

FORS⁺ GUIDES

to survey methods
and data management



Pre-registration and registered reports

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Abstract:

Pre-registration and registered reports are increasingly advocated to improve the credibility and rigor of empirical research. Pre-registration and more strongly registered reports are expected to reduce reporting and publication bias because they request researchers to define a detailed research plan before the data are collected and before the research outcome is known. Thereby, confirmatory and exploratory research can clearly be distinguished.

Keywords: confirmatory research, publication bias, reporting bias, reproducibility, transparency

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The FORS Guides to survey methods and data management

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1. INTRODUCTION¹

Scientific research has witnessed increasing concerns about the credibility, reproducibility and statistical rigor of many published empirical findings (Bijak, 2019; Franco, Malhotra, & Simonovits, 2016; Freese, 2007; Nature, 2018). A major explanation is a strong publication bias towards positive results: Studies identifying a relationship between variables or a treatment effect are more easily published than null results (Bakker, van Dijk, & Wicherts, 2012; Giner-Sorolla, 2012; Nosek, Ebersole, DeHaven, & Mellor, 2018). As a consequence, researchers are motivated to obtain and report results that are more rewarded in terms of publication, which may affect the accuracy or the completeness of results (Casey, Glennerster, & Miguel, 2012; Franco, Malhotra, & Simonovits, 2014; Miguel et al., 2014; Nosek et al., 2018).

Against this background, there is a push towards open science and transparency in scientific research. As part of the discussion, Miguel et al. (2014, p. 30) request that “[s]ocial scientists should adopt higher transparency standards to improve the quality and credibility of research”. Several activities are put into place to produce better and more robust scientific output (Bijak, 2019; Chambers, 2019). A potential and increasingly advocated part of the solution is pre-registration. Pre-registration implies that a researcher publicly registers a research plan before actually collecting the data and executing the analysis. When conducting the study, researchers stick to that research plan. Pre-registration has a tradition in medical research as there was a growing concern that publication bias may harm public health (Chambers, 2019; Miguel et al., 2014; van 't Veer & Giner-Sorolla, 2016). It is increasingly applied in psychology, particularly with respect to experimental research, and has started to be discussed in social sciences (Franco et al., 2014, 2016; Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012). With pre-registration researchers can show that they embrace a hypothetico-deductive approach and clearly distinguish confirmatory from exploratory findings. Moreover, it is supposed to prevent researchers from applying practices such as HARKing (hypothesizing after the results are known) and *p*-hacking (adjusting the analysis or defining the analyzed sample until a statistically significant result is found) (Gelman & Loken, 2013; Kerr, 1998; Lindsay, Simons, & Lilienfeld, 2016; Simonsohn, Nelson, & Simmons, 2014). When having pre-registered a study and following it, researchers cannot come up with post-hoc explanations after having seen the results, also referred to as the ‘I-knew-it-all-along-effect’ (Fischhoff, 2003; Fischhoff & Beyth, 1975; Nosek et al., 2018) or make data-dependent choices and refine their analytical procedure until they confirm their hypothesis. This is beneficial for scientific research in general as it reduces reporting bias. Also individual researchers benefit, as pre-registration can increase the level of confidence in their and others’ findings. A more advanced form of pre-registration are registered reports. Registered reports are directly linked to a forthcoming journal publication for which data were not collected yet.

The aim of this guide is to give an overview of what pre-registration and registered reports are, how they can contribute to improving academic research and how they are applied. For more detailed information, a list of resources is provided at the end of the guide. This guide is based on an ongoing debate and, therefore, further developments in the area of pre-registration, especially for the social sciences are likely to occur.

¹ I thank Nicolas Sommet for fruitful discussions on the topic of pre-registration and his helpful comments on earlier versions of this guide.

2. PRE-REGISTRATION AND REGISTERED REPORTS

Pre-registration implies that a researcher registers a detailed research plan before collecting the data and before knowing the research outcome (Chambers, 2019; Nosek et al., 2018). This research plan includes an in-depth description of hypotheses, methods and analyses. Once finalized the plan is timestamped and cannot be edited (Lindsay et al., 2016; van 't Veer & Giner-Sorolla, 2016). For transparency and to ensure that the pre-registration can be found by other researchers, it is usually made public either immediately or after an embargo period (Chambers, 2019; Nosek et al., 2018). Pre-registration puts more emphasis on the conceptual framework and methodological part of academic papers and less emphasis on the results. Hence, pre-registration values strong theory and sound methodology (van 't Veer & Giner-Sorolla, 2016). Put differently, pre-registration changes “the incentive structure to value “good science” over and above “good results”” (Chambers, 2019, p. 21).

A rationale of pre-registration is to support researchers thinking about how to do their research before actually implementing it and before being biased by having seen the data. The idea is that it helps researchers to conduct better research and to more easily distinguish confirmatory from exploratory research. An additional benefit of pre-registration is that the research plan can be verified and reproduced by other researchers, journal editors and reviewers (van 't Veer & Giner-Sorolla, 2016; Wagenmakers et al., 2012). If there are any deviations from the plan, reviewers and readers can assess their appropriateness (Lindsay et al., 2016).

In this guide, two types of pre-registration are distinguished: Unreviewed pre-registration and registered reports. Unreviewed pre-registration refers to what was described above and will be referred to as pre-registration in what follows. A study based on pre-registration follows the regular publication process. Publication bias towards positive results is likely to remain. A registered report, which is sometimes called reviewed pre-registration, goes a step further as it is related to a scientific journal and a future publication (Lindsay et al., 2016; van 't Veer & Giner-Sorolla, 2016).

A registered report is a to-be-conducted study that is submitted directly to a journal before the study is carried out. Registered reports are part of the scientific publication procedure and the peer review process (Wagenmakers et al., 2012): The researcher submits a detailed research plan to a journal, which then undergoes a two-stage peer review process (Nature, 2018). A first round of peer review takes place before the data are collected (Chambers, 2019). At this stage, the researcher submits a detailed research plan including a theoretical framework, a description of the data that will be collected and the types of analyses that will be carried out. Reviewers then judge if the study is considered scientifically important and robust. Depending on the review, the researcher potentially adjusts the research plan and, if accepted by the journal, the article is offered ‘in principle acceptance’ (IPA) (Chambers, 2019; Nosek & Lakens, 2014). Researchers are assured that the results will be published irrespective of the outcome, as long as they follow the research or provide reasonable explanations for deviations (Nosek & Lakens, 2014). Then, the data are collected and analyzed according to the research plan and then the second part of the review process takes place. If the researcher follows the accepted registered report the article is accepted for publication. The decision whether an article is published does not depend on whether the results are interesting or new, but on the rigor of the research as such (Chambers, 2019; Nosek & Lakens, 2014). Consequently, registered reports should counteract publication bias toward positive results (Lindsay et al., 2016). Registered reports are a powerful tool as they

can prevent practices such as HARKing and p-hacking (Gelman & Loken, 2013; Kerr, 1998; Lindsay et al., 2016; Simonsohn et al., 2014), as well as publication and reporting bias (Chambers, 2019).

An increasing number of journals now offer registered reports. In March 2020, more than 220 journals use registered reports (Center for Open Science, 2020b). Examples are <https://www.rips-irsp.com> and <https://www.journals.elsevier.com/journal-of-development-economics/>. A list of journals is available on the website of the Center for Open Science (COS): <https://cos.io/rr/>.

3. HOW DO PRE-REGISTRATION AND REGISTERED REPORTS CONTRIBUTE TO IMPROVE RESEARCH?

Pre-registration and even more registered reports are expected to improve scientific research and its credibility as they can positively affect the way research is conducted (Nosek et al., 2018; van 't Veer & Giner-Sorolla, 2016). The most important ways of how pre-registration and registered reports can improve research are outlined in the following sections. For more detailed information see the reference list provided at the end of this guide.

3.1. PREVENTION OF HARKING TO DISTINGUISH CONFIRMATORY FROM EXPLORATORY RESEARCH

With pre-registration researchers should stick to the hypotheses and analyses laid out in the research plan. Thereby, pre-registration limits the possibility to engage in HARKing. HARKing implies that researchers alter their hypotheses and analytic strategy once the data are known (Chambers, 2019; Daly, 1996; Nosek et al., 2018; van 't Veer & Giner-Sorolla, 2016). Hence, the hypotheses are (re-)written once the researcher has seen the data and knows the outcomes of the study. HARKing is considered problematic in psychology (Chambers, 2019), but the situation seems similar in other social sciences disciplines. When researchers HARK, the boundaries between confirmatory and exploratory research become blurred. Hence, preventing HARKing is crucial for distinguishing confirmatory from exploratory research. This is one of the key advantages of pre-registration and even more registered reports (Lindsay et al., 2016).

Advocates of pre-registration are not against exploratory research. On the contrary, they encourage it and strike that it is crucial for generating new ideas and making new discoveries (Chambers, 2019; Lindsay et al., 2016; Nosek et al., 2018; Nosek & Lakens, 2014; Wagenmakers et al., 2012). However, in research articles it must be evident whether a result stems from a confirmatory or an exploratory analysis (Center for Open Science, 2020a; Wagenmakers et al., 2012). Currently, results from exploratory analyses are often presented as if they were based on a pre-specified analysis plan, while they are not (Lindsay et al., 2016; Miguel et al., 2014; Simmons, Nelson, & Simonsohn, 2011). Therefore, it is often difficult to judge whether a result stems from pre- or postdiction (Nosek et al., 2018). Presenting postdiction as predictions may increase the attractiveness and publishability of findings; however, it also falsely reduces uncertainty as well as reproducibility (Nosek et al., 2018). Overall, this creates a misleading picture of the existing evidence.

Confirmatory and exploratory research may be confused unconsciously. Often, outcomes seem more predictable once they have been observed, compared to before the observation. A

phenomenon referred to as ‘hindsight bias’ or the ‘I-knew-it-all-along effect’ (Fischhoff, 2003; Fischhoff & Beyth, 1975; Nosek et al., 2018; Wagenmakers et al., 2012). Pre-registration helps to remove hindsight bias as hypotheses are formulated before any data are seen. Moreover as the choices with respect to the analysis are made prior to data collection, they cannot be biased by motivation, memory or reasoning (Gelman & Loken, 2013; Nosek et al., 2018; van 't Veer & Giner-Sorolla, 2016). Pre-registration allows researchers to depart from the initial plan, but it must be clear what part of the analysis was planned and which one carried out post hoc (Franco et al., 2016).

3.2. FLEXIBILITY IN THE DATA ANALYSIS AND SELECTIVE REPORTING

As described above, when not following a clearly pre-specified analysis plan, researchers are somewhat flexible in terms of the data analysis (Gelman & Loken, 2013; Silberzahn et al., 2018). In this context, the term ‘researcher degree of freedom’, describes that sometimes, researchers have some opportunity for flexibility regarding what analyses to conduct and what results to present (Chambers, 2019; Gelman & Loken, 2013; Nosek et al., 2018; Simmons et al., 2011). A common procedure is p-hacking, which is the procedure of adjusting the analysis or defining the sample analyzed until a statistically significant result is found (Gelman & Loken, 2013; Nature, 2018; Silberzahn et al., 2018; Simonsohn et al., 2014). As with pre-registration the analysis plan has to be outlaid having collected the data, it can reduce p-hacking (Chambers, 2019; Nature, 2018).

Another concern stems from the observation that researchers may not even write up their results if they are null findings, because those results are considered uninteresting and unpublishable. This is referred to as the file drawer problem (Franco et al., 2014; Rosenthal, 1979). Such selective reporting entails a strong reporting bias: For example, researchers may only present the positive results from a larger study which overall reveals mixed or null results (Casey et al., 2012; Miguel et al., 2014). Selective reporting of positive results increases the likelihood of false positives (Franco et al., 2014, 2016; Nosek et al., 2018). With the existing incentive structure of publishing novel and positive results (Franco et al., 2016; Nosek & Lakens, 2014), it may be tempting to fine-tune the analysis in order to get the desired result or to ‘cherry pick’ results that generate an interesting narrative (Casey et al., 2012; Chambers, 2019; Nosek & Lakens, 2014; Simonsohn et al., 2014; Wagenmakers et al., 2012). Pre-registration is expected to reduce the likelihood of reporting bias as with pre-registration all previously mentioned hypotheses are tested, the announced analyses are carried out and the results are reported (Camerer et al., 2018; Franco et al., 2014). Yet, pre-registration alone does not necessarily solve this problem; registered reports can be more influential. If a pre-registered study does not confirm the hypotheses, researchers may still be less likely to draft an article and journals would probably still be less likely to publish it (cf. publication bias); this is much less likely with respect to registered reports.

3.3. PUBLICATION BIAS

The way how manuscripts are selected for publication in peer-reviewed journals has been increasingly criticized. Often, the decision is based on the results; hence, that part of a study on which the researcher has no (or should not have an) impact. Hence, publications depend on whether there are any significant or/and ‘interesting’ results, and not on whether a study meets high scientific standards and insignificant results tend to be difficult to publish (van 't Veer & Giner-Sorolla, 2016). This has created a research culture encouraging researchers to report positive and publishable results and making it less attractive to report null findings (cf. reporting bias).

Publication bias results into a misleading body of evidence with hardly any null results and many false positives (Humphreys, De la Sierra, & Van der Windt, 2013; Ioannidis, 2005; Miguel et al., 2014; Stroebe, Postmes, & Spears, 2012). Publication of false positives is highly problematic as researchers, policymakers and funding agencies may derive wrong conclusions and take wrong decisions (Simonsohn et al., 2014).

While the concern of publication bias was first raised with respect to medical research, it is also reported in the social sciences (Ashenfelter, Harmon, & Oosterbeek, 1999; Doucouliagos, 2005; Franco et al., 2014, 2016; Gerber & Malhotra, 2008). Particularly registered reports can play an important role in counteracting publication bias as they put the emphasis on the quality of the study and not on the results (Chambers, 2019; van 't Veer & Giner-Sorolla, 2016). Journals play a crucial role in this respect.

3.4. REPRODUCIBILITY AND REPLICABILITY

While not the main aim, pre-registration can contribute to increasing the reproducibility and replicability of research findings. This is important as there has been a growing concern about the fact that many empirical research results are not replicable (Bijak, 2019; Freese, 2007; Simmons et al., 2011). In psychology, a 'replication crisis' was called out (Nature, 2018). Across disciplines, making research more reproducible is advocated (Nature, 2018). Based on pre-registration, other researchers should find the information to reproduce a study or analysis (Chambers, 2019; Nosek et al., 2018).

3.5. PRE-REGISTRATION AND REGISTERED REPORTS TO CHANGE SCIENTIFIC PRACTICES

As has become clear in the previous sections, registered reports are more powerful than regular pre-registration. Registered reports are more binding, but at the same time, they provide stronger incentives for researchers. In particular, registered reports can reduce reporting and publication bias (Chambers, 2019; Lindsay et al., 2016). Here, scientific journals and particularly editors play a key role. In comparison to registered reports, pre-registration leaves more freedom to the researcher and requires more discipline to indeed stick to the research plan.

4. PLATFORMS FOR PRE-REGISTRATION AND REGISTERED REPORTS

Researchers can make use of different online platforms to pre-register a research project. These platforms usually provide a template to fill in. Most platforms either keep the pre-registration private during an embargo period before it is made public or the researcher can decide to make it public right away.

Below is a non-exhaustive list of platforms where social science researchers can pre-register their projects. So far, for the social sciences there is not yet a platform in Switzerland.

The two probably most popular generic platforms are

- the Open Science Framework managed by the Center for Open Science (COS): <https://cos.io/our-products/osf-registries/>.

- AsPredicted (hosted at the Credibility Lab of the Wharton School at the University of Pennsylvania in the US), which allows for easy and quick registration: <https://aspredicted.org/>. However, this platform does not necessarily ask for a very detailed analysis plan and does not oblige the researcher to make the pre-registration public after an embargo period.

In addition, several discipline-specific platforms exist. Examples are:

- The Evidence in Governance and Politics (EGAP) Registry for policy research: <https://egap.org/registration>
- The American Economic Association's registry for randomized controlled trials (AEA RCT): <https://www.socialscienceregistry.org/>
- The Registry for International Development Impact Evaluations (RIDIE) Registry: <https://ridie.3ieimpact.org/>

Registered reports are usually administered via journal websites. Some journals cooperate with the COS to administer registered reports.

5. PRE-REGISTRATION AND SECONDARY DATA

Pre-registration is usually applied with respect to primary data. There is an ongoing debate about if and how pre-registration can be applied to secondary data (see also OSF: <https://osf.io/x4gzt/>). However, for now, it remains unclear how to apply pre-registration to secondary data (Chambers, 2019; Miguel et al., 2014). If the researcher has not yet seen the data, a "pure" registration is possible (Nosek et al., 2018, p. 2603). If, on the other hand, the researcher has seen the data, this most likely biases the pre-registration (Chambers, 2019). In that case a suggestion is that the researcher reveals potential biases that may affect the research process (Nosek et al., 2018), by making a pre-registration and clearly indicating what was known about the dataset.

6. PRE-REGISTRATION AND REGISTERED REPORTS IN SWITZERLAND

Social science researchers in Switzerland have started to use pre-registration, especially in psychology. Currently, there is not yet a platform in Switzerland that allows researchers to store their pre-registration on Swiss servers. Swiss researchers tend to use OSF, some also use aspredicted.com. Swiss social science journals do not (yet) offer the possibility of registered reports. It is expected that the demand from researchers will increase in the next years and from discussions with researchers in Switzerland it became clear that they would highly appreciate a Swiss solution. The Swiss National Science Foundation is not requiring pre-registration for funded projects. Swiss researchers who want to publish in a journal offering or even requesting a registered report can of course do that via the respective journal. To the best of the author's knowledge, so far no social sciences journal edited in Switzerland is offering the option of registered reports.

7. RECOMMENDATIONS

Recommendation 1 – For your next research project, consider pre-registration. Take a look at the pre-registration templates suggested by the OSF and van 't Veer and Giner-Sorolla (2016). These are valuable resources to define the aim and strategy of your upcoming research project, even if you do not (yet) want to register a plan.

Recommendation 2 – Check on the website of the journal in which would like to publish your work if it offers the option of a registered report.

Recommendation 3 – Consider pre-registration as a push to be clear and precise about your research plan (Lindsay et al., 2016).

Recommendation 4 – In your own articles, be clear about what results are confirmatory and what results are exploratory.

FURTHER READINGS AND USEFUL WEB LINKS

A useful book to learn more about the current discussions on pre-registration and its value for more transparent research is Chambers (2019). Furthermore, there is more literature from Franco et al. (2014), Wagenmakers et al. (2012) and Nosek et al. (2018). van 't Veer and Giner-Sorolla (2016) provide a template for pre-registration in social psychology. The website of the Center for Open Science (<https://osf.io/>) and their section on pre-registration of secondary data: <https://osf.io/x4gzt> are also very useful. For an illustration of selective reporting see Franco et al. (2016).

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