Sometimes, when you are in the middle of a crisis, it is impossible to fully know whether the critical situation will lead to disaster or provide an opportunity for positive growth. The field of psychology is currently experiencing a crisis, and it is a very public one. Popular press outlets as varied as Discover (Yong, 2014), Slate (Baker, 2016), The Atlantic (Bloom, 2016; Yong, 2015), the Washington Post (Nutt, 2016), National Public Radio’s Morning Edition (Vedantum, 2015), and even the Chronicle of Higher Education (Bartlett, 2016) have all brought the “replication crisis” out of the world of academic conventions and organizational newsletters, and into the light of public attention.

Each of those popular press articles described the origin and current status of the “replication crisis” in fairly similar ways. In the last few years, questions were raised about whether a specific well-respected researcher had falsified data for dozens of his articles1. These questions sparked an effort to determine whether other research could be replicated. The results of these replication efforts were dismaying because many studies (even some quite famous ones) failed to replicate. In one massive replication effort (Open Science Collaboration, 2015), 100 articles from three well-regarded journals2 were replicated, but only 36% of the replications were statistically significant, and (on average) the effect sizes of the replications were only half as strong as the effect sizes of the original articles. Several different explanations could be put forward to explain this surprising lack of replication.

First, and I suspect that this is the most frequent cause of nonreplication, seemingly minor methodological differences between the original study and the intended replication (which the replicating researcher may consider negligible or not even be aware of) might introduce factors that systematically change the results; in this case, the second study is not technically a replication but is instead a variant of the first study. For example, in a gender-priming study, the gender of the research assistant performing the priming procedure might influence the

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1The details of the fraud case are described in depth by Bhattacharjee (2013).

2The three journals studied were Psychological Science, Journal of Personality and Social Psychology, and Journal of Experimental Psychology: Learning, Memory, and Cognition.
The Red Badge of Research

Alfred R. Wallace and Charles R. Darwin

Research Report
Writing a Sample Article
And Writing Other Things Too

A hypothetical example of badges awarded to a journal article. In this example, the Open Materials and Preregistered badges are given, because the article provides an external website at which readers can access the research materials and time-stamped preregistered data collection and analysis plans. Retrieved from “Incorporating Badge Visualization Into Publications” by the Center for Open Science at https://osf.io/tyysz/wiki/4.%20Incorporating%20Badge%20Visualization%20Into%20Publications/
The Red Badge of Research

What Potential Concerns Should Be Considered First?

Before uploading one’s data to a public website, several issues must be considered. First, if any identifying data are included in the data set, these variables should be deleted prior to being uploaded. The authors agree to post their data in such a way that others could download the data and reanalyze it on their own. For example, Dietze and Knowles (2016) earned this badge for an article that explored the relationship between social class and motivational relevance. Using three separate experiments, Dietze and Knowles showed that higher class participants looked at other people less often than those from lower classes; for example, eye-tracking software was used to show that higher income participants spent less time looking at people in scenes of city streets than did lower income respondents, which suggested that social status was negatively related to the likelihood of attending to other people. All of the data for this manuscript have been permanently archived at https://osf.io/zzgq7m/, with time-stamps that show that the data were made publicly accessible on August 11, 2016, approximately two months before the online publication of the article. Because the data are available for anyone to download and reanalyze, the article was awarded the Open Data badge.

The COS specifies three criteria for awarding this badge. First, all of the data must be permanently stored at an open-access, time-stamped website, from which anyone could download the data. Any variables that identify the respondents should be deleted because publicly available data must still protect the confidentiality or anonymity of the research subjects, but all other variables collected must be provided. If the data have already been processed (for example, if a scale score has been created based on several individual items in the data set), the raw data that were used to calculate the scale must also be provided. Second, a data codebook needs to be available. Providing open data would be meaningless unless other users could tell what each variable represented. For this reason, the authors need to provide a data dictionary or explanation of what each variable (and each score on each variable) represents. Third, the researcher must provide authorization to allow others to use, copy, and distribute the data. Although the researcher may retain credit and copyright (when applicable), the data are publicly available to be used by anyone else.

What Is It?

The Open Materials badge indicates that the researcher has uploaded all of the surveys, tests, stimuli, and other materials that were used in the collection of the data. This allows other researchers to have access to procedures and items that would be needed to replicate one’s study. For example, Eom, Kim, Sherman, and Ishii (2016) earned this badge for an article that explored cultural variables that predict proenvironmentalism action. As part of this project, responses from a sample of European-American college students were compared with the responses given by Japanese college students to a survey about consumer behavior. The survey, permanently archived at https://osf.io/fb3kq/, asked respondents to indicate which of two products they would purchase; in some cases, one product had environmentally friendly elements (such as Chinet True Green Paper Cups) and the other one did not (such as Chinet Comfort Cups). Eom and colleagues demonstrated that, for the European-American respondents, the choice of environmentally friendly options was correlated with self-rated environmental concern, but for the Japanese students, the choice was correlated with...
the degree to which the respondents perceived those choices as being normative. Because the survey is permanently archived at https://osf.io/fb3kq/, any other researchers could replicate the research. Therefore, this article was awarded the Open Materials badge.

The COS specifies three criteria for awarding this badge. First, all of the research measures, stimuli, and surveys must be archived in a permanent, publicly available, open-access repository in a digitally sharable format. Second, any research components (such as a biological material, equipment, or stimuli that are not in a digital format) that cannot be uploaded have to be described in enough detail to allow for a full replication. Third, information has to be provided to explain the use of the materials, so that other researchers could fully replicate the procedure that generated the data.

What Potential Concerns Should Be Considered First?

Although many research measures can be uploaded for public access, some research measures should not. For example, if a researcher purchased copies of a proprietary personality test for use in a study, uploading a copy of the test would violate the test’s copyright. In addition, public release of test items themselves might violate the American Psychological Association’s Ethical Principles of Psychologists and Code of Conduct, because section 9.11 directs psychologists to protect the security of test questions in order to maintain the integrity of the assessment process. In these circumstances, the test materials should not be uploaded. Rather, the researcher should clearly indicate which tests were used, providing enough information to allow other researchers to purchase or access the tests (assuming they meet qualifications for test use), thereby replicating the procedure.

Preregistered

What Is It?

The Preregistered badge indicates that the researchers clearly articulated important aspects of their research methodology prior to collecting data, saving these research plans in a time-stamped website. After answering questions such as those listed in Table 1, the researcher saved the responses in a website that “froze” the research plans prior to data collection. For example, Lau, Morewedge, and Cikara (2016) earned the Preregistration badge for an article that explored the extent to which respondents expected stronger emotional reactions for in-group members or out-group members, relative to unspecified people. One of their analyses asked Republicans and Democrats to imagine someone from their own party, the opposing party, and an unspecified person losing a competition, and the respondents were asked to estimate how unhappy the person would be. Respondents expected the opposing party members to be most upset, relative to members of their own party and the unspecified individuals. Moreover, all three hypothetical people were expected to be more upset at the situation than a hypothetical Buddhist would be. This suggested that expectations of emotional responses are affected by in-group biases, out-group biases, and even stereotypes of Buddhist nonreactivity. Prior to data collection,

<table>
<thead>
<tr>
<th>Questions related to the study information</th>
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<tbody>
<tr>
<td>01. What is the project’s working title?</td>
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<tr>
<td>02. Who are the authors?</td>
</tr>
<tr>
<td>03. What research questions will be answered by this project?</td>
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<tr>
<td>04. What hypotheses will be tested for statistical significance?</td>
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<table>
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<tr>
<th>Questions related to the sampling plan</th>
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<tbody>
<tr>
<td>05. Do the data already exist? If yes, what steps have you taken to ensure that you are not aware of the results of any planned analyses?</td>
</tr>
<tr>
<td>06. What plans have you made to recruit participants and collect data?</td>
</tr>
<tr>
<td>07. How large do you intend for your sample to be, and how did you arrive at this number?</td>
</tr>
<tr>
<td>08. If you might terminate data collection before reaching the intended sample size, what systematic “stopping rule” will you use?</td>
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<tr>
<th>Questions related to the variables</th>
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<tr>
<td>09. What manipulated variables or treatment conditions are planned (if any)?</td>
</tr>
<tr>
<td>10. What measured variables or outcome measures are planned?</td>
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<tr>
<td>11. What indices (such as total scores from a series of research measure questions) will be calculated (if any)?</td>
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<tr>
<th>Questions related to the research design</th>
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<tr>
<td>12. Would you describe the study as an experiment, observational study, meta-analysis, or “other”?</td>
</tr>
<tr>
<td>13. How would you describe the study design (such as between-subject, within-subject, or mixed design)?</td>
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<td>14. Will there be randomization, and if so how will this be performed?</td>
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<tr>
<th>Questions related to the data analysis</th>
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<tbody>
<tr>
<td>15. Do you plan to transform, recenter, or recode the data?</td>
</tr>
<tr>
<td>16. How will you decide whether or not to exclude data from the analyses?</td>
</tr>
<tr>
<td>17. How will you handle missing or incomplete data?</td>
</tr>
<tr>
<td>18. What statistical tests will be used for each hypothesis?</td>
</tr>
<tr>
<td>19. Do you have any planned follow-up analyses such as pairwise comparisons?</td>
</tr>
<tr>
<td>20. What criteria (such as p-values) will you use to determine whether the results are statistically significant, and will these tests be one-tailed or two-tailed?</td>
</tr>
<tr>
<td>21. Do you have any planned exploratory analyses that are not related to the hypotheses listed above?</td>
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</table>

Other questions

22. Although optional and relatively uncommon, do you have any analysis scripts (such as SPSS syntax files that were created with pilot data) that you would like to preregister?
23. Is there any additional information that you believe should be preregistered in order to be transparent about the research plans?

Note: Retrieved from “Preregistration Challenge: Plan, Test, Discover” by the Center for Open Science at https://osf.io/jea94/
Lau and her colleagues preregistered their study at https://osf.io/x8etz/; in a two-page document, these researchers specified their hypotheses, independent variables and dependent variables, sample size and means of recruitment, data collection procedure, and planned statistical analyses. Because these essential research details were registered in a time-stamped format, the article was granted the Preregistration badge.

Four criteria have been specified by the COS in order for a study to receive this badge. First, the registration has to be saved on a public website created for preregistration purposes, timestamping and rendering the preregistration plans noneditable. In other words, simply saving a pdf file on one’s own privately created website would not be sufficient. Second, the preregistration must be saved and frozen prior to collecting data or initiating an intervention. In other words, the prefix “pre” is important; the registration must occur before a researcher could be influenced by the data. Third, the eventual design and analysis must follow the preregistered plans. Finally, the results of all preregistered analyses must be disclosed in the journal manuscript; additional analyses may also be reported, but the results of the preregistered ones must be provided.

However, the COS guidelines allow two exceptions to the requirements described above. First, a “DE” (i.e., Data Exists) notation can be given to a Preregistration badge if the data had already been collected prior to the registration but the researcher had not yet performed any analyses. Imagine, for example, a researcher who gains access to a large pre-existing data set, and wishes to run novel analyses. In general, this would appear to violate the second requirement listed above. However, the researcher could still preregister the analyses by transparently indicating that the existing data had not yet been examined. Second, a “TC” (i.e., Transparent Changes) notation can be given to a preregistration badge if unexpected changes required a shift in the research design or analyses. Imagine, for example, a researcher who plans to use specific statistical analyses, but when the article is submitted to a journal, a reviewer recommends a more appropriate statistical procedure. In general, a different statistical analysis would appear to violate the third requirement listed above. However, a footnote could be included to explain why the change occurred, transparently explaining the rationale for the changes.

What Potential Concerns Should Be Considered First?

In most cases, Preregistration would not require a dramatic change to one’s research practices because a conscientious researcher will already have considered the questions listed in Table 1 prior to collecting data. In fact, in many cases, these questions had to be answered as part of the Institutional Review Board approval process. The primary difference is that a preregistered study simply makes these answers public, and the researcher commits to take reasonable steps to follow those plans. In many ways, the most revolutionary aspect of the Preregistration badge is that it honors transparency in the planning phase of research.

Nevertheless, some have expressed concern about this practice. In a pair of editorials written in her role as President of the Association for Psychological Science, Goldin-Meadow raised two concerns that she hoped psychological research journals will consider as they are implementing Preregistration badges. First, will the initiation of Preregistration badges cause a bias against exploratory research (Goldin-Meadow, 2016a)? After all, scientists must first discover phenomena before they begin to examine causal factors, and psychological science would be weaker if the value of such exploratory research were minimized. Second, will the use of Preregistration badges (which are more relevant to some types of studies than others) cause a marginalization of studies that do not fit the Preregistration model (Goldin-Meadow, 2016b)? After all, Goldin-Meadow argued, Preregistration seems very well-suited for specific laboratory studies in which a single independent variable is manipulated, but may be less appropriate for large, “messy,” nonexperimental studies. Although she concluded that neither of these concerns should prevent journals from awarding Preregistration badges, she concluded that it will be important to avoid elevating the status of some studies and procedures while devaluing others. In response to Goldin-Meadow’s concerns, three advocates of Preregistration badges (two of whom serve as editors for journals that have implemented these badges) explained that Preregistration does not prevent exploratory research (Lindsay, Simons, & Lilienfeld, 2016). Rather, this process simply asks researchers to differentiate between planned, hypothesis-driven analyses and those that are more exploratory in nature. Registration serves as a useful adjunct to flawed human memory; as research projects progress, it is not uncommon for
one’s memories to shift and fluctuate—which can increase the probability of Type I errors. Preregistration allows the reader to know which results were confirmatory (with specific methods and hypotheses specified before seeing the data) and which were exploratory (which can be an exciting and important part of the research process). Moreover, they noted that Preregistration need not stifle a researcher; as described above, as long as changes are transparent and accompanied by a compelling rationale, additional analyses and even revised analyses are perfectly within the framework of a Preregistration. But preregistration, they argued, is not limited to lab-based experimental studies; any quantitative research with inferential statistical tests can be preregistered—even archival research. This simply requires specifying one’s predictions before running the analyses.

Because of the value of Preregistration, the COS has created a $1,000,000 Preregistration Challenge, which is described at https://cos.io/prereg/. As part of this challenge, one thousand researchers will win prizes of $1,000 each. To be eligible for this award, the researcher must preregister the study and then have it published in a journal that awards Preregistration badges following the COS’s guidelines; now that Psi Chi Journal of Psychological Research has initiated these badges, publication in this journal qualifies for the award.

Replication

What Is It?

In addition to the three badges that were introduced by the COS, Psi Chi Journal of Psychological Research has taken a trailblazing step by introducing a fourth badge to denote replication studies (see Figure 3). As noted by Edlund (2016), replications are an important part of the scientific process, yet some journals are hesitant to publish replications because of an incorrect belief that replications add little to the body of scientific literature. For this reason, the Psi Chi Research Advisory Committee and the Psi Chi Journal of Psychological Research recently launched a replication initiative, encouraging Psi Chi members to conduct replication studies. The creation of a Replication badge demonstrates that the journal’s leadership not only considers replications acceptable but also highly values the contribution that they make. For example, Keeren and Burmeister (2016) conducted a replication of the Knobe effect. Previous research had suggested that the positive or negative unintended effects of an action affect the degree to which people assign credit or blame to the person performing the action; although the previous researchers showed that respondents blame another person when the unintended consequences are negative, respondents are unlikely to praise another person when the unintended consequences are positive. However, that previous research had been called into question by other researchers. Keeren and Burmeister (2016) directly replicated the original study and obtained results that were consistent with the initial study. This study was published before the Replication badges were introduced, but the same level of conscientious replication would earn authors badges in future issues of this journal.

What Potential Concerns Should Be Considered First?

As noted above, seemingly minor differences between the original study and the replication might introduce factors that moderate the previously observed finding. For this reason, replicating researchers must take care to consider whether their study is a true replication or an intentional variant. However, because of word-count limitations in most research journals, some of the minor methodological decisions made by the original researcher might not have been published in the original article. To truly replicate the study, then, replicating researchers should attempt to contact the original researcher and request the original materials used in the study or inquire about their willingness to review the planned methodology of the replication. For example, Jonas et al. (2017)
demonstrated that the input of the original researcher might improve the quality of the planned replications. When a special journal series was announced in which one specific publication would be replicated several times, the authors of the planned replications submitted their proposals to the author of the original publication who worked with the replicating researchers to precisely replicate some aspects of the original article while also systematically manipulating other factors. Together, seven replications of the same article led to a more nuanced understanding of when the previously observed effect would and would not replicate. Therefore, rather than just relying on the information provided in the original article and making assumptions about the similarity of the research methodologies, researchers conducting a replication are urged to make attempts to contact the original authors.

**Getting Started**

Each of the badge-earning journal articles described as examples above posted their data, materials, or preregistration at the same general website, with an https://osf.io/ web address; this refers to the Open Science Framework (OSF), which was created by the COS to provide a free and versatile resource for researchers. Once you create an account on this website, you will be able to create a separate “project page” for each study you are conducting. With unlimited free storage, you can designate each of your coauthors as a “contributor,” giving you a shared space for storing all research-related electronic files. Initially coded as “Private,” you can change the status to “Public” when you reach a point at which you wish to seek a badge for your research manuscript. In addition, built-in Preregistration services guide you through the types of questions listed in Table 1, freezing your responses when you wish to have them preregistered. Therefore, the OSF provides a single resource that allows researchers to easily begin adapting their research processes to seek COS badges for their research articles. Visit https://osf.io/support/ for tutorials and answers to frequently asked questions.

**Conclusion**

As noted by Lindsay et al. (2016), times are changing, but the changes are positive. Although the replication crisis was triggered by a verified case of fraud, and then initiated a troubling concern about the inability to replicate a large number of studies published in highly respected journals, these badges provided psychological researchers with an opportunity to consider how to best conduct research in such a manner as to lead to replicable research. According to the Center for Open Science, the answer is found in transparency: open access of research materials, open access of research data, and open access of preplanned research methods and analyses. Because Psi Chi’s mission is “recognizing and promoting excellence in the science and application of psychology,” it is appropriate that *Psi Chi Journal of Psychological Research* is among the first peer-review psychological journals to recognize best practices of research transparency by awarding badges for Open Materials, Open Data, Preregistration, and Replication.

**References**


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