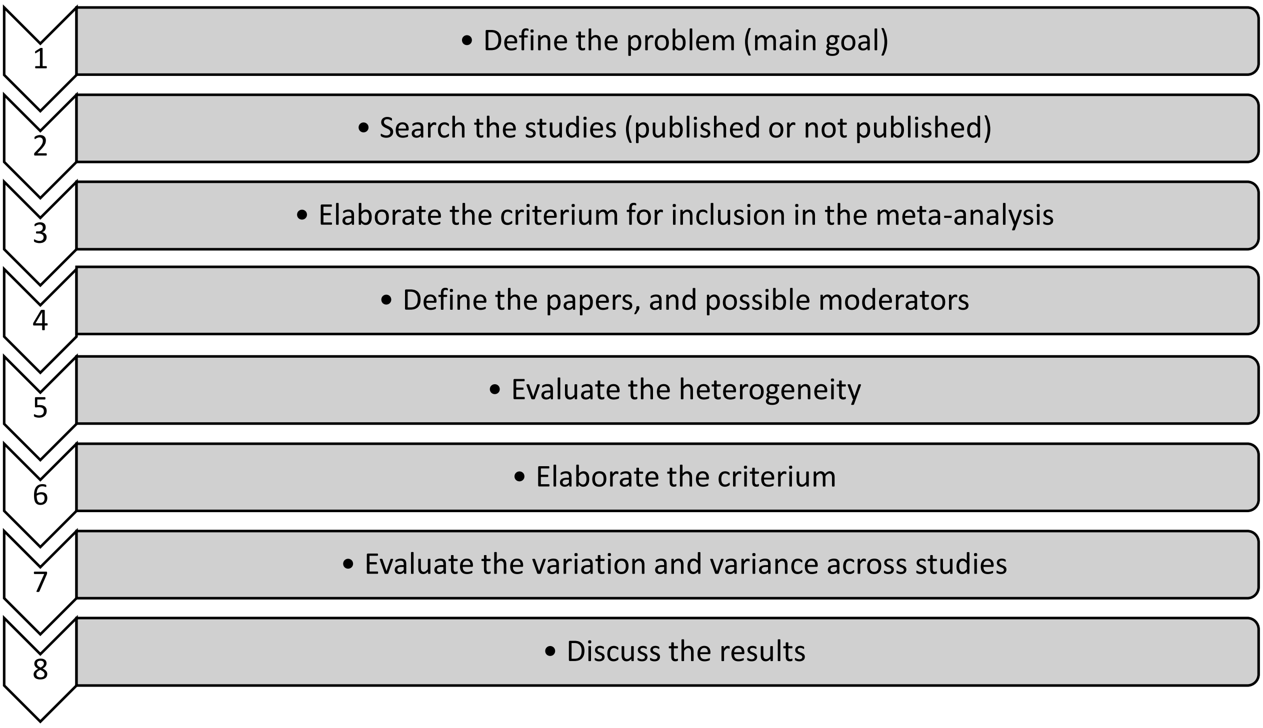

Figure 3 - Meta-analysis steps
Source: Adapted from Irwing et al. (1994), Dinnes et al. (2005) and Sousa and Ribeiro (2009)

➢ **Define the objective**

In order to define the research question, the researcher should be concerned with defining the key-variable of the systematic analysis of the different studies. Thus, the research problem should show if the meta-analytic study proposed would verify the effects of the background of the key-variable, its results, or both.

In the step of defining the objective, the researcher can elaborate hypotheses about the positive or negative effect of the key-variable. The elaboration of one or more hypotheses is optional for each meta-analytical work. If a hypothesis is elaborated, it is important that the author present theoretical arguments that justify an association between the variable and the purpose of this aggregation.

➢ **Search for the empirical studies**

After explaining the objective, the next step is to search for the studies to be included in the database, a key-step of any meta-analytical procedure. A good database makes studies available that have passed through a blind review processes. Publications in periodicals and congresses that have less scientific recognition can be added to elaborate larger samples, but they should be coded for control.

For Berwanger et al. (2007), a meta-analysis should try for the maximum evidence that exists on a certain subject. For this, the most recognized databases should be used in a specific field of knowledge, such as Emerald, EBSCO, Proquest, and Scopus. The strategy of searching and selecting should be defined before the consultation of the different databases and maintained throughout the study, as an ample and systematic search is one of the criteria that help guarantee the quality of the studies obtained.

➢ **Define the search criteria**

Search criteria vary in each study. The researcher should create search, selection, and inclusion criteria for the articles to be investigated. The clarity of the criteria description has two main objectives: to allow the reviewer to evaluate the quality of the search and consent to future researchers adopting similar criteria for new studies. The inclusion and exclusion criteria should be described and rigorously followed by the analyst (BERWANGER et al., 2007). Thus, the reader can decide if the results have relevance and applicability.

➢ **Select the studies**

After an ample search of the publications in various databases with clear and precisely defined criteria, the researcher should be occupied by selecting only those studies that have the searched-for information. Not all of the studies obtained possess useful information that can be converted into a statistic.

Meta-analysis can be understood as a form of research in which each individual study is considered as a “respondent”. Information is extracted from each study that will create a database especially constructed for each meta-analysis. In this database, each study is included as a row and the extracted information is included in different columns. Then, this database is analyzed with the main objective of estimating an overall mean effect-size.

➢ **Evaluating the Heterogeneity**

Given that each study is based on a different sample and that measurement procedures vary among studies, it is normal to expect heterogeneity among the studies in the database. To guarantee the quality of the analyses, the researcher should evaluate the reasons for the variance among the studies, if this variation was unforeseen, and if it were caused by methodological aspects, such as the use of experimental methods or surveys, different scales of measuring, etc.

Sousa and Ribeiro (2009), based on Dinnes et al., (2005), proposed some heterogeneity evaluation criteria among the studies and interpreted the variations of the result:

- Ignore the heterogeneity and use methods with fixed effects (versus random effects);
- Use heterogeneous statistic tests (which have very little sensitivity) and do not combine results if there is heterogeneity;
- Incorporate heterogeneity by using the methods with random effects;
- Explain the differences through the subgroup analyses of the studies or by meta-regression, including co-variables in the analysis.

With this, the researcher can minimize the impacts of the previously published measuring variability. After this minimization, it is possible to pass to the step of calculating the effect-size.

➢ **Calculate the results of each study, combining the effects**

In statistics, the effect-size (ES) is a measure of power of the relationship between two variables in a population. In other words, it is the magnitude of the effect that a variable exercises over another in terms of association. A calculated effect-size, starting with the data, is a descriptive statistic that conveys the estimated magnitude of a relationship, without making any declaration about the existence of any statistical significance between the variables. For this reason, the effect-sizes should be complemented with the statistical inferential p-value (i.e., level of significance), which demonstrates the existence of a statistical relationship between the variables.

The objective of the researcher in a meta-analysis is to compute an average effect-size between two variables, considering all the studies included in the review, and to interpret this index. Effect-sizes are obtained through the conversion of the effects of the associations, such as a t test, F tests from ANOVA/ANCOVA, difference in the measure before and after the treatment, χ^2, Pearson's r correlation, and others.

In practice, the statistics r, F, t, beta, β, χ^2, etc., all represents the extent to which a given variable is associated or has an influence on another variable. In Figure 4, there is a presentation of the magnitude of the effect-size. The circles are the variables, which represent their respective variances.

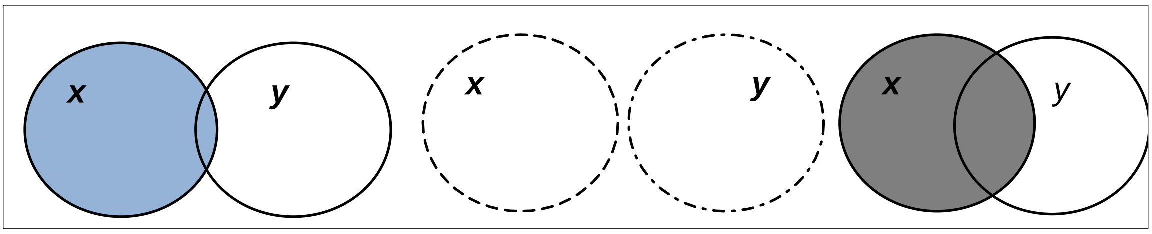

Figure 4 - Magnitudes of weak (left), null (center) and strong (right) effect-size

Specifically, 100% of the circle is the maximum total of a variance that you wish to explain. On the left side of Figure 4 there is a weak relation between x and y, i.e. a small effect, represented by the small overlay between the circles. The overlay is the explained variance, measured by r^2, η^2, R^2, ω^2, etc, depending on the specific statistical analysis.

In the cases previously presented, the relation between variables is presented as a bivariate relationship. If there is only one relation, the result of the association is more "pure", being that it does not suffer any interference of other independent variables. Therefore, there is no co-linearity nor is there the necessity of converting the results.

Other studies use regression analysis or structural equation modeling to verify the relationship between various independent values and one, or more, dependent variables. In such cases, articles that present effect-sizes calculated from the information such as beta regression and *p*-value, should be included in the analysis. However, these statistics should be converted into a single metric.

The process of converting this information into a standardized metric is in consonance with the studies by Brei et al. (2011), Leonidou, Katsikeas and Samiee (2002), Matos and Henrique (2006) and Vieira (2013a,b). The coefficients of the studies are transformed to r and added to the other coefficients obtained in the meta-analysis plan. This transformation has a limitation that can be questioned: the conversion of β, *p*-value, or t-score of the regression does not create an exact value of r. This is because, in the regression, there is the influence of co-linearity between independent and the influence of the indirect effect in surveys, which use the regression analysis of the structural equation model.

Furthermore, the p-value is, at times, underestimated. For example, a significant value at a $p<0.01$ level can be, in fact, $p=0.00001$. This is why the p-value is underestimated. Lastly, another limitation for the calculation of the effect-size is that different studies usually do not present one same set of exogenous variables to compare and/or control. Next we present some formulas for the transformation/conversion and calculation of the ES, discussed below.

5.1 Formulas for the transformation/conversion of the effects

As discussed above, for each statistical test (e.g., group comparison by t test or F from Anova) there is a specific formula to estimate the respective magnitude of the effect (i.e., the effect-size). Lipsey and Wilson (2001) provide the main formulas needed to compute the effect-size in each situation. Next we present and discuss some of the most typical.

a) The standardized mean difference

The mean discrepancy represents the standardized comparison between two groups based on a metric variable.

Direct calculation:

$$ES = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\dfrac{s_1^2(n_1-1)+s_2^2(n_2-1)}{n_1+n_2-2}}} = \frac{\overline{X}_1 - \overline{X}_2}{s_{pooled}}$$

Equivalent formulas:

For the t test:

$$ES = t\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$$

For one comparison of two groups using one-way ANOVA:

$$ES = \sqrt{\frac{F(n_1 + n_2)}{n_1 n_2}}$$

If you do not have the t or F value, but only the associated p value, it is possible to use this p-value of a t or F test to convert it in the t or F value. Then, the above formulas can be applied.

For chi-squared of a 2 x 2 table (*d.f.* = 1) and sample N:

$$ES = 2\sqrt{\frac{\chi^2}{N - \chi^2}}$$

phi coefficient **(r), non-parametric:**

$$ES = \frac{2r}{\sqrt{1 - r^2}}$$

Two dichotomous variables (2 x 2 table), where a, b, c and d are the frequencies.

$$ES = \frac{(ad - bc)}{\sqrt{(a_b)(c + d)(a + c)(b + d)}}$$

t value for the r significance:

$$ES = \sqrt{\frac{t^2}{t^2 + df}}$$

Estimate t from r:

$$t = \frac{r}{\sqrt{\frac{1 - r^2}{df}}}$$

Point-biserial correlation (between a categorical and a metric variable):

$$ES = \frac{(\bar{X}_1 - \bar{X}_2)/s_{pooled}}{\sqrt{((\bar{X}_1 - \bar{X}_2)/s_{pooled})^2 + \frac{1}{p(1-p)}}}$$

b) Correlation Coefficient

A correlation coefficient represents the degree of association between two metric values. Generally, this is presented directly as “r” (Pearson’s coefficient). This is a formula that is often used to calculate the ES, since most of the articles supply the coefficient of the correlation between two variables.

$$ES = r$$

c) Inverted variance

Studies usually vary in sample size. The effect-size of a study with 500 respondents is seen as a more precise (i.e., with smaller sampling error) estimate of the true population parameter than the effect-size of a study of 50 respondents. Thus, studies with larger samples should have a heavier weight in the analyses than studies with smaller samples. There are two possibilities for weighting:

1) Simple correction: Weigh each effect-size by the sample size
2) More complete correction: weigh by inverted variance.

In the latter approach, the standard error (SE) is a direct index of the precision of the effect-size. The standard error is used to create reliability intervals; the less the standard error, the more precise the effect-size. In the case of standard mean difference:

$$w = \frac{1}{SE^2}$$, where:

$$SE = \sqrt{\frac{n_1 + n_2}{n_1 n_2} + \frac{(\overline{ES}_{sm})^2}{2(n_1 + n_2)}}$$

For each study, then, you should have the effect-size, the standard error of the effect-size, and the inverted variance. Note that the inverted variance is correcting only the sampling error. To correct for measurement (un)reliability, one can weigh the inverted variance (w) by the reliability index of each variable of the relationship being investigated.

$w' = w(r_{xx})$
$w' = w(r_{xx})\ (r_{yy})$

In this approach, the effect-size is corrected both by the sampling and measurement error (LIPSEY; WILSON 2001, p.110). At this time, the researcher should have the following statistics for each study: the effect-size, the standard error, and the inverted variance corrected by reliability (w').

d) The weighted mean effect-size

Consider the illustrative Table 2 that brings an example of the data referring to ten studies.

Table 2 - Example of the data referring to ten studies

Studies	ES	w	w*ES
1	-0.33	11.91	-3.93
2	0.32	28.57	9.14
3	0.39	58.82	22.94
4	0.31	29.41	9.12
5	0.17	13.89	2.36
6	0.64	8.55	5.47
7	-0.33	9.80	-3.24
8	0.15	10.75	1.61
9	-0.02	83.33	-1.67
10	0.00	14.93	0.00
Σ		269.96	41.82

$$\overline{ES} = \frac{\sum (w \times ES)}{\sum w} = \frac{41.82}{269.96} = 0.15$$

We begin with the effect-size and the inverted variance for each study. Next, we multiply the effect-size by w in each study; adding the products of the w and ES columns; then we divide the sum of the products (w x ES) by the sum of w. In other words, we do a weighted average and we obtain the median effect-size, weighted by the inverted variance. We calculate the standard-error of the mean effect-size by:

$$SE_{\overline{ES}} = \sqrt{\frac{1}{\sum w}} = \sqrt{\frac{1}{269.96}} = 0.061$$

Then we do the Z test for the mean ES:

$$Z = \frac{\overline{ES}}{SE_{\overline{ES}}} = \frac{0.15}{0.061} = 2.46$$

Following, we present the reliability interval:

$$Lower = \overline{ES} - 1.96(SE_{\overline{ES}}) = 0.15 - 1.96(.061) = 0.03$$

$$Upper = \overline{ES} + 1.96(SE_{\overline{ES}}) = 0.15 + 1.96(.061) = 0.27$$

e) Homogeneity Analysis

The null hypothesis of the homogeneity test states that the distribution of the effect-size is homogeneous (Table 3). To test this hypothesis, we calculate a new variable, which is the weight (w) multiplied by the square of the effect-size.

Table 3 - Example of the data referring to the ten completed studies

Studies	ES	w	w*ES	W*ES^2
1	-0.33	11.91	-3.93	1.30
2	0.32	28.57	9.14	2.93
3	0.39	58.82	22.94	8.95
4	0.31	29.41	9.12	2.83
5	0.17	13.89	2.36	0.40
6	0.64	8.55	5.47	3.50
7	-0.33	9.80	-3.24	1.07
8	0.15	10.75	1.61	0.24
9	-0.02	83.33	-1.67	0.03
10	0.00	14.93	0.00	0.00
Σ		269.96	41.82	21.24

In such a way that now you have 3 sums:

$$\sum w = 269{,}96$$
$$\sum (w \times ES) = 41{,}82$$
$$\sum (w \times ES^2) = 21{,}24$$

Hence, the Q test is calculated as:

$$Q = \sum(w \times ES^2) - \frac{\left[\sum(w \times ES)\right]^2}{\sum w} = 21,24 - \frac{41,82^2}{269,96} = 21,24 - 6,48 = 14,76$$

The interpretation is the following: *Q* follows a chi-square distribution; *d.f.* = number of effect-sizes – 1. In the example above, there are 10 effect-sizes, therefore d.f. = 9. Considering the significance level adopted (5%), we can calculate the significance of the above value (Q = 14.76) using an Excel® spreadsheet:
=DIST.CHI(14.76;9)
= 0.098

Based on the calculated significance value, which is higher than the reference of 0.05, H_0 **should not** be rejected, concluding homogeneity is supported. We conclude that these 10 effect-sizes are homogeneous and that the variation that exists between them does not exceed what was expected based only on the sample error.

f) And if the Q test indicates that the effect-sizes are heterogeneous?

In this case, it is necessary to seek additional variables that might explain the *ES* variation. One of the possibilities is to analyze the moderators:

- Categorical variables: one can run tests of mean differences (ANOVA) of the effect-sizes between the groups. You should also estimate the median effect-size for each group, as well as the reliability interval, with the aim of seeing the overlay degree. Another option is to enter with the categorical variables as dummies in a regression to try to explain the effects.

- Metric variables: you can estimate a regression and evaluate which of the variables have a greater impact on the ES.

A common limitation in the analysis of moderators is the small sample size in a specific group (e.g. a group of 20 effect-sizes, with 15 coming from experiments and 5 from surveys), precluding the application of more robust techniques (ex: regression). In this case it is not recommended to apply a multivariate technique. The regression would suffer from low statistical power, which is the ability of the analysis to identify a true significant effect (Hunter & Schmidt, 2004).

6 EVALUATE THE VARIANCE EFFECT

One of the best options to evaluate the variance effect is to use the Forest Plot Graph (BERWANGER et al., 2007). The graph serves to illustrate the relative power of the treatment effects in multiple studies and the number of effects variability, ranging from extremely negative results to strongly positive ones. Thus, they allow for a visual analysis of the effect-size as well as the reliability intervals, facilitating the visual comparison of the findings of the different studies.

The results of the effects previously transformed into *r* or *d* by a meta-analysis can be evaluated by the reliability interval, in other words, the estimation of a parameter of interest in the population. The objective of the reliability interval is to show the mean variation in the selected studies. Furthermore, it allows the establishment of a reference, with which the results of future studies can be compared. Thus, instead of estimating the parameter through a single value, the reliability interval can serve to show an interval where that parameter probably is found (from the significance level (p-values) selected by the researcher).

7 INTERPRETING THE RESULTS

The last step to complete a meta-analysis is the interpretation of the results in a global manner. We recommend a final table for meta-analysis which presents, at least, the following information: 1) number of studies; 2) number of observations; 3) sample size (*N*); 4) simple *r* value; 5) Fisher *Z* value; 6) the *r* value corrected by reliability; 7) value of *r* corrected by the sample; 8) the standard-error of the effect-size; 9) Cohen's *d* value, calculated from the effect-size; 10) reliability interval and 11) Homogeneity test (*Q*) with respective significance level.

Within all of the proposed data, individually, the effect size is the most important statistic to interpret the results, mainly the version of the effect-size that is weighted by the sample and by reliability, because it allows the researcher to evaluate the relative power of the relation between the principal variables of the study. In other words, it becomes possible to analyze if there is a weak, medium, or strong effect and to draw the proper conclusions about the power of the relation between the variables. However, this is not always easy as Cohen (1988, p. 25) emphasizes:

> “The terms ‘small’, ‘medium’, or ‘large’ are relative, not merely in relation to one another, but also in relation to the area of behavioral sciences or, even especially, in the specific content and research method applied in data investigation. [...] In the face of this relativity, there is a certain inherent risk in offering conventional operational definitions for these terms for the use of analyses of statistical strength in an area of research as diverse as the behavioral sciences. The risk is, however, acceptable in the face of the belief that there is more to gain than to lose by supplying a common structure of reference to use only when there is no better basis to estimate effect-size”.

In summary, the steps to conduct a meta-analysis are various, detailed, and require substantial knowledge of descriptive and inferential statistics, both bivariate and multivariate, on the part of the researcher as well as the dominion of at least some good statistical software, such as the SPSS®. These are the pre-requisites necessary so that, subsequently, the researcher can evaluate and interpret the results with propriety.

8 CONCLUSIONS AND SUGGESTIONS FOR USE OF META-ANALYSIS IN MARKETING

The number of scientific articles published world-wide has grown without interruption for many years, making it difficult to follow so many scientific results, turning it into an arduous task, whether by individual researchers or by research groups. This is a reality for all of the areas of knowledge, including the field of marketing, considering there are more than 100 marketing journals.

Due to this, meta-analysis has become a powerful tool to summarize previously published quantitative results that are different, incomplete, or even antagonistic. In this article we present the basic definitions of meta-analysis, its aims when it is indicated and, especially, a script for its application.

Within the area of marketing, there are numerous subjects that have been and still can be the object of meta-analyses, such as satisfaction (SZYMANSKI and HENARD, 2001), relationship marketing (PALMATIER et al., 2006), satisfaction with the distribution channel (GEYSKENS, STEENKAMP, KUMAR, 1999), elasticity of prices (TELLIS, 1988), market orientation (KIRCA, JAYACHANDRAN, BEARDEN, 2005; GRINSTEIN, 2008; VIEIRA, 2010), international marketing (KIRCA et al., 2012), adaptation or standardization of the marketing mix in the internationalization of companies (BREI et al., 2011), exportation (LEONIDOU et al., 2002), word-of-mouth communications (MATOS, 2009), consumer satisfaction (MATOS and HENRIQUE, 2006), service recovery paradox (MATOS; HENRIQUE and ROSSI; 2007), and the retail environment (VIEIRA, 2013a,b), among others (see PEREIRA, 2004 for more examples).

Meta-analysis is presented as a powerful method that contributes to the development of scientific knowledge, assisting in the theoretical construction and the processes of scientists and practitioners of marketing in making decisions. However, for these benefits to be achieved, it is necessary to apply the criteria with precision in order to be successful in using this method. This article seeks to present these steps aiming to help other researchers to promote and advance the frontier of knowledge in marketing.

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