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Community-Augmented Meta-Analyses: Toward Cumulative Data Assessment

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Abstract

We present the concept of a *community-augmented meta-analysis* (CAMA), a simple yet novel tool that significantly facilitates the accumulation and evaluation of previous studies within a specific scientific field. A CAMA is a combination of a meta-analysis and an open repository. Like a meta-analysis, it is centered around a psychologically relevant topic and includes methodological details and standardized effect sizes. As in a repository, data do not remain undisclosed and static after publication but can be used and extended by the research community, as anyone can download all information and can add new data via simple forms. Based on our experiences with building three CAMAs, we illustrate the concept and explain how CAMAs can facilitate improving our research practices via the integration of past research, the accumulation of knowledge, and the documentation of file-drawer studies.

Keywords

introduction, meta-analysis, repository, data sharing

Following up on a series of incidents around current research practices (see Ledgerwood, 2014, this issue), a number of researchers have proposed ways in which we can change our practices to facilitate the accumulation of true knowledge (as compared to false positives and insensitive data; Cumming, 2014). In this article, based on the idea that carefully looking back can help us better move forward, we present a simple yet novel tool that significantly facilitates the accumulation and evaluation of previous studies within a specific scientific field: a community-augmented meta-analysis (CAMA). A CAMA is a combination of two common tools for accumulating and evaluating knowledge, namely open repositories and meta-analyses. The former include method-specific (e.g., BrainMap.org; Gibbons, 1992) and replication repositories (e.g., PsychFileDrawer.org; Spellman, 2012), both of which can remain up to date since they are open to and updated by users. Such repositories, however, tend to be overly broad in coverage and are often insufficiently detailed along potentially cognitively relevant dimensions. In contrast, meta-analyses more readily speak to our psychological interests, as they address a specific topic in a compact format. Meta-analyses have the further advantage that results across diverse methodologies are expressed in a common metric in the form of standardized effect sizes (Lipsey & Wilson, 2001). Unlike repositories, however, meta-analyses are private, static endeavors. The load of the work is done by the meta-analysts, who hold all decision power in terms of study inclusion and moderator coding. Moreover, the resulting database is crystallized at publication, and it ages thereafter. We propose that these two tools can be merged to create topic-oriented CAMAs that are accessible to the whole research community. The content of these open-access databases corresponds to meta-analyses, thus containing methodological and outcome variables of studies centered around one relatively restricted topic. The format resembles repositories in that the database can be accessed as well as updated at any point, either via a restricted group of moderators or more directly by the research community. camas.acristia.org

We have created three such CAMAs (accessible at sites.camas.acristia.org): InVarInf (focusing on individual variation in infancy), InPhonDB (focusing on infant speech perception), and InWordDB (focusing on infant speech

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segmentation). We first describe in general terms how these CAMAs were created and how they are maintained today. Readers interested in actually creating a CAMA are encouraged to consult our online tutorial, which provides hands-on tools and instructions (available at createyourowncama.acristia.org). Based on our experience creating and managing several CAMAs, we then outline the opportunities and challenges associated with such an endeavor and clarify how they can facilitate the implementation of three practices recommended in an earlier Special Section on Improving our Methods and Practices.

CAMAs

Our three databases emerged from specific research interests of the people who are the current database moderators. They were thus "born" as regular meta-analyses and structured literature reviews. We think it is likely that the first steps in the creation of a CAMA will be taken by one or a few individuals, who can select an appropriate coverage of a research topic. Indeed, the topic should probably be narrow enough that methods and outcome variables can remain comparable, but broad enough to attract sufficient attention and to be informative for other researchers who work on different but related questions with comparable experimental designs.

Once the scope of each CAMA had been decided upon, we identified relevant research following the PRISMA statement on structured reviews and meta-analyses (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). Each study was then coded along multiple dimensions, which included (a) study identifiers (e.g., title, unique digital object identifier), (b) participant characteristics (e.g., gender distribution), (c) key methodological variables (e.g., language in which speech stimuli had been recorded), and (d) dependent variables and derived effect sizes. Data entry was split among the authors, and the first author of each database later went through all records to check for consistency in criteria. In our experience, it is possible to provide specific instructions to achieve high reliability across coders; nonetheless, if possible, an experienced database moderator should check for cross-record consistency.

Sometimes key information was unavailable (e.g., not allowing the calculation of an effect size), or our literature review had missed a study. Both of these limitations could, in most cases, be addressed through personal communications with fellow researchers who provided the missing information.

Up to this point, the creation of a CAMA strongly resembles a meta-analysis. In the next step, the database is rendered public and amenable to augmentation by the community. This critical feature facilitates the implementation of three practices recommended in an earlier Special Section: integrating past research, cumulating knowledge, and publicizing file-drawer studies. We address each topic in detail below.

Integrating Past Research

The importance of appropriately powered studies has been repeatedly emphasized in the psychological sciences (e.g., Braver, Thoemmes, & Rosenthal, 2014; Lakens & Evers, 2014; to cite just two recent examples). Underpowered studies can lead to erroneous conclusions regarding the presence or absence of an effect and are therefore directly related to many important and continuously problematic issues such as replicability (e.g., Pashler & Wagenmakers, 2012) and file drawer studies (e.g., Spellman, 2012). To carry out power analyses, one needs a good estimate of the expected size of an effect as well as an estimate of effect size heterogeneity (McShane & Böckenholt, 2014, this issue). However, the steps leading up to power calculations can consume a considerable amount of time and resources: literature screening, careful coding of independent and dependent variables, effect size calculation, and the application of meta-analytic methods. CAMAs provide an efficient way to pool resources and significantly reduce the cost of power calculations for researchers within a field. The researchers who undertake these steps for their own power calculations merely need to spend a little extra effort making the resulting database open to others.

Quantitative reviews of previous work can also inform our research practice in other ways. For example, researchers can use an extant CAMA to decide on design variables for their next experiment, including the selection of methodological parameters that are more common and/or lead to the largest effect sizes.

With all the advantages of open-access databases also come challenges. At the moment, CAMAs facilitate accessing effect sizes but they cannot replace an understanding of what power analyses and effect sizes are. For instance, users must decide on the criteria for selecting "similar studies" for their power calculations; they may also need to consider how to integrate effect sizes when databases include repeated testing (i.e., effect sizes might be reported for multiple tasks presented to the same participants). Depending on the complexity of research designs entered in a CAMA, more such decisions might be required to reach a sensible evaluation of the available data. CAMA creators may consider including links to relevant articles and websites, in order to educate naive users about power analyses and meta-analyses, and/or simplified instructions specific to the database. For example, InPhonDB includes step-by-step tutorials to do power analyses and more complex scripts to facilitate the

use of the database (sites.google.com/site/inphondb/what-can-you-do-with-inphondb).

Cumulating Knowledge

CAMAs not only enable the evaluation of previous studies, they also permit the continuous addition of new studies. As such, they speak to the suggestion of cumulative approaches to data aggregation (Braver et al., 2014) in addition to a retrospective summary of past studies. New studies can be uploaded following a few easy steps, thus providing the community with a current, comprehensive database. In addition to enabling a dynamic assessment of quantitative variables, CAMAs are useful for those desiring to get a qualitative overview of a research field, to identify gaps in the literature, and to track new developments. Thus, with minimal costs for each researcher who adds a study, a whole research community profits from a sustainable and dynamic resource.

Options for structuring a CAMA

Which data should contributors enter into a CAMA and how should they do so? We have made different choices in our three extant CAMAs. InVarInf has very few and straightforward variables (study identifier, descriptors of two tasks, and correlation coefficients between them are the key columns on the final spreadsheet). As contributing does not require great expertise, contributors fill in a Google form, which immediately feeds the publicly available database. Studies thus added are immediately available, but automatically marked as "not checked" until the moderator looks them over. It is then up to the user to decide whether to take such studies (for which the data may have been entered using different criteria) into account or not.

InWordDB has a more complex structure, and a submission form on the website gives details for each required variable. Here, filling in crucial information that is consistently present in the database (study identifier, core participant descriptors, dependent variables) is mandatory and all other fields are optional. Moderators screen all additions before they are added to the public database.

InPhonDB contains data coming from a wide variety of methods in which different types of dependent variables are relevant. Data entry here is done through downloadable Excel spreadsheets that are customized to each method. Each variable is accompanied by detailed descriptions and an example entry, and these materials are complemented with well-documented instructions for submission. Once filled in, the form is emailed to the moderators, who check it and add it to the database. We reduced the number of fields in InPhonDB by assessing whether they predicted effect size and removed those that did not (a step also conceivable for InWordDB).[1]

Publicizing a CAMA

Once a system for contribution is in place, the second step involves raising awareness of the CAMA and the possibility of contributing new data. We have taken multiple approaches to this end, which we evaluated through the number of visits to the site (using Google analytics):

- We sent personalized emails to editors of major specialized journals, key researchers in the field, and authors of new articles that would fit the database with a request to add their data. We noticed little change in traffic following these events.
- We published reports in specialized, international, peer-reviewed journals; there was little change in traffic. Traffic increased from 4 views per month before publication to 6 views per month after reporting on InVarInf (Cristia, Seidl, Junge, Soderstrom, & Hagoort, 2014) and from 5 views per month before publication to 12 views per month after reporting on InPhonDB (Tsuji & Cristia, 2014).
- We gave presentations at specialized international peer-reviewed conferences as well as organized dedicated workshops; in some cases we noticed a change in traffic (an increase from 4 to 44 views in InWordDB). In addition, these events triggered specific requests for slides and approaches to create new CAMAs.
- We posted announcements of InPhonDB to specialized mailing lists; traffic increased substantially after such announcements (an increase from 34 to 395 views) and slowly returned to a higher baseline thereafter (an average increase from 7 views per month 2–5 months before the initial announcement to 19 page views per month 2–5 months after).

In the few months that have elapsed since the publication of our first CAMA articles (Cristia et al., 2014; Tsuji & Cristia, 2014), only a few relevant studies have been published for each database. We have contacted the authors to suggest submission of their data. Although no submissions have been undertaken so far, this may be solely due to the brief time that has gone by, since the contacted authors do seem interested and willing to contribute.

Whereas the steps we have undertaken so far are primarily targeted at contacting interested researchers directly, partnerships with professional organizations or journals may additionally foster CAMA use. Being hosted and

managed by, for instance, the Association for Psychological Science (APS) may raise awareness and act as a guarantee for a CAMA's sustainability. Journals can boost submissions to a CAMA by marking articles that have been incorporated into a CAMA with a badge (along the lines of those provided today in *Psychological Science* for open data and open materials). In addition, journals publishing a CAMA could be persuaded to update the reference list to reflect additions after publication and thus boost the contributing author's citation index more directly. Professional organizations and journals will also indirectly support the concept of CAMAs once they make the reporting of power analyses a requirement in their guidelines.

It is nonetheless possible that authors cannot easily be persuaded to add their published studies to the database themselves. There are still other options that build on the crowdsourcing aspect of CAMAs. One alternative is that authors delegate the task to students or trainees. Another is that professors teaching research methods, statistics, or psychology courses propose this as a task or short internship to their students. Both of these alternatives are plausible because of the formative value of filling in a submission form: Looking through the list of variables demonstrates the complexity of even our simplest research paradigms, finding the appropriate information is an exercise in reading research papers, and missing key information can help a learner appreciate that detailed reporting serves the accumulation of scientific knowledge. Database managers can also organize working groups around relevant conferences, during which participants can more easily dedicate the time to contribute their own or other researchers' data.

File-Drawer Studies

Underreporting of null findings can lead to the overestimation of the strength and presence of certain effects (e.g., Rosenthal, 1979). CAMAs provide an efficient platform for file-drawer studies. Different from general file-drawer repositories (see e.g., PsychFileDrawer.org), results added to a CAMA can directly be integrated with published results and analyzed within one model in a single step. Moreover, researchers interested in continuing along the lines of a given research topic might be more motivated to immediately contribute their failed study to a CAMA rather than a more general repository, as they can directly profit from comparing their submitted file-drawer study with the other studies available in the CAMA. The relatively narrow focus of a CAMA will also render otherwise unreported data visible and usable to the relevant audience. For instance, all researchers working on topics related to a CAMA can directly benefit from added file-drawer studies, as they can easily obtain effect sizes based on less biased samples.

Naturally, file-drawer studies have not undergone a peer-review process before publication, which could lead to systematic differences in data quality. Indicating a study's publication status ensures that users can focus on peer-reviewed results if they choose while assessing the effect of methodological choices on experiment outcome.

One expected challenge involves motivating researchers to contribute their file drawer studies to any repository. For example, in our three CAMAs we do not have a single file-drawer study, despite the fact that we know from personal communications that there have been a number of studies that are unlikely to be published. Discussions with authors of this work and the answers to an anonymous online questionnaire revealed that one of the primary reasons to not contribute such work related to the time and effort involved in "digging up" the data and retrieving the relevant information. In general, we believe it is unlikely that researchers in our field who have long finished such studies can be persuaded to make this effort, and this may apply to other research fields (particularly when the data are in a format that is no longer usable or have not been fully coded).

However, we suspect that once researchers in a field are aware of the existence and potential utility of a CAMA, this particular reason for not contributing will not be convincing, especially for studies conducted after the publication of the CAMA. That is, the information a researcher usually needs to decide that a study "did not work" is the same that would be needed to be entered in the CAMA. Rather than having to dig through old data to contribute to a meta-analysis, which can take considerable time and effort, contributing a just-completed study to an existing CAMA is relatively easy.

Some researchers may worry that they forfeit a later chance of publication by submitting key information on such studies to the CAMA. This need not be true, since many journals (e.g., *Science, Proceedings of the National Academy of Sciences*) allow for the publication of preprints, which necessarily includes the information that would be added to the respective CAMA. The CAMA contribution would then include a link (either anonymized or containing an authorship statement) to the preprint or an archived document describing the study in question.

Conclusions

CAMAs are a promising tool to facilitate data evaluation and accumulation. Similar to regular meta-analyses, they enable the assessment of overarching questions in a specific field, including the identification of relevant moderator variables whose influence would be difficult to capture in a single study. The key difference is that they can be viewed as a dynamic endeavor by the community, as data inputting can be crowdsourced (thus distributing the load

of data entry), and for the community, as everyone can download and use the ensuing database. We have described how CAMAs could facilitate specific research practices that are increasingly recommended, yet remain otherwise difficult to implement, and we have detailed the initial investment and subsequent challenges that await others inclined to build a CAMA.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Note

1. The minimum number of items to be filled in ranges from 9 (InWordDB) or 10 (InVarInf) to 17 (for the most common method in InPhonDB), allowing for a quick entry.

References

Braver, S. L., Thoemmes, F. J., & Rosenthal, R. (2014). Continuously cumulating meta-analysis and replicability. *Perspectives on Psychological Science*, *9*, 333–342. doi:10.1177/1745691614529796

Cristia, A., Seidl, A., Junge, C., Soderstrom, M., & Hagoort, P. (2014). Predicting individual variation in language from infant speech perception measures. *Child Development*, *85*, 1330–1345. doi:10.1111/cdev.12193

Cumming, G. (2014). The new statistics: Why and how. *Psychological Science*. Advance online publication. doi:10.1177/0956797613504966

Gibbons, A. (1992). Databasing the brain. *Science*, *258*, 1872–1873. doi:10.1126/science.1470907

Lakens, D., & Evers, E. R. K. (2014). Sailing from the seas of chaos into the corridor of stability: Practical recommendations to increase the informational value of studies. *Perspectives on Psychological Science*, *9*, 278–292. doi:10.1177/1745691614528520

Ledgerwood, A. (2014). Introduction to the special section on advancing our methods and practices. *Perspectives on Psychological Science*, *9*, 275–277. doi:10.1177/1745691614529448

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.

McShane, B. B., & Böckenholt, U. (2014). You cannot step into the same river twice: Why power analyses are optimistic. *Perspectives on Psychological Science*, *9*, 612–625.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(6), e1000097. doi:10.1371/journal.pmed1000097

Pashler, H., & Wagenmakers, E.-J. (2012). Editors' introduction to the special section on replicability in psychological science: A crisis of confidence? *Perspectives on Psychological Science*, *7*, 528–530. doi:10.1177/1745691612465253

Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin, 86*, 638–641. doi:10.1037/0033-2909.86.3.638

Spellman, B. (2012). Introduction to the special section: Data, data, everywhere . . . especially in my file drawer. *Perspectives on Psychological Science*, *7*, 58–59. doi:10.1177/1745691611432124

Tsuji, S., & Cristia, A. (2014). Perceptual attunement in vowels: A meta-analysis. *Developmental Psychobiology*, *56*, 179–191. doi:10.1002/dev.21179