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How do psychology researchers find studies to include in meta-analyses?

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ABSTRACT. Meta-analysis is a technique used in a variety of disciplines to combine and summarize the findings of previous research. One step in the production of a meta-analysis is a thorough literature search for relevant studies. A variety of methods can be used to increase the number of studies that are found. This study examines the extent to which some of these steps were taken in meta-analyses published in American Psychological Association in journals in 2004. Some techniques were applied in almost all of the meta-analyses, and other techniques were applied in few of the meta-analyses.   Implications of these results for librarians are discussed.

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ABSTRACT. Meta-analysis is a technique used in a variety of disciplines to combine and summarize the findings of previous research. One step in the production of a meta-analysis is a thorough literature search for relevant studies. A variety of methods can be used to increase the number of studies that are found. This study examines the extent to which some of these steps were taken in meta-analyses published in American Psychological Association in journals in 2004. Some techniques were applied in almost all of the meta-analyses, and other techniques were applied in few of the meta-analyses. Implications of these results for librarians are discussed.

Introduction

What has research discovered so far? What still is not well understood? Review articles often consider these questions. Systematic reviews use a systematic approach to synthesize the literature on a topic. Unlike a traditional literature review, in which the authors discuss the reports they personally consider the most important, systematic reviews involve a thorough literature search. Reports are chosen for inclusion in a systematic review based on pre-defined criteria rather than on the authors' opinions. It has been argued (e.g. Bent, Shojania, and Saint 2004) that systematic reviews present less biased coverage of a subject than traditional reviews. Systematic reviews that use statistical techniques to combine results across studies are referred to as meta-analyses. Meta-analyses can be found in medical, business, and psychological research.

The basic process of a meta-analysis, as described in Schell and Rathe (1992), has six steps. They are 1) question definition, 2) definition of inclusion parameters including qualitative parameters, 3) collection of data and bibliography, 4) coding of data and statistical analysis, 5) summary of findings and 6) clinical application.

Decisions made at each phase of this process can influence the results of a meta-analysis. Seemingly minor decisions, such limiting the meta-analysis to English language publications, can matter (Egger et al. 1997; Grégoire, Derderian and Le Lorier 1995). The focus of this report is on the decisions made in the collection of data and bibliography. This step is particularly relevant to librarians because a major component of this step is the literature search process.

It is generally believed that the literature search for a meta-analysis should be through. If the literature search is incomplete, important, relevant studies that otherwise would have been included in the meta-analysis may be missed. If missed studies differ in their results from

studies that are included, the conclusion of the meta-analyses could be erroneous. Erroneous results in a meta-analysis defeat its purpose of correctly synthesize and clarify the available knowledge on a topic. Occasionally meta-analyses are challenged with the claim that the outcome would have been different had other studies had been included (e.g. Stewart and Roth 2001, challenged by Miner and Raju 2004, countered by Stewart and Roth 2004).

There is a growing body of published research about ways to find relevant studies for inclusion in systematic reviews and meta-analyses. Although the research on literature searches for systematic reviews and meta-analyses is not definitive, it is suggestive of methods that can be used to find a large number of studies. Although many of these methods are long-established in library and information science (e.g. Bates 1989), it is useful examine to them in the context of systematic reviews and meta-analyses.

Searching for Unpublished Studies

One concern in meta-analyses is publication bias, that findings with no statistically significant effect are less likely to get published than findings of an effect. Although there are non-search methods of dealing with publication bias (e.g. Begg and Berlin 1988; Bennett et al. 2004), it has been suggested that meta-analyses should include unpublished reports and reports from small circulation publications. McAuley et al. (2000) examined thirty-three meta-analytic reports in medicine and found that exclusion of grey literature (abstracts, unpublished studies, conference proceedings or programs, graduate theses, book chapters, company reports and applications) would result in an overestimate of intervention effects by an average of 15%. McLeod and Weisz (2004) compared dissertations to published studies on child psychotherapy

and found that the effect sizes in the dissertations were smaller than those in the published reports and that the dissertations were at least as methodologically strong as the published reports. Unpublished and small distribution studies can be found in dissertation databases, by contacting authors or research groups and by searching conference proceedings and programs.

Searching Multiple Databases

The indexing and abstracting databases used to find studies also can make a difference in meta-analyses. Sampson et al. (2003) examined meta-analyses that included both studies indexed in the European medical database Embase and studies indexed in the American medical database Medline. The studies indexed only in Embase had significantly smaller estimates of effect sizes than the non-Embase studies, but because the number of studies found only in Embase was small, they only influenced the pooled estimate of the intervention effect by an average of 6%. Sampson et al. (2003) concluded that random controlled trials indexed in Medline could not be assumed to be like those indexed in databases other than Medline and that meta-analysts should search as many sources as their resources permitted.

Other research supports this conclusion. In their systematic review on rehabilitation for people with mental illness, Brettle and Long (2001) used multiple methods to find ninety-six studies. Almost all of these studies were found through database searches, but no one database was sufficient to locate them all. Forty-two percent of the studies included in the review were found in just one of the databases searched. PsycLIT, which uncovered the highest number of relevant studies, located just 44% of the studies that they used. Another study (Hood and Wilson

2001) indicated that searching several databases was necessary to find 80% of the articles on a topic.

Controlled Vocabulary and Free-Text Searching

There are many ways to construct a database search (Hawkins and Wagers 1982). One part of this construction process is to decide what terms to enter in the search box. Many database systems include both free-text and controlled vocabulary features.

In a free-text search, the searcher enters the search terms that he or she can think of, and the system queries selected fields of the database for records containing those terms. If the words that the searcher enters are present any of in those fields, the records are retrieved. If they are not present, the records are not retrieved. Many database search interfaces have truncation and wildcard systems, so a searcher only has to type "friend*" to search for friend, friendly, friends, friendship, etc., and some systems perform this function automatically. Such a system does not assist the searcher in thinking of the synonyms, such as pal, acquaintance, buddy, etc, to include in the search. It is up to the searcher to think of all the possible terms that different authors would have used for a particular idea.

Controlled vocabularies attempt to resolve this difficulty. In a controlled vocabulary search, the searcher consults a subject list or a thesaurus of controlled terms that have been specified by the database creator and enters those terms in the search box. The controlled vocabulary designates a particular term for a concept. A database producer adds the relevant terms from the controlled vocabulary into the database records. That way, even if the original

document does not contain the controlled term, a searcher still is able to find the document by entering the appropriate term from the controlled vocabulary.

Controlled vocabularies are not without problems. The controlled vocabulary itself may contain terms that are near synonyms. Someone searching in PsycINFO for information on aggression in children would find that "aggressive behavior" is listed in the relevant controlled vocabulary, *Thesaurus of Psychological Index Terms,* but "bullying," "school violence" and "conduct disorder" also are listed there. Instead of facing the problem of thinking of all of the appropriate search terms, the searcher faces the problem of finding all of the relevant terms in the controlled vocabulary. Even if the searcher enters all the relevant terms from the controlled vocabulary, it still is possible that a relevant database record will not contain any of those terms. If the indexer did not consider the document to be about that topic, relevant terms from the controlled vocabulary would not be added to the record. In addition, different databases use different controlled vocabularies, so a controlled vocabulary search of multiple databases would entail looking for the appropriate terms in multiple controlled vocabularies. Finally, sometimes the controlled vocabulary does not have any terms for a particular concept, especially if the topic is a new area of research (Walker and Mulholland, 1992).

Nearly twenty years ago, it was concluded that using a combination of terms found in a controlled vocabulary and free-text terms was necessary for a comprehensive, high-recall search (Tenopir 1987; Bates 1988). van der Weijden et al. (1997) reiterated this point within the context of searching in Medline for systematic reviews. They found that some relevant studies uncovered by using Medical Subject Headings (MeSH) would not have been uncovered with free-text searching, and some uncovered by free-text searching would not have been found using

MeSH. They concluded, "In a search for diagnostic studies to perform a systematic review,

MeSH terms should be combined with freetext terms to gain high sensitivity," (p. 208).

Manual Searching

It is difficult to find all the published literature on a topic solely by searching indexing

and abstracting databases. These databases index selected publications, not all publications in an

area. For publications that are indexed, there can be a time lag between publication and

appearance in the database. Another problem is that it is difficult to generate a search statement

that will retrieve everything. In fifteen searches to identify trials for systematic reviews,

Dickersin, Scherer and Lefebvre (1994) carefully constructed search strategies in Medline, and

on average, they found only 77% of the known trials that were indexed there. Because Medline

did not index everything, on average, their Medline searches revealed just 51% of the known

trials.

Instead of relying exclusively on databases, studies can be found through manual

searches. One manual search technique is to look at the contents of journals that are known to

publish articles on a particular topic. Another technique is to use the references listed in review

articles or in studies already selected for the meta-analysis to find other studies on the topic.

Avenell, Handoll, and Grant (2001), in their search for randomized controlled trials for use in a

systematic review, for example, found one study out of fifteen exclusively by manually

searching relevant journals and the citations of other randomized controlled trials.

Documenting the Search

Although there are many ways that the authors of a meta-analysis can increase the number of studies they include in the meta-analysis, these techniques are not universally used. In some cases, an author may deliberately ignore one of the suggestions, such as someone who excludes results not published in peer-reviewed sources out of concern over the quality of the data. Resource limitations also can make it difficult to implement all of the techniques. For example, locating and obtaining unpublished studies can be difficult and time consuming. Simply expanding a database search has costs because there generally is a tradeoff between recall and precision (Lancaster 1972; Bates 1984; Savoy 2005). To find additional relevant documents, additional irrelevant documents also must be examined.

Given the variability among search techniques used, the QUOROM Group (Moher et al. 1999) has promulgated recommendations for the reporting of meta-analyses of randomized controlled trials in medicine. Among those recommendations are that the report include a complete description of the search method, including, "The information sources, in detail (e.g., databases, registers, personal files, expert informants, agencies, manual searching), and any restrictions (years considered, publication status, language of publication)," (p.1897). A complete description allows the reader to assess the thoroughness of the search and makes it easier for others to reproduce the methods applied by the authors. Thus far, the practice of including a complete search strategy is far from universal. In their study of medical meta-analyses, Patrick et al. (2004) found that 29% of the meta-analyses did not report the search strategy in sufficient detail for the search to be reproducible.

The research on how to find literature for meta-analyses and on documenting the search process often has been published in medical journals and in library and information science

journals. It is unclear if researchers who conduct meta-analyses in other fields have applied the methods suggested by this literature. To examine the extent to which these suggestions have been implemented in psychology, I used the descriptions provided in the "Method" sections of psychological meta-analyses to explore the search process that the psychology researchers use. In particular, I examined their methods to determine the extent to which they searched for unpublished and small circulation studies, searched multiple databases, used controlled vocabulary and free-text database search methods, and documented the search.

Methods

Meta-analyses published in American Psychological Association journals in 2004 were examined. These journals were selected because they generally are well-respected within the field of psychology and because they cover a broad range of psychological topics. These journals also were chosen because I wanted to focus on articles in psychology written from a psychological, rather than a medical perspective. A limitation to this approach is that the results may not generalize to meta-analyses published in other journals or in other years, and results may not generalize to systematic reviews that do not apply meta-analytic statistical techniques.

To locate these meta-analyses, I searched in PsycINFO (1806 to September Week Four 2005) for articles with the publisher URL http://www.apa.org. Results were then limited to journals, year 2004, and to methodology Meta Analysis. This produced a list of forty-one articles. Of these articles, one (van Dick et al. 2004) was excluded because it used meta-analytic statistical techniques to summarize data collected within that study rather than using previously published data. Two other articles were excluded because they were not conventional meta-

analyses. One article (Rotello, Macmillan and Reeder 2004) developed a new model and applied

that model to existing data. The other article (Kulic, Horn and Dagley 2004) provided a

descriptive summary of the literature without applying meta-analytic statistical techniques.

Although both of these articles involved a thorough literature search, I considered them different

enough from the conventional meta-analysis to exclude. The remaining thirty-eight articles were

used for my investigation.

I examined the literature search methods described in the "Method" section of each

article as well as any appendices and tables of search descriptions. This examination was limited

to the process described for locating candidate studies for potential inclusion in the meta-analysis

and did not extend to the description of the filtering process used by the authors to select which

of these candidates to include in the meta-analysis. These descriptions were coded for the search

methods used to find studies, the indexing and abstracting databases used, the methods used to

search the databases, and the completeness of the description.

For articles that provided a complete list of search terms and databases, I examined the

database search strategy more carefully. Search terms listed in were compared to terms provided

by the controlled vocabularies of databases the authors searched. This comparison was done for

four controlled vocabularies: *Thesaurus of Psychological Index Terms* for searches in PsycINFO,

PsycLIT, Psychological Abstracts or Psychological Literature; *ERIC Thesaurus* for searches in

Education Resources Information Center (ERIC), Medical Subject Headings (MeSH) for

searches in Medline or PubMed, and the *CINAHL Subject Heading List* for searches in the

Cumulative Index to Nursing and Allied Health Literature (CINAHL). In all cases, the

electronic versions of the controlled vocabularies that were provided within the databases were

used. To find psychological index terms, the OVID search interface with PsycINFO was used.

The EBSCOhost interface was used to find controlled vocabulary terms in ERIC, Medline and

CINAHL. Both of these search interfaces provided relevancy-ranked mappings to the controlled

vocabularies as well as the broader term, narrower term, related term and scope note information

often found in the print thesaurus. To make each comparison, the system was set to map the

term entered to terms in the thesaurus or subject heading list. Each search term provided by the

authors was entered. If the mapping generated a term that was not included in an author's

search, this term was noted. Additional terms in the controlled vocabulary, including broader,

narrower and related terms, which the authors did not use but that appeared relevant to the search

topic also were noted. Unless the author indicated that they had used truncation or wildcard

symbols, if the term provided by the controlled vocabulary was a variant of the word used by the

author (e.g. emotions in the controlled vocabulary and emotion in the author's search), this was

noted as an excluded term. If the term provided by the controlled vocabulary was a multi-word

phrase, and the author had included part of that phrase in their search (e.g. chronic illness in the

controlled vocabulary and illness in the author's search), this was not considered an excluded

term.

Findings

Overall Search Methods

Search descriptions from thirty-eight meta-analyses in psychology journals were

examined. These meta-analyses varied in the amount of detail they provided to describe the

searches. One article (Gregory et al. 2004) provided almost no description. Instead, the authors

wrote that they used "…standard procedures for journal literature search" (p. 276) and offered to provide complete details on request. The remaining meta-analyses included some sort of description of the database searching, manual searching, and other search methods used to find studies.

The authors of the meta-analyses used a variety of methods to find studies, as shown in Table 1. Database searching was mentioned in nearly all, thirty-six (95%) of the articles. Manual searching methods also were mentioned in thirty-six (95%) of the meta-analyses. It was less common for the meta-analyses to include a search for unpublished or small circulation studies; fifteen (39%) of the meta-analyses included a search for unpublished data. Fourteen (37%) of the meta-analyses included all three: searching for unpublished studies, searching multiple databases, and some form of manual searching.

<Table 1 here>

Some of the meta-analyses used other database search methods to find studies. In their database searches, author searches and citation searches, two methods mentioned by Bates (1989), were employed in some meta-analyses. Three meta-analyses used database searches on author names to find reports by researchers in the topic area. One of these searched for the names of authors from relevant articles used in the meta-analysis; one selected twelve specific authors to search, and one searched on the name of one prominent researcher in the field. Two of the meta-analyses used a citation database to find newer works that cited other works. One of these used the citation database to find studies that cited the studies that had been selected for the meta-analysis, and the other used it to find studies that had cited specific tests that were relevant

to its topic. Although seven other meta-analyses used the citation databases Web of Science or

Social Sciences Citation Index, their search descriptions generally indicated that the databases

were used for keyword searching rather than for citation searching.

Searching for Unpublished Studies

To the extent that the indexing and abstracting databases used by the researchers included

conference proceedings and dissertations, it could be argued that all of database searches

included some search of unpublished or small circulation material. Less than half, fifteen (39%),

of the meta-analyses specifically sought out unpublished or small circulation studies.

Eleven (29%) of the meta-analyses mentioned searching for dissertations, making it most

common search technique for unpublished material. Ten (26%) of the meta-analyses used a

search of a dissertation abstracting database. One of the meta-analyses obtained dissertations

from the authors' personal files and did not indicate that a dissertation abstracting database was

used.

Other methods also were used to find unpublished and small circulation studies. Ten

(26%) of meta-analyses mentioned contacts with individual researchers, listservs, or

organizations to find unpublished studies. Six contacted researchers individually; four sent

messages to relevant listservs, and two contacted organizations. Another method to find

unpublished studies was the use of conference proceedings or programs. Four (11%) of the

meta-analyses mentioned use of this method.

Searching Multiple Databases

Almost all, thirty-six (95%) of the meta-analyses included a search of an indexing and abstracting database to find relevant studies. Of the other two meta-analyses, one relied solely on manual searching, and the other did not provide a description of the search methods. Most of the meta-analyses, thirty (79%), named more than one database that was searched.

Controlled Vocabulary and Free-Text Searching

The meta-analyses generally did not describe how the terms used in the database searches were generated. One of the meta-analyses explicitly mentioned that some search terms came from a controlled vocabulary. Another stated that they used the search terms provided by another study rather than attempting to generate the terms themselves. For the remaining articles, I could not directly determine from the text whether a controlled vocabulary was consulted.

It is possible that the authors used controlled vocabularies and chose not to describe this step. Robbins et al. (2004, p. 283), for example, hint at the use of different controlled vocabularies in different databases when they write, "Terminology searched for varied slightly for *PsycINFO* and *Educational Resources Information Center* on the basis of different terminology used in the theoretical models for psychological and educational literature."

To investigate controlled vocabulary use, I compared the search terms used in the meta-analyses to those provided by the relevant controlled vocabularies. Twenty-four of the meta-analyses provided complete lists of the search terms that they used. Of these, twenty-three meta-analyses indicated searching at least one database with a controlled vocabulary. I compared the

terms listed by the authors to those listed in controlled vocabularies of the databases the authors

searched. This comparison was limited to four controlled vocabularies: *Thesaurus of*

Psychological Index Terms for searches in PsycINFO, PsycLIT, Psychological Abstracts or

Psychological Literature; *ERIC Thesaurus* for searches in Education Resources Information

Center (ERIC), Medical Subject Headings (MeSH) for searches in Medline or PubMed, and the

CINAHL Subject Heading List for searches in the Cumulative Index to Nursing and Allied

Health Literature (CINAHL). Search terms that were provided by the controlled vocabularies

but not included in the meta-analysts' searches are listed in Table 2.

<Table 2 here>

        Additional search terms were uncovered from the controlled vocabularies for eighteen

(78%) of these twenty-three meta-analyses. Thirteen (57%) of the twenty-three meta-analyses

had additional terms in all of the relevant controlled vocabularies that I checked. Five (22%) of

these twenty-three searches included singular version of a term when the controlled vocabulary

used the plural version. If interface used had included autostemming, or if the authors had used

wildcard operators, these search terms would have been included. Only two (5%) of all the

meta-analyses mentioned that they used truncation or wildcard symbols in the search.   For the

others, if the authors of the meta-analyses used it, they did not document it.

        Free-text searching relies on the searcher's ability to think of the relevant terms. It is

difficult to assess how much the authors of the meta-analyses used free-text search strategies

because it is difficult to establish exactly how many terms they missed. Nevertheless, some of

the meta-analyses were notably limited in the breadth of terms included in the searches. One

meta-analysis used the terms *mentor, mentoring, protégé, mentorship*, and *career success* to

search for studies on the career benefits associated with mentoring. Within the abstract of this

meta-analysis, *career benefits*, *compensation*, *career satisfaction*, and *career outcomes* all were

used to describe the idea of career success, and the phrase *career success* was not used at all.

Another meta-analysis combined the keywords *smoking cessation*, *tobacco* or *nicotine* or

smoking, nicotine, and *nicotine replacement therapy* to find smoking cessation treatment

outcome studies that used nicotine replacement therapy. Inspection of the citations in this meta-

analysis revealed that *transdermal nicotine*, *nicotine inhaler*, *nicotine chewing gum*, *nicotine

gum*, *nicotine nasal spray*, *nicotine patch*, and *nicotine lozenge* were other terms that could have

been used to search for the concept of nicotine replacement therapy.

Manual Searching

Some form of manual searching was used in almost all, thirty-six (95%), of the meta-

analyses. Twenty-one (55%) of the articles used backward citation searches in which they

consulted the reference lists of the studies found for meta-analysis to find additional relevant

studies. Seventeen (45%) of the meta-analyses mentioned that the authors used the manual

technique of consulting the reference lists of previous meta-analyses, review articles, or other

articles. Another method used in twelve (32%) meta-analyses was manually searching journals

that publish in the field for relevant articles. In addition, one meta-analysis indicated that studies

were found by manually searching the authors' personal files, and one meta-analysis indicated

that studies were found through manual inspection of published articles without indicating how

those articles were found.

Documenting the Search

Ideally, a published research report should contain enough information for the technique to be reproducible by someone else. Within each of the search domains investigated: searching for unpublished studies, database searching, and manual searching, I examined whether this sort of detail was included in the reports of these meta-analyses (see Table 3). Missing information in any one area would make the search less than fully reproducible. Six (16%) of the thirty-eight meta-analyses described all aspects of the search process in sufficient detail to be reproducible. Although many of the others provided detailed descriptions of most aspects of the search process, they did not provide complete descriptions of all aspects.

<Table 3 here>

Six of the fifteen (40%) meta-analyses that actively attempted to find unpublished studies documented this process enough to be reproducible. Of the meta-analysts that contacted other researchers either individually, via a listserv or through agencies, four out of ten (40%) provided complete descriptions of these contacts either by naming them or describing how the names were located. Two (50%) of the four meta-analyses that mentioned using conference proceedings or programs named all the proceedings, programs, or program databases used.

To be reproducible, a description of a database search would include the names of the databases searched, the date limits and a full list of search terms. Of the thirty-six meta-analyses that indicated database searching was used, eleven (31%) provided complete descriptions of all three of these pieces of information.

All thirty-six of the meta-analyses that involved a database search described the databases searched. These descriptions generally were clear, but there were some exceptions. For example, almost all (thirty-three) of the meta-analyses mentioned use of PsycINFO or PsycLIT to find studies, but two used alternate names: Psychological Abstracts International and Psychological Literature databases to refer to searches in what probably was PsycINFO or PsycLIT. One article named the search interface (WebSPIRS) rather than the databases within WebSPIRS that were searched.

Twenty-four (67%) of these thirty-six articles included lists of all the search terms used, but three of these lists did not give enough information to reproduce the search. One meta-analysis provided a complete list, but it indicated that truncated keywords were used without indicating where the truncation began. The reader would not know if psychoimmunology was entered as psychoimmunolog* or psychoimmun*. Two others provided complete lists but were ambiguous about what database or databases were used with the terms. Twenty-one (58%) provided a term list that could be used to reproduce the authors' search.

Of the thirty-six meta-analyses that indicated database searches were used, twenty-two (61%) provided complete date ranges for all of the databases searched. Many of the others provided partial date ranges. These date ranges were incomplete because they indicated the beginning or end of the date range but not both, or they indicated the date ranges for just some of the databases searched.

To reproduce a manual search, the description would include the names and date ranges of all journals hand searched and the names of all review sources used to find references. Of the thirty-six meta-analyses that mentioned using any manual search techniques, nineteen (53%) described them in a way that was fully reproducible. Of these, eleven (57%) only manually

searched the citations of studies found for the meta-analysis, and the other eight used other manual search methods.

Of the seventeen meta-analyses that used the reference lists of previous reviews, seven (41%) indicated which reviews were used. The others gave partial lists of the review sources or indicated that this method was used without indicating the sources. Of the twelve meta-analyses that used manual searching of journals, most, eight (67%), provided the names of all the journals that were searched, but only four (33%) included the date range. Three (25%) indicated both the names and the dates of all the journals that were manually searched.

Discussion

Overall, the results from this study show a mixed picture of the extent to which psychology meta-analysts applied different strategies to find studies and of their thoroughness in documenting the searches. Generally, the researchers used both manual searching and database searching to find studies. Generally, they searched more than one database. Sometimes the authors made an effort to find unpublished studies, and sometimes they did not. Generally, they did not provide enough documentation of all aspects of the search for it to be reproducible. At least based on their search descriptions, generally they did not use controlled vocabularies or wildcard operators in their searches of indexing and abstracting databases.

The results of this study do not quantify the effect that the limitations in these searches had on the results of the meta-analyses. The effect on the meta-analysis could be substantial if limitations in the search strategy resulted in missing a large number of studies with substantially different results from the included studies. On the other hand, if the studies that were not found

had essentially the same results as the studies that were found, the results of a meta-analysis would be relatively unaffected by adding more search strategies or more terms to the database searches. Similarly, if only a small number of small studies would be found via additional search strategies, they would not produce much of a change in the results of the meta-analysis. Extended search strategies even could have a deleterious effect on the results of a meta-analysis. Database searches for just one author, manually searching references from just one review article, and manually searching in just one journal could introduce biases if that search led to reports with one conclusion and ignored the authors, review articles and journals that would lead to reports with the opposite conclusion.

The results of this study also do not answer the question of why authors used some search strategies but not others. It is possible that the authors made conscious choices to limit their searches in a balance between the available resources and the goal of producing a high-quality meta-analysis. It also is possible that the authors were not aware of all the techniques available to increase the number of relevant studies they found.

Additional research on the effects of search limitations on the results of meta-analyses could help researchers and librarians make informed decisions about which strategies to include and which strategies to forgo. Ideally, this research also would consider the costs of a particular strategy, so a researcher would have guidance to balance the benefit of uncovering additional studies against the resources needed to use a particular approach.

The idea of balancing the benefits of an additional search strategy against the costs of doing so assumes, of course, that the researcher is aware that a strategy exists. It is unclear from the current study if the researchers were aware of the controlled vocabularies and wildcard tools that they could have used in their database searches. Some authors may have chosen to exclude

terms from a controlled vocabulary out of concern for the time needed to consult the thesaurus and filter through additional results or because they felt the controlled vocabulary terms suggested in Table 2 were not on-topic.   I find it hard to believe that the authors of more than half of the articles that provided complete lists of their search terms made this choice.

The authors may not realize how much of the literature they missed. Blair and Maron (1985) vividly demonstrated this problem. When they introduced a full-text searchable database to a law office, the system typically retrieved 20% of the relevant documents. Subjectively, the lawyers felt that the system was retrieving close to 75% of the relevant documents, and they were surprised that the recall was so low.

Librarians who serve psychology researchers have a role to play in improving the quality of searches used for meta-analyses. Weller (2004) has argued that the role of librarians in the meta-analysis process is essential. Librarians can help researchers understand the challenges of a thorough search and help them to make informed decisions about what databases to use, what search strategies to apply, and how to conduct efficient searches. This role could be an instructional one to aid the researchers devising their search strategies (e.g. Wykoff 1985). The role could also be as an active member of the research team (e.g. McGowan and Sampson 2005), or it could be an intermediate role of providing the database search and of assisting in document retrieval (e.g. Mead and Richards 1995).

Regardless of the approach, these roles fit squarely in the definition of what user services librarians do. As described in the *Occupational Outlook Handbook* (U.S. Department of Labor Bureau of Labor Statistics, 2004), "The job involves analyzing users' needs to determine what information is appropriate, as well as searching for, acquiring, and providing the information. The job also includes an instructional role, such as showing users how to access information."

For librarians to successfully play this role in meta-analyses, they should understand the need for a high-recall, unbiased search in this situation and consider the tradeoffs involved in using or excluding different search strategies.   Librarians also should discuss with the researchers the level of assistance that they are able to provide. Most importantly, the researchers and the librarians first must make contact with each other. With this contact, the librarian's expertise in searching can combine with the researcher's expertise in the subject area to produce a result better than either could produce alone.

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Meta-analyses considered for this report are marked with an asterisk.

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Table 1 Search methods described in psychology meta-analyses

Search Methods Described in Meta-Analysis	Number of meta-analyses	%
Searching for unpublished studies	15	39
Dissertation search	11	29
Contacting relevant researchers or organizations	10	26
Conference proceedings	4	11
Database Searching	36	95
More than one database	30	79
Truncation or wildcard operators	2	5
Controlled vocabulary	1	3
Manual Searching	36	95
Reference lists of studies included in meta-analysis	21	55
Reference lists of other articles	17	45
Journal scanning	12	32
Other methods		
Author searching	3	8
Forward citation searching	2	5

Table 2 Additional search terms found by consulting controlled vocabularies

Article[1]	Databases used	Controlled vocabulary terms NOT searched[2]
Allen et al.--Career Benefits Associated With Mentoring for Protégés: A Meta-Analysis.	PsycINFO	occupational success
Archer--Sex Differences in Aggression in Real-World Settings: A Meta-Analytic Review.	PsycINFO, PsycLIT	aggressiveness
Bogg and Roberts--Conscientiousness and Health-Related Behaviors: A Meta-Analysis of the Leading Behavioral Contributors to Mortality.	PsycINFO	impulsiveness, Sixteen Personality Factors Questionnaire, dietary restraint, psychosexual behavior, sexual risk taking, marijuana usage
	PubMed	Cattell Personality Factor Questionnaire, MMPI, sexual behavior, substance-related disorders
Bono and Judge--Personality and Transformational and Transactional Leadership: A Meta-Analysis.	PsycINFO	---
Cepeda-Benito, Reynoso and Erath, Stephen--Meta-Analysis of the Efficacy of Nicotine Replacement Therapy for Smoking Cessation: Differences Between Men and Women.	Medline	---
	Psychological Abstracts	---
Curtis, Ronan and Borduin--Multisystemic Treatment: A Meta-Analysis of Outcome Studies.	Psychological Literature	---
	ERIC	delinquency, delinquent rehabilitation, family relationship, parent child relationship
Dickerson and Kemeny--Acute Stressors and Cortisol Responses: A Theoretical Integration and Synthesis of Laboratory Research.	Medline	neurosecretory systems
	PsycINFO	Hypothalamo Pituitary Adrenal System
DiMatteo--Social Support and Patient Adherence to Medical Treatment: A Meta-Analysis.	Medline	treatment refusal, patient dropouts
	PsycLIT	treatment compliance, treatment refusal, treatment dropouts
Frazier, Demaree and Youngstrom--Meta-Analysis of Intellectual and Neuropsychological Test Performance in Attention-Deficit/Hyperactivity Disorder.	Medline	intelligence tests
	PsycINFO	intelligence quotient, cognitive ability
Henry and Crawford (2004a)--A Meta-Analytic Review of Verbal Fluency Performance Following	PsycLIT	---

Article[1]	Databases used	Controlled vocabulary terms NOT searched[2]
Focal Cortical Lesions.		
Henry and Crawford (2004b)--A Meta-Analytic Review of Verbal Fluency Performance in Patients With Traumatic Brain Injury.	PsycLIT	---
Henry et al.--A Meta-Analytic Review of Prospective Memory and Aging.	PsycLIT	intention
Hervey, Epstein and Curry--Neuropsychology of Adults With Attention-Deficit/Hyperactivity Disorder: A Meta-Analytic Review.	Medline	neuropsychological tests
	PsycINFO	hyperkinesis, neuropsychological assessment
Kumkale, and Albarracín--The Sleeper Effect in Persuasion: A Meta-Analytic Review.	ERIC	persuasive discourse, *attitudes, opinions, beliefs*
	PsycINFO	persuasive communication, *attitudes*
Lorber--Psychophysiology of Aggression, Psychopathy, and Conduct Problems: A Meta-Analysis.	Medline	---
	PsycINFO	cardiovascular reactivity, skin resistance, physiological correlates
Martire et al.--Is It Beneficial to Involve a Family Member? A Meta-Analysis of Psychosocial Interventions for Chronic Illness.	CINAHL	*patients*, chronic disease, *caregivers*, *spouses*, significant other
	ERIC	*patients, caregivers, spouses*
	Medline, PubMed	chronic disease, *caregivers, spouses*
	PsycINFO	*patients*, *caregivers*, *spouses*, husbands, wives, significant others
Mezulis et al.--Is There a Universal Positivity Bias in Attributions? A Meta-Analytic Review of Individual, Developmental, and Cultural Differences in the Self-Serving Attributional Bias.	ERIC	---
	PsycINFO	self perception, social perception
Moyer, Rounds and Hannum--A Meta-Analysis of Massage Therapy Research.	CINAHL	manual therapy, myofascial release
	Medline	kinesiology applied
	PsycINFO	---
Nummenmaa and Niemi--Inducing Affective States With Success-Failure Manipulations: A Meta-Analysis.	ERIC	*moods,* emotional response
	PsycINFO	emotional responses*, emotions,* emotional states*, achievement*
Rhodes--Age-Related Differences in Performance	Medline	---

Article[1]	Databases used	Controlled vocabulary terms NOT searched[2]
on the Wisconsin Card Sorting Test: A Meta-Analytic Review.	PsycINFO	---
Robbins et al.--Do Psychosocial and Study Skill Factors Predict College Outcomes? A Meta-Analysis.	ERIC	---
	PsycINFO	college students[3], creativity, *expectations*, *educational aspirations*, *occupational aspirations*, family relations, peer relations
Segerstrom and Miller--Psychological Stress and the Human Immune System: A Meta-Analytic Study of 30 Years of Inquiry.	Medline	life change events
	PsycINFO	life experiences, immunology, immunoreactivity, psychoneuroimmunology
Stice and Shaw--Eating Disorder Prevention Programs: A Meta-Analytic Review.	CINAHL	*eating disorders*, female athlete triad
	Medline	*eating disorders*
	PsycINFO	*eating disorders*

[1] Complete references are provided in the reference section.
[2] Terms listed in italic are plurals of the terms used by the authors and would have been found if the authors used wildcard operators.
[3] This meta-analysis used "students" as a search term but not in the facet of the search related to higher education. Records containing "college students" also had to contain "higher education," "undergraduate study," "undergraduate students," or "college attendance" to be found with the authors' search strategy.

Table 3 Detail provided in description of search strategy

Description Feature	Number possible	Number providing	%
All aspects of search reproducible	38	6	16
Complete description of search for unpublished studies	15	6	40
Names or reproducible description of contacts	10	4	40
Names of conference proceedings / database	4	2	50
Complete description of database search	36	11	31
Names of databases searched	36	35	97
All search terms used	36	24	67
How and where all search terms used	36	21	58
Beginning and ending date limits	36	22	61
Complete description of manual search	36	19	53
Names of all review sources used to find references	17	7	41
Complete date ranges of journals manually searched	12	4	33
Names of all journals manually searched	12	8	67
Names and date ranges of journals manually searched	12	3	25