Università degli Studi di Padova

Dipartimento di Psicologia dello Sviluppo e della Socializzazione

Corso di laurea triennale in Scienze Psicologiche dello Sviluppo, della Personalità e delle Relazioni Interpersonali

Tesi di laurea tiennale

Come la preregistrazione e i Registered Reports possono promuovere ricerca di alta qualità in psicologia

How Preregistration and Registered Reports can Foster High-Quality Psychological Research

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Anno Accademico 2024/2025

Acknowledgements

This dissertation has been one of the most challenging tasks in my academic journey so far. I would like to begin by thanking my supervisor, Professor Altoè, for providing me the opportunity to explore the topic of preregistration and Registered Reports in a manner that resonated with my academic perspective and for guiding me throughout the process. I would also like to thank Matteo for his kindness in helping me with the formatting. Special thanks go to my friend Francesca, with whom I was fortunate enough to share these three years. A shouth-out to my other close friends: Diletta, Margherita, Eleonora, Agata, Nicole, Greta, and Raffaele. Thank you for making this experience so rewarding, I will always hold our memories dear. You are the main reason I will miss Padua so much. I would like to dedicate this thesis to my parents. Mom, dad, none of this would have been possible without your support. Your presence means the world to me. I am grateful to all of you, this has been truly special,

Emma

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Summary

This thesis is an overview of the innovative practices of preregistration and Registered Reports in the context of the replication crisis. With suspiciously high rates of significant positive results and failed replication attempts, there is growing concern about the credibility of findings in the psychological literature. Possible causes include theoretical, methodological, and institutional issues. Preregistration and Registered Reports are a proposal for counteracting questionable research practices and publication bias, given that they require scientists to carefully design and report intended studies prior to data collection. With Registered Reports, researchers get early expert feedback and in principle acceptance, which guarantees publication in spite of the results. Recent evidence suggests preregistration and Registered Reports might lead to lower rates of positive results and higher-quality protocols, thus promoting transparency in the research process and a more realistic scientific literature.

Chapter 1

The Replication Crisis in Psychological Science

This chapter analyses the role of replication in science and the current replication crisis in psychological research. As a consequence, critical problems have emerged: with many findings being potentially false, scientific knowledge could lose credibility. Several factors contribute to the crisis, ranging from individual to institutional biases. Fortunately, many of these behaviours can be corrected. The chapter ends on a positive note, recognising the crisis as an opportunity for scientific progress. Open Science, preregistration, and Registered Reports are current projects that promote transparency and better research practices.

1.1 Reproducibility and Replicability Crisis

1.1.1 The Importance of Replication

Replication is the general term used to describe the repetition of a study, and it can be subdivided into reproducibility and replicability. An experiment is reproducible if the results remain quantitatively similar when using the same data and analysis methods (Hicks, 2023). On the other hand, replicability refers to "repeating a study or experiment with the goal of verifying effects or generalising findings across new models or populations" (Korbmacher et al., 2023, p. 1). In other words,

if new data provides qualitatively similar outcomes, a study is called replicable (Hicks, 2023). The crisis affects both reproducibility and replicability, with the latter conditioning how much scientific claims can be generalised and serve as a basis for solid theories.

In order to understand the importance of replication, it is necessary to look at science from a philosophical standpoint. There are different perspectives and goals in the scientific community, but certain principles guide most researchers in their work. This paper will analyse the replication crisis from an error statistical philosophy that recognises testing predictions as one of the main goals for creating scientific knowledge (Lakens, 2018). Replication is so crucial because it confers epistemic value to science. Results become trustworthy when followed up and verified in other studies (Romero, 2019). Replication accumulates evidence for or against claims, and with time, it allows us to strive towards more accurate theories and truthful facts by identifying errors (Frias-Navarro et al., 2020). It allows science to self-correct and move towards truthful knowledge; it renders credibility to both researchers and their work, makes their findings more precise, and allows for generalisation (Frias-Navarro et al., 2020).

In recent years, replication in science has received a lot of notice, especially in the fields of psychology and social psychology. Most studies do not get replicated (Makel et al., 2012), and the ones that do often show results that differ greatly from the original experiments (Romero, 2019). The failure to replicate is also known as the replication crisis, the replicability crisis, or the crisis of confidence. There have been several attempts to understand the prevalence of this problem, and it is reasonable to think most results in research are false because many studies have been found to be irreplicable (Ioannidis, 2005). One proof in this direction is the fact that most conclusions in accessible scientific papers are significant and in line with the hypothesis. This is statistically impossible since only a fraction of the results should come close to the hypothesis, thus leaving questions about the validity of the research in itself. In Open Science Collaboration (2015), when replicating studies, statistically significant effects went from 97% to 39%, and of the 39%, many were as low as half the original effects. This indicated that, more often than not, studies failed the test of replication, and only a small percentage were proven to be successful. It is very concerning because the estimated percentage was much higher: in the case of no false positives, the successful replication attempts should have been around 89% (Korbmacher et al., 2023). The Reproducibility Project also found that roughly one-third of results in psychology could not be replicated, even those posted in highly cited scientific papers (Open Science Collaboration, 2015).

Unreliable findings make theories pointless and progress questionable at the least. Single results, if not supported by other evidence, are of little use to science. Whilst it is true that the replication crisis has gained a lot of attention, especially in the last 15 years, the issue has been going on for decades and has been recognised as early as the 1960s (Romero, 2019).

Since irreplicability seems to occur for more studies than not, there is a strong case for thinking it is a major problem. In his findings, Baker (2016) observed that 52% of researchers considered the reproducibility crisis a significant issue for science: 38% believed it to be a small crisis, 7% were unsure, and a small percentage thought there was no crisis at all (3%).

From the replication crisis, many questions on the integrity of science and the quality of research arise. With data and results mainly in line with the hypotheses, is the scientific literature even trustworthy? In fact, a worrisome consequence of the crisis is the impact it has on the way researchers and the public view the scientific enterprise, and whether they still consider it credible (Romero, 2019). Even though it seems obvious that such premises would determine a loss of trust in science, there is also reason to believe otherwise. On the one hand, there is evidence for more skepticism towards past research, but not so much for future projects (Anvari & Lakens, 2018). Concerns with irreplicability are a sign of ongoing self-correction in science, therefore legitimising hope for its future progress. Researchers and the public might be more prone to trust when there is an open conversation about the problems that the scientific community faces, in this case, the replicability crisis. Such criticism is proof that scientists take these issues seriously and care about the quality of their work (Anvari & Lakens, 2018).

1.1.2 Questionable Research Practices

Recognising an issue is the first step towards change: the next thing to do is to analyse the possible causes. The reasons for such a high rate of failure in replication can result from wrong conclusions drawn in the original studies, low power, or poorly conducted replication studies (Frias-Navarro et al., 2020). It is plausible that false conclusions are greatly responsible for issues with replicability. Some of the possible explanations can be found in Questionable Research Practices, pressures from publishing companies, counterproductive institutional rewards, and insufficient statistical preparation and knowledge (Frias-Navarro et al., 2020).

Questionable Research Practices (QRPs) are unethical decisions that researchers make while conducting a study to obtain a desired outcome. They are frequently used because they increase

the researchers' chances of getting published. They can be implemented even unconsciously, and are easily unnoticeable, particularly in the field of social psychology, because of the degrees of freedom researchers have (Simmons et al., 2011). Since psychology is a relatively new science, it is founded for the most part on recent theories that still need further exploration. It is also very complex to study because of all the variables to consider; therefore, much flexibility in data analysis is permitted. This means there are many ways subject matters can be analysed.

The knowledge that many researchers have taken part in malpractices in the past is not new, with some having admitted to it (Anvari & Lakens, 2018). QRPs are often mentioned in the replication crisis because they inflate the Type 1 error rates, thus leading to a proliferation of wrong conclusions. They also reduce the severity of studies, namely, the ability of the study to prove a prediction is false gets compromised (Lakens, 2018). The Type 1 error corresponds to a false positive, meaning an effect is wrongfully claimed, and it occurs when the null hypothesis in Null Hypothesis Significance Testing (NHST) is mistakenly rejected. These types of errors are well known in statistics and can be controlled, conventionally having a 5% presence.

Some of the most common QRPs include p-hacking, fishing for variables, selecting data, data fabrication, HARKing, cherry picking, and publication bias (Frias-Navarro et al., 2020). P-hacking indicates manipulating the p-value to surpass the conventional threshold of significance in order to obtain a specific outcome (Romero, 2019). For example, reporting a p-value of 0.054 as 0.05 might just be enough for some researchers to obtain a not otherwise statistically significant effect (Frias-Navarro et al., 2020). Fishing for variables means deciding which variables to include or exclude in the study based on whether they help get to the desired result, without giving valid theoretical reasons for such maneuvers. A similar concept can apply to data: scientists can choose what data to add or remove according to their preferences (Frias-Navarro et al., 2020). They can also decide when to stop or continue collecting data until they are satisfied with the results at hand. If data gets fabricated, it implies that it gets changed or invented altogether, and it constitutes a fraud. Another questionable practice is cherry picking. Cherry picking refers to only selecting significant results likely in line with the hypothesis of the study, whilst getting rid of inconvenient or not big enough effects. If sufficient tests are conducted, the probability of finding at least one significant result is almost certain, and it can be selected whilst ignoring all the other conclusions. Because analyses in psychology are so flexible and a research question can be answered in many different ways, there is a high chance of finding at least one significant result at some point, often a false

positive. Another questionable practice is HARKing, that is, hypothesising after the results are known. It happens when hypotheses made after examining data are sold as if they had been thought of all along (Świątkowski & Dompnier, 2017). It is much easier to derive a hypothesis post-hoc than it is to predict one. Original hypotheses can be modified or even removed if considered unsuitable (Frias-Navarro et al., 2020). By doing so, the research becomes exploratory and no longer classifies as confirmatory, even though it often gets mistakenly labeled.

Another plausible reason for the prevalence of statistically positive results in the scientific literature is publication bias. Researchers have a higher inclination to publish outcomes that are in accordance with their hypotheses (Cooper et al., 1997). There is evidence that findings not in line with expectations are both submitted and published less often (Greenwald, 1975). This phenomenon distorts evidence in research in favor of only certain results. Where publication bias occurs, there is no way of obtaining the full picture of a topic, for instance, of the negative or non-significant outcomes. As a consequence, the number of omitted null conclusions is up for speculation (Świątkowski & Dompnier, 2017). The file-drawer effect refers to the plausible phenomenon that false positives are the results that get published most of the time, whilst the remaining 95% of findings are hidden. Hence, the public never reaches the full evidence for and against hypotheses. The file-drawer effect can also lead to supporting false theories if applied to replications (Romero, 2019). By solely relying on the experiments that get published, scientists might forge misleading theories, thus creating incomplete or false knowledge surrounding a topic.

Publication bias is also likely prompted by the current research framework and publishing system (Frias-Navarro et al., 2020). Journals tend to favour positive and novel findings over negative or null conclusions because they are the ones that gain the most attention and prestige. Thus, researchers are pressured into delivering positive, statistically significant results. This not only increases their chances of getting published but also helps with their career advancement. One way to obtain academic positions is by publishing many great findings (Świątkowski & Dompnier, 2017). There is much more emphasis on the number of articles published and on positive results, rather than on the quality of the research. Biased measures such as QRPs can get results easily, hence scientists might be motivated to take advantage of them.

1.2 How to Increase Replication

1.2.1 Statistical, Methodological, and Social Reforms

The replication crisis is likely not attributable to a single cause, but results from different factors intertwined: statistical inaccuracies, vague theories, research methods, the publication system, and institutional incentives (Altoè et al., 2020; Świątkowski & Dompnier, 2017). Since many of the possible contributing causes of the crisis are behaviors, change is possible, and we should strive towards it (Korbmacher et al., 2023).

One of the ways replication can be improved is through better statistical inference. NHST is currently the most common tool used for interpreting data. There are several criticisms put forward that point out the limits of this method. One of them is whether the standard 0.05 *p-value* is low enough: some researchers argue it is too moderate and does not provide sufficiently precise evidence (Frias-Navarro et al., 2020). This is because it allows too much space for false positives.

Other researchers question NHST as a practice altogether: making statistical decisions with such a fixed dichotomous acceptance-rejection mindset might not be the best option (Świątkowski & Dompnier, 2017). Exploring alternatives such as Bayesian statistics or other more continuous techniques, like estimating the effect size and intervals, could lead to better statistical inference (Nuijten, 2019). NHST is also often implemented incorrectly because of insufficient knowledge on the researchers' part (Romero, 2019). *P-values* can be easily misinterpreted and therefore lead to erroneous conclusions. This is why it is essential to, first and foremost, provide all researchers with proper training, teaching them the correct use of NHST and other methods (Frias-Navarro et al., 2020).

As seen previously, low power is among the problems that lead to irreproducible findings, especially in the field of psychology (Nuijten, 2019). One way to mitigate this issue is through multisite collaborations. Low power occurs when the sample sizes are small or there is a lot of variability in the study matter, therefore leaving a higher chance for false positives or effect size overestimation. Multisite collaborations are a way to conduct studies with multiple research facilities united, and they make use of the combined resources to obtain higher power studies (Nuijten, 2019). As the article suggests, some implemented examples are the ManyBabies project, or online platforms such as Psychological Science Accelerator and StudySwap. Multisite collaborations can be intended for original studies but also for high-quality replication studies (Nuijten, 2019). They can allow for

self-criticism and self-correction throughout the whole research conduction (Frias-Navarro et al., 2020).

The replication crisis also has to be addressed by looking at the current scientific culture. When it comes to the scientific reward system, researchers face a dilemma: on one hand, they should conduct rigorous studies, but on the other, they are pressured into obtaining novel, statistically significant results. Positive results would increase their chances of getting published in the best journals and of receiving academic recognition (Świątkowski & Dompnier, 2017). High competition in prestigious journals requires scientists to look for the best outstanding results possible in order to stand out among their peers (Romero, 2019). This can make them more prone to performing questionable research practices, and to aim for the best-looking data rather than the highest-quality research (Świątkowski & Dompnier, 2017). In addition, replications do not receive the right recognition: scientists are encouraged to be the first to discover results and theories, hence replication loses meaning completely.

Relying on the goodwill of scientists is not enough: there must be "a social reform attempt to align career incentives with statistical and methodological expectations" (Romero, 2019, p. 9). To promote replications, there should also be a system in place that promotes career growth for replication scientists, provides funding for their projects, and facilitates publication in high-impact journals (Świątkowski & Dompnier, 2017). In order for scientists to pursue good research practices, results should not be the only parameter considered when publishing a study: other factors that determine the quality of the research, like the robustness of the study plan, can be placed at the same level of importance (Romero, 2019). Rewarding good practices can lead researchers to naturally pursue them (Frias-Navarro et al., 2020). Lastly, to improve statistical training, it is also important to focus on education and academic programs.

Ultimately, the replication crisis can be seen as a great opportunity to work on the quality of science and promote good practices (Frias-Navarro et al., 2020). A way to mitigate the credibility crisis is to make research more transparent and open to external evaluation. Interesting steps in this direction can be seen with Open Science and preregistration.

1.2.2 Open Science and Reproducibility Projects

With the rising concern for irreplicability, many scientists believe transparency in the research process to be essential for scientific credibility. Open Science originates with the intention of pre-

venting biases and malpractices. It promotes the idea that "scientific knowledge, when appropriate, should be openly accessible, transparent, rigorous, reproducible, replicable, accumulative, and inclusive" (Korbmacher et al., 2023, p. 2). Transparency means honesty when reporting decisions made through all research phases (Korbmacher et al., 2023). Open Science increases reproducibility and robustness of conclusions, and encourages replicability and good practices (Hicks, 2023). It consists of six main principles: "open data, open methodology, open source, open access, open peer review, and open educational resources" (Korbmacher et al. 2023, p. 2). Open data, that is, transparently sharing raw data to a public repository, is important because it allows external peer examination of both original and new analyses (Nuijten, 2019). One repository example is The Open Science Framework (Hicks, 2023). The Transparency and Openness Promotion (TOP) Guidelines also sum up practices that scientists can implement in their work for high-quality transparent research (Nosek et al., 2015). So far, Open Science initiatives, like the open scholarship, have led to several positive changes in research (Korbmacher et al., 2023).

Although Open Science can be extremely beneficial for research integrity, it costs resources and slows down research. It is also important to notice it does not solve all issues associated with the replication crisis, such as sample size, good use of statistics and *p-values*, and the reward system. However, it can encourage replicability and help students learn how to handle real data before conducting their own study (Hicks, 2023).

Other interesting proposals for improving data and procedural transparency are preregistration and Registered Reports. Preregistration consists of describing the study plan in all its aspects before collecting data (Van 'T Veer & Giner-Sorolla, 2016). It serves the purpose of limiting publication bias and preventing other questionable procedures as they become more easily identified when reviewed by peers. It also promotes high levels of severity because it implies careful description of how the hypotheses presented in the study can be demonstrated false (Lakens, 2018). Examples of platforms that facilitate preregistration are the Open Science Collaboration and the Many Labs Replication Project (Świątkowski & Dompnier, 2017).

In Registered Reports, on the other hand, studies get peer-reviewed twice: the first time prior to data collection, and the second when the study has already been conducted, to make sure the original plan was carried out consistently (C. D. Chambers & Tzavella, 2021). One of the most interesting things about Registered Reports is the concept of in-principle acceptance (IPA). When articles receive IPA, at the end of the first review, their research will get published, no matter the

direction of the results (C. D. Chambers & Tzavella, 2021). This is relevant because it shifts the focus from the outcomes to the actual quality of the research. However, it is necessary to consider that even these proposals come at a cost: in fact, peer reviews take a lot of time and resources (Świątkowski & Dompnier, 2017).

To sum up, some innovative practices that can promote transparency and good practices, therefore leading to more reliable results, can be found in replication studies, Open Science, preregistration, and Registered Reports (Frias-Navarro et al., 2020).

1.3 The Theory Crisis and Questionable Measurement Practices

The main issues identified in the research field do not end with the replication crisis. As of today, other crises that are relevant in science are the theory crisis and questionable measurement practices (QMPs).

In fact, the validity of research can be undermined in different ways, not just by misinterpreting data and statistics. There can be issues from as early as measuring variables and constructing theories. Some measurement maneuvers put the validity of experiments in question (Flake & Fried, 2020). Measuring in research means converting variables into numbers. Measurement malpractices threaten internal, external, and statistical-conclusion validity (Flake & Fried, 2020). A way to address the issue is by describing the measurement process in detail for public evaluation. For example, defining the construct and specifying how the measurements were conducted (Flake & Fried, 2020).

The theory crisis has also gained a lot of notice, especially in social psychology. The discussion revolves around the reliability of the main accepted theories that prevail in the psychological landscape. As already seen, psychology is a very complex field that needs to be explored in all its facets. Because of the number of variables at play, scientists have a hard time discovering sound theories and facts. And, in order for replication to make sense, it is crucial to work on building robust, valid theories that can be evaluated with confirmatory studies (Eronen & Bringmann, 2021). Some theories in social psychology can be so broad that they cannot even be falsified. This can also explain the slow pace of progress in psychological research. Especially in psychology, the problem with the severity of a study can many times be due to how precise theories are (Lakens, 2018). To

address the theory crisis, scientists should aim to make better, more specific theories that can be statistically refuted (Eronen & Bringmann, 2021). It is plausible to think issues with replicability might also stem from the theory crisis (Oberauer & Lewandowsky, 2019).

1.4 Objective of This Thesis

The reproducibility crisis has pointed out widespread problems in the research field, such as questionable practices, statistical inaccuracies, biased publications, and backwards institutional rewards. These problematic behaviours produce misleading results and create a distorted literature, raising questions about the credibility of scientific findings. That said, the crisis can also be seen as an opportunity for scientific progress. With recent projects like Open Science and preregistration, some researchers have decided to take on issues of bias and low-rate replication studies by focusing on reporting research transparently. This paper will analyse preregistration and Registered Reports as innovative proposals for mitigating bias, promoting good practices, and high-quality research in psychological science.

Figure 2.1 provides a summary of the relationship between the replication crisis and preregistration, as well as Registered Reports.

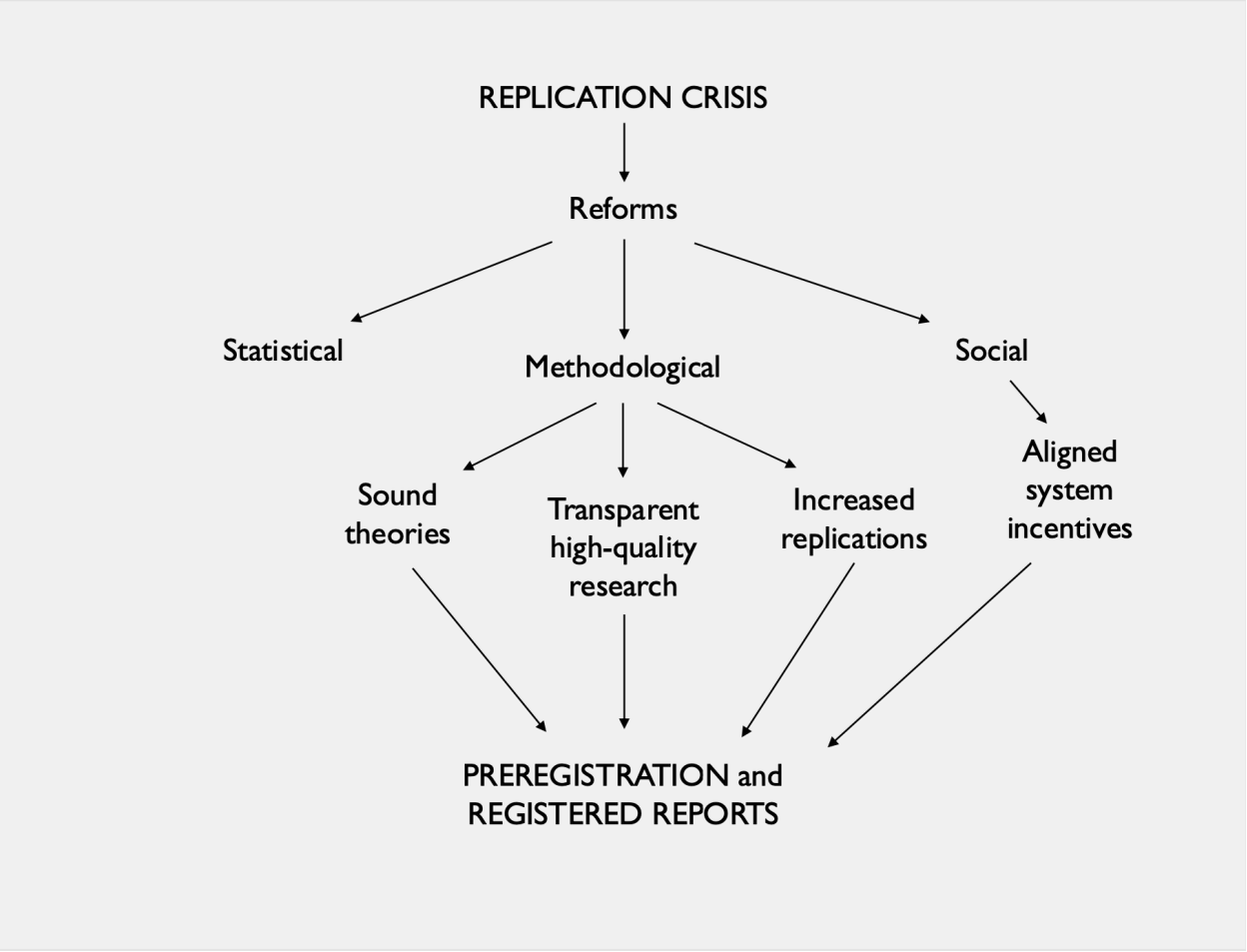

Figure 1.1: The replication crisis and ways forward: preregistration and Registered Reports as an innovative proposal for methodological and social reforms in the scientific research culture.

Chapter 2

Preregistration and Registered Reports

This chapter illustrates preregistration and Registered Reports as proposals to counteract the replication crisis, as they promote good research practices and prevent biases. When preregistering, researchers outline the intended study design before collecting data. The preregistration is made public in order for peers to assess whether the protocol was adhered to. In Registered Reports, on the other hand, the preregistration is submitted directly to a journal and is evaluated prior to conducting the study. If accepted, the document will receive IPA and will be published regardless of the outcome. After the data is collected, researchers complete the report with a discussion of the results and go through a second stage of review, to make sure the approved plan was followed. Preregistrations and Registered Reports have many benefits, but also limits: they do not render science credibility alone. The goal in this chapter is to analyse their strengths and weaknesses, and consider them as having great potential for advancement in the research culture and the scientific field of psychology.

2.1 Preregistration

2.1.1 Ways to Preregister and Why

The goal of preregistration is to increase replicability in science (Simmons et al., 2021). Preregistrations are time-stamped documents that contain all the necessary information of a planned study (Nosek et al., 2018). Their main purpose is to prevent bias and other questionable practices that would lead to a lower rate of false positives and an increase in successful replications. For instance, transparently detailing methods and planned analyses mitigates the bias that can occur when reporting certain analyses over others, commonly the ones that yield the best conclusions (Van 'T Veer & Giner-Sorolla, 2016). In addition to advancement in scientific research, preregistration also benefits individual researchers: as they have to specify all the intended procedures, they are encouraged to plan ahead and think about their studies in detail, a recipe for conducting research optimally (Van 'T Veer & Giner-Sorolla, 2016). Still, as Pham & Oh (2021) point out, preregistration alone does not make research good. Nevertheless, it is reasonable to suggest science can largely benefit from it (Simmons et al., 2021).

When preregistering, authors are called to detail how they intend to conduct their studies before collecting data. Preregistrations contain the research question, the derived hypotheses, and the methods used to test them, as well as the data analysis plan (Van 'T Veer & Giner-Sorolla, 2016). They are then made openly accessible for evaluation on a public repository or registry (Van 'T Veer & Giner-Sorolla, 2016).

Starting from the research question, scientists should justify it adequately, reason why having deep knowledge about topics that interest them is crucial. Researchers should make hypotheses clear, essentially how they expect a phenomenon to manifest; in other words, what they expect to see from their data based on the available literature (Van 'T Veer & Giner-Sorolla, 2016). They should describe the relationships between variables in detail, categorising them as dependent, independent, or moderators. There could also be the necessity to include networks of variables when multiple of them come into play, and in this case, specifying the directions of the predicted effects is best (Van 'T Veer & Giner-Sorolla, 2016). Researchers should also make the underlying theory for each prediction clear, differentiating between the multiple hypotheses presented (Van 'T Veer & Giner-Sorolla, 2016).

Regarding the methods used, a preregistration should explain how the research question will

be put to the test. The information has to be enough to allow for the study to be replicated: it should include materials, measures, procedures, and possible changes and corrections (Van 'T Veer & Giner-Sorolla, 2016). The sample size should be specified and explained, as it would also allow for statistical power examination, along with detailing both rules for terminating data collection and principles for data exclusion (P. Simmons et al., 2021). Authors should also make clear how they will enroll participants, and whether they intend to replace ruled-out data with information from new participants or not (Van 'T Veer & Giner-Sorolla, 2016). There are different reasons why participants can be left out of a study: for example, biases in answers or reaction times (Van 'T Veer & Giner-Sorolla, 2016). Researchers can also choose criteria for stopping and restarting the study, with some changes, if exclusion parameters are met over a certain level, for example, in the case of too many invalid answers (Van 'T Veer & Giner-Sorolla, 2016). Describing the location of data collection might be helpful as it would permit explaining future changes due to unanticipated circumstances (Van 'T Veer & Giner-Sorolla, 2016).

The next step is to outline the analyses. This section of the document is crucial because it largely determines the level to which Type 1 errors are inflated based on research flexibility (Van 'T Veer & Giner-Sorolla, 2016). Analyses have to be specified regardless of the type of statistical testing system used, whether it be NHST or Bayesian testing. Analyses can be both confirmatory and exploratory: this way, data can be examined beyond the initial hypotheses, as long as these analyses are made clear not to have been anticipated (Van 'T Veer & Giner-Sorolla, 2016). The key is to label all considerations appropriately, distinguishing what is confirmatory from what is not. As well as the methods, the analyses should be replicable (Van 'T Veer & Giner-Sorolla, 2016).

A preregistration has to be precise but also concise: simple and short documents benefit researchers, as they are easier to follow, and reviewers, since they make it easier to evaluate whether the study was carried out as planned (P. Simmons et al., 2021). In order for a preregistration not to be overextended but still contain enough information, researchers should mainly focus on the elements that are most relevant in controlling for p-hacking and bias (P. Simmons et al., 2021). One of the aims of preregistration is to plan a rigorous study efficiently: it is not necessary to detail every analysis excessively; the focus should be kept on the fundamental ones (P. Simmons et al., 2021). Additional information, such as explaining how the sample size was chosen, is of secondary importance.

When writing a preregistration for the first time, researchers may have difficulties with under-

standing exactly what to write or leave out, given it is a process they are unfamiliar with. To avoid this initial barrier, they can follow standard guidelines and suggestions (Van 'T Veer & Giner-Sorolla, 2016). To name one example, at AsPredicted.org, scientists can answer nine questions before conducting their study (P. Simmons et al., 2021). As far as submission goes, the important matter is the quality of the document rather than the website it gets sent to (P. Simmons et al., 2021). A problem that could arise from publishing preregistrations immediately is the possibility that research ideas get stolen: to prevent this, researchers can keep their articles private for a period of up to four years (Van 'T Veer & Giner-Sorolla, 2016).

Once the document has been completed and made publicly available, the next step is to have it reviewed (P. Simmons et al., 2021). To ensure the validity of the process, the article has to be evaluated by peers. It could even be written perfectly, but if researchers do not follow through with the outlined plans and do not report the changes, preregistration loses its whole purpose (P. Simmons et al., 2021). The review stage consists of verifying that the preregistration contains all the necessary information and has been carried out accordingly (P. Simmons et al., 2021). Peers should evaluate the logic behind the study, the methods, the analyses, and the inferences (Van 'T Veer & Giner-Sorolla, 2016). They have to consider if the conclusions drawn are fair, and can also evaluate exploratory analyses. At the same time, expecting researchers to follow their preregistrations word for word is unrealistic, given all the variables at play and unexpected situations that can occur (P. Simmons et al., 2021). In cases in which the study deviates from its original plan, it is important that there is a justified explanation for doing so, as well as a careful consideration of all the ramifications. Reviewers have to be able to easily identify how the study was altered, understand the reasons behind such decisions, and acknowledge the repercussions on the process and end results (P. Simmons et al., 2021).

It might be frightening to see how strict preregistration is and how careful researchers have to be not to make mistakes. But the purpose of preregistration is, first and foremost, transparent research: this means that errors and changes in studies are allowed as long as they are reported and analysed openly, as the aim is not to have perfect research on the surface (P. Simmons et al., 2021). The goal of research should not be to look nice: in this sense, preregistration works to promote a realistic scientific literature that is complex, imperfect, and changeable in its results. Even in the case of research not yielding significant results, it does not mean that the whole background theory has to go to waste (Van 'T Veer & Giner-Sorolla, 2016). A result that differs from expectations is

not a failure but valid information that can be used as motivation to discover new ways of refining the underlying theory (Van 'T Veer & Giner-Sorolla, 2016). This is why, even faulty preregistrations are still a good step towards honesty and transparency in research, and can be appreciated more than studies that do not get preregistered (P. Simmons et al., 2021).

2.1.2 Advantages and Limits

Preregistration has many advantages for both the research culture and individual scientists. It is important to keep in mind that it does not solve all issues, but it most likely addresses one of the biggest problems concerning the replication crisis: false positives (P. Simmons et al., 2021). Although it does not eliminate the possibility of false results, it limits their prevalence.

As seen in Chapter One, false findings hinder the development of valuable theories, thus generating skepticism about the psychological literature (P. Simmons et al., 2021). But, Type 1 errors do not necessarily result from a lack of integrity or preparation on the researchers' part (P. Simmons et al., 2021). Obtaining distorted conclusions is much simpler than one could think: favouring certain results over others is enough (P. Simmons et al., 2021). With all the decisions scientists have to make in the research process, it would only be natural for them to tend towards maneuvers that do not undermine their hypotheses. Plus, not only is it easy to p-hack, it is hard not to p-hack (P. Simmons et al., 2021). To avoid p-hacking, researchers have to clearly plan out the analyses they intend to conduct on collected data, or else a degree of p-hacking would almost be certain. This is why preregistration insists on careful documentation of study designs before data collection (P. Simmons et al., 2021). In such a manner, researchers can control for p-hacking, therefore limiting the possibility of false results.

Preregistration has numerous other advantages. Since it demands clarity in the study hypotheses, methods, and analyses, it allows less space for a plethora of questionable practices such as HARKing, selecting data, and cherry picking (Stewart et al., 2020). It is also a useful memory aid (Stewart et al., 2020).

Since preregistration forces researchers to devote much time to planning the study properly, this saves a lot of wasted resources further down the line (Stewart et al., 2020). Researchers avoid having to correct many future errors by easily adjusting the research at its beginning stages (Stewart et al., 2020). Having a planned-out path forward is also important and beneficial for research collaborations: it allows co-working teams to agree on how to jointly conduct their study,

consequently avoiding misunderstandings (Van 'T Veer & Giner-Sorolla, 2016).

But, like any practice in science, preregistration is not devoid of its limits and drawbacks. It does not address all issues, and will not solve all problems with the current scientific culture (P. Simmons et al., 2021). It does not guarantee good science alone; in fact, it can be misused (Yamada, 2018).

As already mentioned, if on one hand, preregistration promotes true findings, on the other, it does not get rid of Type 1 errors; therefore, a certain degree of false results is inevitable (P. Simmons et al., 2021). Even the file-drawer effect, that is, when false-positive results are selectively published because of their convenience, cannot be prevented by solely preregistering a study. That being said, the file-drawer effect is less of an issue if false positives are not inflated, which should be the case for preregistration, as it prevents QRPs. Publishing only false positives in preregistrations becomes unsustainable: researchers would have to conduct 20 studies to get to one desired result (P. Simmons et al., 2021). So, even though preregistration does not stop the preference for publishing certain results, it makes it harder to obtain these types of conclusions (P. Simmons et al., 2021).

Preregistration also does not stop from fabricating data (P. Simmons et al., 2021). Reviewers cannot know whether data was added at will, and it is unrealistic to ask them to inspect data so closely each time. In this sense, periodically assigning studies for data auditing tests could help, as just the possibility of being found guilty of fraud should largely address this particular issue, and would also support a sustainable culture of trust among researchers (P. Simmons et al., 2021).

Another limit of preregistration is that researchers can still choose not to report some details that would otherwise invalidate the study: it is arduous to detect omitted manipulations from looking at the document alone (P. Simmons et al., 2021). One way to prevent this could be publishing precise materials used (P. Simmons et al., 2021).

Preregistration might also not be the best fit for all types of studies (Van 'T Veer & Giner-Sorolla, 2016). When analysing a new topic through exploratory research, for example, it is possible that it is not as useful: it likely displays most of its potential with analyses that are at least in part confirmatory (Van 'T Veer & Giner-Sorolla, 2016). Preregistration might also not be suitable for all types of data: in some qualitative studies, for example, it is necessary to collect data first to understand how to organise and analyse it (P. Simmons et al., 2021).

Lastly, preregistration does not make results generalisable (P. Simmons et al., 2021). It is one thing to affirm conclusions are replicable, essentially confirmed using similar specific procedures;

it is different to claim they apply to various settings, with different measures and situations. If a study is replicable, it does not mean that its findings can be generalised: instead, the results prove to be true in that specific situation (P. Simmons et al., 2021).

Along with legitimate concerns, there are also unsubstantiated beliefs about how preregistration works. One often voiced worry is that it does not allow space for exploratory analyses, essential to science (P. Simmons et al., 2021). This simply is not the case: preregistration requests to distinguish clearly what is confirmatory from what is not (Van 'T Veer & Giner-Sorolla, 2016). It is important that researchers engage in exploratory analyses, and preregistration certainly does not advocate against them; it simply asks to label them as such (Simmons et al., 2021). One of the purposes of preregistration is to clearly distinguish prediction from post-diction (Nosek et al., 2018). This way, reviewers can differentiate what was predicted from what was not (P. Simmons et al., 2021). Changes in original hypotheses are also possible, and do not classify as HARKing as long as they are documented transparently (Van 'T Veer & Giner-Sorolla, 2016).

Another belief is that preregistration is too burdensome for both researchers and reviewers (P. Simmons et al., 2021). According to this view, it adds more work compared to the usual without the need for it, since commonly performed reviews would be enough. There are a few ways to refute this belief. First of all, in many cases, p-hacking is very difficult to identify and usual reviews would not be sufficient (P. Simmons et al., 2021). Secondly, there is a case for believing preregistration actually improves efficiency in research: the thought process that goes into planning the analyses is a part of every research, therefore placing it at the beginning of the study, rather than after data collection, should not result in added work (P. Simmons et al., 2021). And, even if it was true that it took researchers more effort to think about their planned research in detail in advance, it would still be a big step towards high-quality and credible science (Van 'T Veer & Giner-Sorolla, 2016).

Another misconception is thinking that deviations render preregistrations useless (Simmons et al., 2021). The purpose of preregistering is not to have perfect and exactly-as-planned executed studies; it is instead to increase replication and credibility in the field of science through transparency in the research process (Simmons et al., 2021). Therefore, researchers should not focus on being excessively rigid in following their preregistrations when conducting their study: they should strive to conduct high-quality research, and that sometimes means deviating from original plans. The important thing is to point out and justify the changes (Simmons et al., 2021).

Some researchers may also argue that preregistrations augment mistrust and skepticism towards

the scientific community (P. Simmons et al., 2021). But, it is important to note that preregistration does not distrust the good intentions of researchers, quite the contrary: it recognises that unreliable results can come in spite of that and works to prevent them. Along with the idea of mistrust, some authors may be worried that null conclusions will take over the scientific literature (Van 'T Veer & Giner-Sorolla, 2016). Even if true, it should not be a reason not to preregister. Null effects are as valuable as significant results (Van 'T Veer & Giner-Sorolla, 2016).

In sum, preregistration is an innovative practice that promotes transparency and rigor in conducting a study. Along with Open Science and replication initiatives, its purpose is to strive towards good practices and high-quality research (Gonzales & Cunningham, 2015). Although it has grown in popularity in the past few decades, it has not reached mainstream usage, and many journals still have not considered the format (Gonzales & Cunningham, 2015; P. Simmons et al., 2021). This could be due to concerns with lower rates of citation, as preregistrations come with the risk of more disappointing results (Gonzales & Cunningham, 2015).

2.2 Registered Reports

2.2.1 What Are Registered Reports and When Are They Good Science?

Registered Reports are a combination of preregistration and peer review (Reich, 2021). Their goal, as for preregistration, is improved research quality and successful replications (Timming et al., 2021). What makes Registered Reports different from usual articles is not the structure of the final document, but the review process (Oshiro et al., 2024).

In Registered Reports, there are two stages of peer review: Stage 1, before data collection, and Stage 2, when the study is completed. At first, researchers are required to submit a Stage 1 document containing the following information:

- The research question and the available literature on the topic;
- Hypotheses, their reasoning, and specific variables;
- The methodological plan, and procedures to test and falsify the hypotheses;
- The power of the study;
- Exclusion criteria;

- The analysis plan and rules for how the results will be interpreted (C. D. Chambers, 2013).

In this first stage, reviewers are asked to evaluate the pertinence of the document, offer suggestions for improving the quality of the design, and decide whether to refute it, accept it, or accept it with revisions (Montoya et al., 2021). Expert advice can be very useful for researchers, as they get the chance to refine and adjust their study at a moment when it is still possible, before collecting data (Carsten et al., 2023; Montoya et al., 2021; Van 'T Veer & Giner-Sorolla, 2016). This feedback, if constructive, allows for better research and promotes a collaborative spirit in the scientific field (Henderson & Chambers, 2022).

When approved, the document receives IPA and will be published regardless of the direction of the results, as long as researchers stick to the registered design and methods (Riegelman, 2021). The paper also gets preregistered in a repository, and is either made immediately publicly available or temporarily private.

At this point, researchers proceed by conducting their study and composing the Stage 2 document. This final article will include:

- The study materials;
- Data and code;
- Planned analyses and unregistered analyses;
- A discussion of the results (C. Chambers, 2019; D. Chambers et al., 2014).

Afterwards, original reviewers are asked to assess the finished version of the manuscript. At this stage, they can no longer invalidate the information they approved in the first document, such as methods, hypotheses, and their rationale (C. Chambers, 2019). They cannot comment on the validity of the study, its design, or the direction of the results; they instead evaluate the completeness of the results section and whether the initial preregistration was adhered to (Montoya et al., 2021).

As for the first stage, reviewers have to accept or reject the document, but it is very unlikely for Registered Reports to get rejected at this point (Boehnke & Rutherford, 2020). If there are great deviations from the first article, there is a chance they might be rejected. There is also the problem that, after the Stage 1 document is submitted, unexpected situations could happen, and the research could be compromised if the researcher decides to stick to the registration (Baldwin,

2024). In such cases, it is possible to communicate with the reviewers and potentially offer an updated way forward. This proposal can be either accepted or rejected, and in the case of the ladder, the research can be published as a regular article and no longer as a Registered Report (Baldwin, 2024; Stewart et al., 2020).

To better understand the differences from a common review process, Figure 2.1 represents the phases of a Registered Report schematically.

Figure 2.1: How Registered Reports come about and the stages of peer review.
Center for Open Science. Registered Reports. Retrieved May 21, 2025, from https://www.cos.io/initiatives/registered-reports

As can be seen in Figure 2.1, once the Stage 2 document is approved, it gets published as a Registered Report.

Registered Reports share many benefits with preregistrations, but have two added features: the two-stage review process and IPA. IPA allows researchers to focus primarily on the quality of the research process rather than the sole outcome, therefore preventing publication bias (Van 'T Veer & Giner-Sorolla, 2016). Scientists no longer have to worry about achieving great results for journals to approve of their work. Their job is to prove worthy of publishing in the first review, when the outcome of the research is still unknown; therefore, the results are no longer decisive in publication. This is especially useful for first-time researchers, as they get to focus on learning how to conduct a rigorous study without the pressure of obtaining certain results. By introducing IPA, Registered Reports are an attempt to realign the reward system with good scientific principles. Scientists get to focus on the process rather than the conclusions, and are encouraged to perform high-quality, transparent research. With this format, researchers also have a harder time p-hacking (Timming et al., 2021). This leads to fewer false findings and more replications (Braden, 2024). As expected, there is evidence of higher rates of null findings in Registered Reports compared to other articles

(Allen & Mehler, 2019; C. D. Chambers & Tzavella, 2021; Scheel et al., 2021a). Not just that, as Soderberg et al. (2021) found, there is proof that Registered Reports are perceived as higher quality documents and are evaluated as methodologically on point. Lastly, they are more computationally reproducible compared to other articles (C. D. Chambers & Tzavella, 2021; Obels et al., 2020).

Registered Reports, like preregistration, lead to precise study designs and less research waste (Boehnke & Rutherford, 2020). Although planning requires a lot of effort, it can be seen as time saved in the future, as making changes down the road would be much more costly (Spiller & Olff, 2018).

As seen in Figure 2.2, Registered Reports combine the benefits of preregistration, peer review prior to data collection, and IPA.

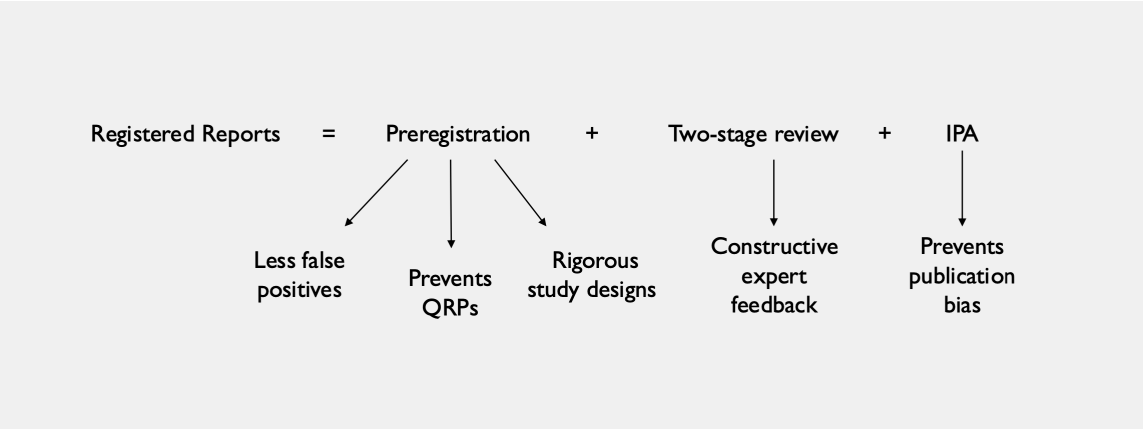

Figure 2.2: Registered Reports: the advantages that come from integrating preregistration, two-stage review, and in principle acceptance.

2.2.2 Questions and Concerns

As for preregistration, Registered Reports alone will not resolve all problems in research, and conclusions from Registered Reports are not definitive truths (Nosek & Lakens, 2014). Registered Reports aim at facilitating and promoting good research practices in order to foster a more robust scientific literature. They are not to be seen as ensuring valid science, but are a tool that researchers can use to prevent a multitude of malpractices (Grand et al., 2018).

Having two stages in the review process has many benefits, but it also comes at a cost: it takes a lot of work and time. Nevertheless, it is also the case that the Stage 2 review should take little

time, provided much of the evaluations have already been made at Stage 1 (Spiller & Olff, 2018).

Registered Reports are also likely not fit for every research type, like studies performed on already existing data sets, because of the interfering bias that comes with knowing the results (Baldwin, 2024; C. Chambers, 2019). As well as preregistrations, they also tend to favour quantitative work over qualitative studies (Timming et al., 2021). But, although the format was originally intended for the hypothetico-deductive method, it is expanding towards other types of research (Karhulahti et al., 2023). Examples are meta-analytic reviews, computational studies, and field intervention studies (Gerpott et al., 2024). And, just as preregistrations, Registered Reports do not constrain researchers to confirmatory analyses exclusively. Researchers are free to make exploratory analyses, as long as they report them as such (C. Chambers, 2019). As Chambers (2019, p. 146) puts it, "Registered Reports are a plan, not a prison".

Among other limits, C. D. Chambers & Tzavella (2021) point out scarce protocol transparency. Another potential issue with using Registered Reports is anonymity: reviewers might not be impartial when addressing the report of an author they have information about, for the reason that their evaluations could be influenced by biases (Montoya et al., 2021). Lastly, as for preregistration, ideas from Registered Reports can get stolen, since first-stage reviewers might draw inspiration from the research questions they evaluate. That said, editors' names are made public and they would be easily caught for copied ideas (Montoya et al., 2021).

2.2.3 Journals Adopting Registered Reports

As of 2023, 278 journals were using Registered Reports (Lin et al., 2024). Registered Reports first launched with *Cortex* in 2013 (C. D. Chambers, 2013), with the idea of improving the quality of published articles. They recognised that problems concerning QRPs, false findings, and bias in publication could be mitigated by introducing a format that promotes transparency, replications, and quality in the design and methods, even at the cost of obtaining disappointing but credible results (C. D. Chambers, 2013). Soon later, the format was also adopted by *Perspectives on Psychological Science* in 2014 (Simons et al., 2014). Other journals that currently use Registered Reports are *Nature Methods*, *Quality of Life Research*, *College & Research Libraries*, *Communications Psychology*, *AIMS Neuroscience*, *Human Resource Management Journal*, and *Journal of School Psychology* (Boehnke & Rutherford, 2020; Braden, 2024; D. Chambers et al., 2014; "Reciprocating Trust in Registered Reports," 2024; "Registered Reports," 2023; Riegelman, 2021; Timming et al., 2021).

The feedback on Registered Reports seems to be overwhelmingly positive ("Registered Reports," 2023). For instance, though there might be concern with how frequently they get cited compared to other articles, Registered Reports citations have been found to be similar to ones of mainstream articles (C. Chambers, 2019).

However, even though recognised as a valid, innovative alternative, Registered Reports still have low submission rates (Baldwin, 2024; Montoya et al., 2021). A big obstacle might be the perception of the review process as excessively troublesome, since time and resource-consuming (Montoya et al., 2021). There is also a delay of approximately two years from when journals decide to implement Registered Reports to when they actually publish one for the first time (Montoya et al., 2021). To avoid any type of confusion and to make the process easier and more direct, there are supplies and guidelines for getting started that can be found at the Center for Open Science's site, *Registered Reports* (n.d.).

To sum things up, preregistration and Registered Reports are great tools for increasing replications and promoting high-quality and good practices in research (Nosek & Lakens, 2014). As seen in Chapter One, replications are crucial for credible science and sound theories. With a review process that ensures publication before knowing the results of the study, the focus of research shifts to the design and process (Nosek & Lakens, 2014). In this way, researchers are incentivised to conduct robust studies rather than reach significant results, therefore helping to restore credibility in the scientific literature (Nosek & Lakens, 2014).

Chapter 3

Recent Perspective on Preregistration and Registered Reports

This chapter begins with an overview of recent evidence on the effectiveness of preregistrations and Registered Reports. Compared to traditional articles, these formats tend to produce more null and negative results, suggesting a more reliable literature in terms of how representative the results are. Researchers also seem to evaluate the final documents as higher-quality, and appreciate the opportunity to think through the research in detail in advance. However, they often report concerns with the time and effort required.

The second part of the chapter focuses on reasons why authors might choose to deviate from preregistrations and how such deviations should be handled appropriately. It is important that researchers are transparent when deviating from original plans, providing justification for the changes, and specifying their consequences.

3.1 Are Preregistration and Registered Reports Effective?

Registered Reports and preregistration have a great potential for improving research practices, as well as results, and recent studies are beginning to show their effectiveness (Scheel et al., 2021b; Toth et al., 2021). This is relevant because it would be illogical to increase researchers' workload and delay the research process without good reasons for doing so (Lakens et al., 2024).

Registered Reports and preregistration are essential for cumulative science (Scheel et al., 2021b). As seen in Chapter One, hypotheses in psychological research are confirmed more often than expected. Scheel et al. (2021b) conducted a study to investigate whether null hypotheses were rejected less frequently in Registered Reports, that is, if they contained higher rates of null or negative results compared to other articles. This was tested by comparing the proportion of positive results in Registered Reports with traditional studies (Scheel et al., 2021b). The parallel was justified on the basis that both formats had similar quality and statistical power. Consequently, higher rates of null or negative results in Registered Reports would not be explained by mediocrity or false positives (Scheel et al., 2021b).

The main variable considered was the direction of the sampled article's conclusions (Scheel et al., 2021b). Both null and negative outcomes were grouped as negative conclusions, while positive results were considered regardless of the size of the effect, big or small. The researchers also pointed out that merely finding a difference was not enough: if the difference was too small, it would be negligible. To be deemed worthy of notice, they established a threshold greater than 6%, which is the difference between positive results in psychology and general social sciences (Fanelli, 2010). The results found a striking difference of 52.39%: 96.05% positive outcomes for standard reports and 43.66% for Registered Reports, an effect considered significant (Scheel et al., 2021b). Since many of the Registered Reports were close replications of previous studies, the authors investigated whether this factor played a big role in such a large gap. However, when excluding close replications from their analyses, the difference remained large (45.95%) (Scheel et al., 2021b). Such a remarkable gap suggests that a considerable amount of controversial literature may be missing from current psychological literature (Scheel et al., 2021b). As seen in Chapter One, such high success rates may be due to QRPs, publication bias, and vague theories. As Registered Reports seem to produce a greater range of results, they may provide a more realistic picture of the literature on a given topic (Scheel et al., 2021b).

In another study, Toth et al. (2021) examined whether preregistration was associated with more transparency in the research process. To test this, they analysed whether studies gave a justification for the sample size and excluded data. They also considered the degrees of freedom in the design with the following variables: planned analysis method and planned rules for deciding when to stop collecting data. Finally, they investigated the prevalence of positive results.

From the results, Toth et al. (2021) found that most preregistrations provided a rationale for the sample size (72%), whilst traditional articles in only 29% of cases. Similarly, 78% of preregistrations reported excluded data, versus 51% of non-preregistrations. Stopping rules were included in 43% of preregistrations but almost never in standard articles (2%). Preregistrations also reported a priori analysis plans 82% of the time, while this type of information was unavailable for standard articles, for obvious reasons. These conclusions are consistent with what preregistrations seek to achieve: more transparency in the research design. Lastly, preregistered hypotheses were supported in 48% of preregistered cases, compared to 66% of non-preregistered ones.

In another study, Spitzer & Mueller (2023) examined researchers' beliefs and attitudes toward preregistration. One of the main reasons was to investigate why preregistration has not yet been implemented on a large scale, despite its great potential and considerable support from most scientists (Ferguson et al., 2023). Spitzer & Mueller (2023) found that, of their sample, 62% of researchers had used preregistration before, and their experience was positive overall. The majority reported intending to use the method again for future research, and some also suggested it should become a mandatory practice (Spitzer & Mueller, 2023). Researchers evaluated preregistration positively in terms of transparency, quality, and study planning (Spitzer & Mueller, 2023). On the other hand, the percentage of researchers concerned that preregistration made the process laborious and time-consuming was high: 61.70% for scientists who never used the format before and 45.26% for scientists who had already. Logg & Dorison (2021) similarly found that 38% of the sampled researchers believed preregistration added substantial work to the process. However, scientists should be reassured that the time spent in planning a study is not pointless: since one of the problems in research is a lack of transparency in the procedures, the additional hours invested in planning a study are a remedy, not a burden (Sarafoglou et al., 2022). As Lakens et al. (2024, p. 11) said, "a higher-quality study is a time-consuming task". Rigorous methods often require more effort; what matters is making that effort worthwhile (Spitzer & Mueller, 2023). Efficiency can still be improved with better templates, high-quality training, and incentives (Spitzer & Mueller, 2023).

Similarly, Sarafoglou et al. (2022) analysed attitudes of researchers towards preregistration. When observing the results of scientists who used the format before, most were supportive of it, and 82% reported it being a useful tool for preventing QRPs. 88% of the sampled researchers would recommend preregistration to peers, and 83% reported they would consider it for their future studies. For researchers that never implemented the method before, results were a bit different: 70% agreed it was useful for avoiding QRPs, but just 45% would recommend it to peers, and only 7% would preregister in the future. In their study, Sarafoglou et al. (2022) also found that most researchers believed preregistration had a positive impact on their work. For example, that it clarified hypotheses and improved the methodological plan (Sarafoglou et al., 2022). However, they also reported some drawbacks, like time investment and work-related stress.

In another study, Soderberg et al. (2021) found that researchers viewed Registered Reports as higher-quality and more rigorous compared to traditional papers. They also found that scientists did not perceive preregistrations as less creative or valuable. There are several reason why, on average, Registered Reports are perceived as very high-quality: authors need to think through hypotheses and research designs more carefully from the start; reviewers and journals get to impartially evaluate the methods and procedures; and the feedback at Stage 1 allows for change before the research is conducted (Soderberg et al., 2021). So, Registered Reports benefit researchers because they require careful reflection on the research plan and promote collaboration among scientists (Lakens et al., 2024).

Still, despite the evidence in favor of preregistration and Registered Reports, it is not possible to claim that their benefits indisputably outweigh their consequences (Lakens et al., 2024). It is difficult to exactly outline them, and it is impossible to quantify the cost of deciding not to preregister (Lakens et al., 2024). However, evaluating advantages and shortcomings should not be the main reason why researchers decide to implement preregistration (Lakens et al., 2024). The rationale for preregistration should be to, first and foremost, produce transparent, high-quality research that can be evaluated for its severity (Lakens et al., 2024). In fact, evaluating the severity of a test is crucial (Lakens, 2018). The severity of a test is the extent to which a hypothesis can be falsified: the higher the severity, the higher the likelihood of negative outcomes (Lakens, 2018). Essentially, results in line with broad predictions are not surprising, whilst more narrow predictions are riskier and more difficult to be proven true (Lakens, 2018). When severity is high, it is harder to obtain positive results than it is negative ones (Lakens et al., 2024). Preregistration allows peers to

transparently evaluate how easily claims in a study can be confirmed. It is often the case that, with vague psychological theories, studies fall short of severity (Lakens, 2018). It must be noted, though, that the argument for severity is built on the premise of statistical testing as valuable information for research: an error-statistical perspective of science that analyses claims by testing predictions (Lakens, 2018). If that is not the main focus of researchers, preregistration might not be seen as valuable or useful (Lakens et al., 2024).

3.2 When Deviating from a Preregistration Is Appropriate

Deviations are common remedies to unexpected events and mistakes that can occur during the research process (Lakens, 2024). Preregistrations do not lose their value when deviations occur: the crucial point is that any changes are reported openly so they can be transparently evaluated (Willroth & Atherton, 2024).

Adhering to preregistrations to a certain degree is indispensable for the protocol to be meaningful, but this is different from not having any room for change. In their study, Spitzer & Mueller (2023) found that some researchers (17.58%) perceived a low degree of flexibility in preregistrations. Deviations are normal; nevertheless, many scientists, 17.37% of those who had preregistered before and 44.68% who had never done so, were concerned it killed their work's credibility (Spitzer & Mueller, 2023). It is important that researchers know deviations do not nullify their projects. If they decide to deviate from a preregistration, this does not necessarily imply the study will be ineffective or the consequences will be drastically negative (Lakens, 2024). For example, when analysing data, researchers might observe unanticipated biases in responses and consider the preregistered exclusion criteria inappropriate. It is not important that hypotheses are only high in severity, but also in validity. Validity refers to the rationale and accuracy of a claim, and can be considered partly independent of severity (Lakens, 2024). In other words, if a claim is high in severity, there are many ways it can be proven false; if it is high in validity, it means it is precise and well grounded (Lakens, 2024). Consequently, a deviation might be the attempt to correct what would otherwise be an invalid hypothesis, at the cost of lowering the severity of the test (Lakens, 2024). It is often the case that, even after deviating from the protocol, the severity still remains higher than that of non-preregistered tests (Lakens, 2024).

Reasons why researchers deviate from a preregistration can be summarised in five categories:

unanticipated circumstances, mistakes in the preregistration, missing information, invalid presuppositions, and falsified additional assumptions (Lakens, 2024).

With regards to unanticipated circumstances, researchers may come across a situation that changes data collection in a way they did not expect (Lakens, 2024). For example, they may not be able to reach the preregistered sample size when ruling out certain data. It is important to point out that data must not be excluded for biased reasons or questionable practices. When the sample size is reduced, the severity of the test also decreases, and vice versa. In such cases, researchers should clearly communicate the problem, explain how it changed their study plan, and specify how the severity of the test was impacted as a result (Lakens, 2024).

Errors in preregistration are another reason for deviations (Lakens, 2024). Some errors are straightforward: for example, affirming to recruit participants ages 25-135, when the range intended was 25-35. In such cases, the severity should not be impacted. But when the correction for the mistake is not so obvious, the evaluation of the severity might drastically change (Lakens, 2024). There are also cases in which peer reviewers point out mistakes in the analyses performed, or consider them inappropriate altogether, and suggest other better ways to examine data (Lakens, 2024). If alterations are made at this stage, after data collection, it is very problematic because the severity of the test is considerably reduced. This is one reason why Registered Reports are so useful, as they offer early-stage feedback (Lakens, 2024). To recap, scientists should report any mistakes, correct them and and explain how they affected the severity. They should also specify all the ways in which the mistakes could have been corrected, and can also explain how the changes can preserve the validity of the test.

Another case in which deviations might be necessary is missing information (Lakens, 2024). This occurs when researchers fail to detail certain aspects of the study. The size of the problem depends on the nature of the omitted information, and there is the risk that scientists address the shortcomings in a way that benefits them, because of the amount of flexibility at stake. When important aspects of the research are missing, the severity usually declines (Lakens, 2024). Registered Reports can act as a safeguard for crucial missing information, which can be pointed out at Stage 1 review, before the data is collected. When realising they made a mistake, researchers should state what type of information was omitted, adjust it, and consider the impact on the severity (Lakens et al., 2024).

Deviations when analysing data are also possible because researchers cannot exactly anticipate

how data collection will unfold, or how participants will behave (Lakens, 2024). For example, they cannot predict all types of biases in responses. Adding exclusion criteria might be necessary to preserve the validity of the inferences, although they lower the severity of the test, assuming these changes are not made to manipulate results. Researchers should describe the situation, the changes made, evaluate their impact on the severity, and comment on the validity of inferences (Lakens, 2024).

Lastly, falsified additional assumptions (Lakens, 2024). When scientists conduct a study, they build it on a set of hypotheses for the research design and measurements. For example, assuming that the analysed variables are independent. The difference between these assumptions and invalid presuppositions is that the first can be empirically tested using the collected data, whilst violations of unproven presuppositions do not get forthrightly rejected (Lakens, 2024). When these additional assumptions are falsified, researchers should describe the issue, outline the falsified assumptions, report what was changed, and evaluate the impact on the severity of the test (Lakens, 2024).

To make sure deviations are correctly performed and not just used as cover for biased decisions, they can be evaluated in follow-up studies (Lakens, 2024).

Chapter 4

Conclusions

4.1 General Comment

In this dissertation, preregistration and Registered Reports are presented as a response to the replication crisis. This is because they control for QRPs, which inflate false positive results, and publication bias, both of which may contribute to the disproportionately high rate of successful studies and significant positive outcomes in the psychological literature. Therefore, the goal is to obtain a literature that includes all types of results, regardless of how advantageous they are for institutions and individual researchers, as they would yield a more representative and credible literature. But, the benefits do not stop with lower rates of the Type 1 error or more null and negative results. Preregistrations, when carried out properly, not only prevent improper research conduct and bad habits, they encourage good research practices and openness in the scientific process. In the case of Registered Reports, researchers are also promised publication if they demonstrate potential for high-quality research through rigorous designs. This concept is key for realigning the reward system to be in favour of scientific exemplary conduct. These aspects on their own are valuable for better research, as they help generate an environment of transparency, credibility, and trust in the scientific community.

In conclusion, after considering all the advantages and limits, it is reasonable to suggest preregistration and Registered Reports are worth their weight in gold for the research culture.

4.2 Limitations

When looking at the limits of this dissertation, the first is that it considers the replication crisis, preregistration, and Registered Reports primarily within the field of psychology. Yet, these issues concern various scientific disciplines; therefore should be examined more broadly. Secondly, there are limits withing the cited studies. For instance, when discussing researchers' attitudes and experiences with preregistration, the findings from Spitzer & Mueller (2023), Sarafoglou et al. (2022), Logg & Dorison (2021), and Soderberg et al. (2021) are based on self-report data, which may be subject to biases. Finally, this dissertation is grounded on a philosophy of science that values hypothesis testing and statistical error, thus focusing on concepts such as severity and cumulative evidence for assessing the credibility of a claim (Lakens, 2018). While this is a valuable approach, it is not the only valid perspective from which to study scientific research.

4.3 Future Directions

As discussed in Chapters Two and Three, preregistration and Registered Reports are methods that are still growing in popularity and require further refinement. They are not the solution to all problems in scientific research. Future work should also include investigating both the empirical benefits and potential downsides of these formats, in order to improve them and make their implementation more effective (Spitzer & Mueller, 2023). By having a more precise idea of advantages and limits, researchers can better understand the differences with traditional articles, overcome common fallacies, and better understand how to implement the formats in order to maximise their potential. Some of the improvements that can be made in the future concern enhancing efficiency and quality, and aligning incentives appropriately (C. D. Chambers & Tzavella, 2021).

This paper also aims to inform early-career researchers about the opportunity to preregister their studies and the great potential these formats hold. The hope for the future is also that those who are hesitant, due to uncertainty or unfamiliarity, will give preregistration a try and decide for themselves whether it is worthwhile. The goal is also that these formats become more widely adopted: the more researchers implement them, the more likely it is that their peers will follow, helping to promote a culture of transparency and collaborative effort in scientific research (Logg & Dorison, 2021).

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