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► **To cite this version:**

Lonni Besançon, Anastasia Bezerianos, Pierre Dragicevic, Petra Isenberg, Yvonne Jansen. Publishing Visualization Studies as Registered Reports: Expected Benefits and Researchers' Attitudes. 2021. hal-03441049v1

HAL Id: hal-03441049

<https://inria.hal.science/hal-03441049v1>

Preprint submitted on 22 Nov 2021 (v1), last revised 22 Sep 2022 (v2)

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Publishing Visualization Studies as Registered Reports: Expected Benefits and Researchers' Attitudes

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ABSTRACT

Background:

Registered Reports are publications in which study proposals are peer reviewed and pre-accepted before the study is ran. Their adoption in other disciplines has been found to promote research quality and save time and resources.

Objectives:

We offer a brief introduction to Registered Reports and their expected benefits for visualization research. We then report a survey of the visualization community on their attitudes towards Registered Reports. This survey takes the form of a *quasi* Registered Report, the first one presented at a visualization venue as far as we know.

Method:

We will run an online survey that will be open from the end of August until the day of the alt.VIS workshop.

Results:

Not available yet.

Conclusion:

Not available yet.

Reproducibility: All the material is available at osf.io/4nrma/.

Index Terms: Human-centered computing—Visualization—Visualization techniques—Treemaps; Human-centered computing—Visualization—Visualization design and evaluation methods

1 INTRODUCTION

Publishing scientific papers is the primary mean of communicating results, ideas, and tools to the public and scientific community. The publication of new scientific communications, in journals or conferences, is subject to peer-reviewing which eventually decides if the communication is worth publishing [24]. However, traditional peer-review and publication has been found to be sub-optimal [6, 28, 30]: it is hardly objective and there are many biases hindering the process (e.g., bias for positive results [9]). To address some of these issues and after facing the replication crisis [21], many fields tried improving their research and publishing methodology. Out of these efforts, Registered Reports emerged. According to the Center for Open Science, a Registered Report is:

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“a form of empirical journal article in which methods and proposed analyses are pre-registered and peer-reviewed prior to research being conducted. High quality protocols are then provisionally accepted for publication before data collection commences. This format of article is designed to reward best practice in adhering to the hypothetico-deductive model of the scientific method. It eliminates a variety of questionable research practices, including low statistical power, selective reporting of results, and publication bias, while allowing complete flexibility to conduct exploratory (unregistered) analyses and report serendipitous findings.”

The benefits of Registered Reports have been discussed extensively in the literature (see Sect. 2), and this publication format has been advocated for in empirical computer science [9]. However, to our knowledge, no visualization journal or conference offers Registered Reports as a publication format. We aim at (i) explaining Registered Reports and their benefits to the visualization community, and (ii) reporting the results of a survey. This survey aims at better understanding the visualization community's general awareness of Registered Reports, in how far such a publication model fits into people's habits and expectations, and in crowdsourcing potential issues which may need to be taken into account to adapt Registered Reports to the needs of the visualization community.

We refer to this article as a *quasi* Registered Report, because it is trying to be as close as possible to a Registered Report but it has not been submitted to a venue with a proper two-stage Reviewing Process already in place. Even then, to the best of our knowledge, this article is the closest to a Registered Report that has been published in a visualization venue so far.

2 REGISTERED REPORTS

The concept of Registered Report has been conceived more than a decade ago. We summarize here the hypothesized benefits and the evidence found to support them.

2.1 Mitigating the File-Drawer Effect

Reviewing of Registered Reports is inherently result-agnostic: decisions to accept or reject publications are solely based on the relevance of the research questions and the proposed methodology to study these. As such, Registered Reports are expected to mitigate the bias towards the publication of positive findings, also known as the file-drawer effect. Not only this bias hides interventions that do not work, it negatively impacts the trustworthiness of published results and can harm the credibility of a field [13, 29]. Initial investigation in psychology [26] seem to have found some evidence that Registered Reports can indeed mitigate publication bias: Registered Reports presented only 47% of positive results while comparable classical submissions presented an outstanding 96% of positive results.

2.2 Avoiding Questionable Research Practices

By design, Registered Reports are meant to prevent questionable research practices. In particular, they render HARKing (hypothesiz-

ing after the results are known) [10] impossible, and help prevent selective reporting and p-hacking [9]. In addition, because most Registered Report formats involve peer review prior to data collection, the process can improve experimental design and methods through recommendations made by reviewers.

2.3 Improving Quality and Reducing Scientific Waste

The reviewing of Registered Reports focuses on the authors research questions and their importance, as well as the proposed methodology. The iterations between authors and reviewers before the study is conducted are likely to improve experimental design [1], help correct a wrongfully chosen research outcome/question, and detect errors or imprecision in data analysis. These iterations all take place before any data collection begins and thus before any scientific resource is used, be it participants that are enrolled, money spent, or devices/doses used. For this reason, Registered Reports have been said to help reduce waste of scientific resources [5, 7, 8]. In addition, they could help reduce the norm of submitting already completed but potentially flawed studies to many different journals until they get accepted [14, 22]. Even when only considering the time spent reformatting scholarly articles from one journal template to another [17], Registered Reports would already save precious scientific time.

2.4 Perceived Quality and Novelty

While Registered Reports do seem to increase research quality and mitigate many of the biases of the publishing system, some have voiced concerns that they could lead to scientists pursuing less novel or interesting research questions [3, 11]. However, initial evidence would seem to suggest that such fears are ungrounded, and that Registered Reports are perceived by scholars as being statistically indistinguishable from regular papers in terms of novelty or creativity, while being at the same time perceived as more robust and of higher quality [27].

3 REGISTERED REPORTS FOR VISUALIZATION RESEARCH: WHY AND HOW

Today, according to the Center for Open Science, more than 300 scientific venues offer the option to submit Registered Reports. However, to the best of our knowledge, no visualization or even human-computer interaction venue offers the possibility to submit or review Registered Reports. Cockburn et al. [9] argued that the adoption of Registered Reports to major venues could be daunting, but that reviewing workflows could easily be adapted to allow it.

Visualization papers come in many different types [18, 20], and not all of them report a user study. Those who do not, would not be able to benefit from the addition of Registered Reports as a publication type since no experimental design is included in them. Such manuscripts would continue to be submitted as regular papers and reviewed accordingly. On the other hand, papers with any form of empirical evaluation would likely benefit from being reviewed as Registered Reports. Of course, it should be up to the authors to choose which format they prefer.

As an example, an author who wants to publish a novel technique or system with an evaluation would submit a first-stage Registered Report that contains an introduction of the problem the new system or technique is intended to solve, an overview of related work, a full description of the novel system or technique (ideally with an implementation available for reviewers to try it), and a final section detailing how the empirical evaluation will be conducted, what data will be collected and how the data will be analyzed. As another example, if an author wants to compare existing techniques or conduct a study that does not involve any new technique, their Registered Report would contain all the sections previously mentioned with the exclusion of the section on the novel system or technique. As reviewers may ask for changes in the experimental design, it would

be futile to commence data collection before the reviews are sent to the authors. Discussions and conclusion sections should also be left out.

For reviewers to be able to evaluate the methodology proposed by authors, the empirical evaluation section needs to be described as precisely as possible, much like a pre-registration of the experimental study would be detailed [23]. Authors should include: research questions and hypothesis, measures considered, data analysis plan, sample size (or data collection endpoints). Adding drafts of plots and tables with fictional data can be very helpful to reviewers. As an example, the first-stage version of the present *quasi* Registered Report can be found at osf.io/4nrma/.

4 SURVEY OF VISUALIZATION RESEARCHERS

We set out to understand visualization researchers' attitudes towards Registered Reports. We describe below our research questions and hypotheses as well as our survey questions, its administration and data analysis plan.

4.1 Research Questions and Hypotheses

We want to understand visualization researchers' knowledge of and attitudes towards Registered Reports. We set out to answer if the visualization community knows about them, feels confident about submitting and reviewing them, and is ultimately interested in adopting them for submissions. We anticipate that interest and confidence might be dependent on the respondent's level of adoption of open science practices (e.g., pre-registrations), and perhaps also on their the number of years of expertise in the field.

4.2 Administration and Ethics Approval

Once the first-stage *quasi* Registered Report (this submission) is reviewed and the survey questions finalized, we will submit our protocol for ethics approval at the first author's institution. The survey will be presented as an online form, and participation will be voluntary. Participants will be informed about the purpose of the survey and its approximate completion time (based on pilot studies) before they start answering. No personal information will be collected. No compensation will be offered, but participants will be given the link to our OSF repository so they can later check the results of the survey.

4.3 Recruitment

We will share the survey on social media (Twitter, Slack,...) and by email to past and present collaborators. We will also invite colleagues through word of mouth and informal sharing. We consequently will not present a response rate to the survey and will not specify a target sample size. Instead, we will stop data collection the day of the alt.VIS workshop, at 23:59 AoE time. On the day of workshop, we will present our preliminary results, and invite participants of the workshop to also answer the survey. Based on previous similar survey of the visualization community, we anticipate that our survey should gather at least 50 answers.

4.4 Timing

Once the reviews for the alt.VIS workshop are released, we will use the feedback from our reviewers to improve our survey design, our data analysis plan, and our *quasi* Registered Report (this article). We will then submit our study protocol for ethics approval, and post the revised *quasi* Registered Report as a preprint linked to our OSF repository. Once we receive ethics approval, we will immediately start data collection. Soon after the alt.VIS workshop and after the survey is closed, we will publish a third and final version of this manuscript that includes all of our results and our final conclusions. In order to remain as close as possible to a Registered Report, we will send our last revision to the workshop organizers for approval,

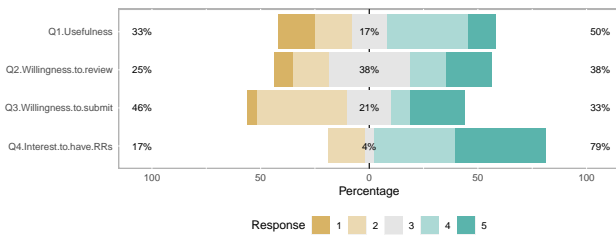


Figure 1: Mock-up of Likert Plots for the four attitude questions.

if they agree to do so (see letter to workshop organizers submitted together with this article).

4.5 Survey and Analysis Plan

We describe below the content of our survey and our analysis plan.

4.5.1 Survey

The current draft of our survey is available for review on our OSF repository (osf.io/4nrma/). It currently consists of five different pages. The first page details the aim of the survey and asks for the participant's informed consent. The second page aims to gather participants' research experience through Likert items, asking them, for example, how long they have been active in the visualization community. The third page asks participants if they know what a Registered Report is, before giving, on the fourth page, the definition of Registered Reports according to the Center for Open Science. After having been explained what Registered Reports are, participants are invited to answer four Likert items to assess:

- Q1 how helpful they think it would be to have their study design reviewed before data collection,
- Q2 how willing they would be to submit a Registered Report,
- Q3 how willing they would be to review a Registered Report,
- Q4 how interested they would be in having Registered Reports as a publication option in the visualization community.

All of the questions above are complemented with an optional text field where participants can explain their answers and make comments if they wish to.

4.5.2 Data analysis plan

Our current analysis plan is available for review on our OSF page with R code (osf.io/4nrma/). It currently includes a qualitative and quantitative analysis of the data. We will also report the results of the research experience questions on page 2 as descriptive statistics.

Quantitative Analysis: We will report a Likert plot showing responses to each of the four attitude questions (see Fig. 1). To check whether attitude depends on current adoption of open science practices (operationalized as the number of pre-registered studies previously submitted) and on seniority (operationalized as years of experiences in visualization research), we will produce figures showing, for each of the four questions, the mean response with 95% bootstrap confidence intervals [16], broken down by category (see Fig. 2 and Fig. 3). While the use of means to summarize ordinal responses is not universally accepted [25], it is a common and methodologically-defensible practice [19, 25]. We will interpret our results with an estimation approach based on a visual inspection of interval estimates [12] and will focus on conveying strength of evidence instead of drawing dichotomous conclusions [4, 15]. We will not adjust for multiplicity but will instead draw the reader's

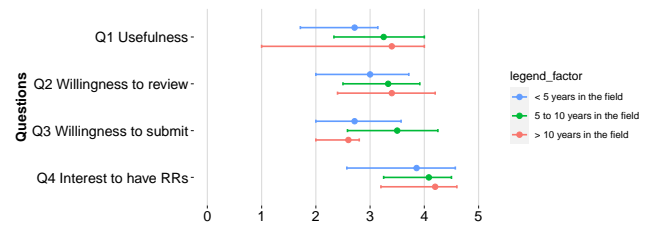


Figure 2: Mock-up of mean responses to the four attitude questions depending on years of experience in visualization research. Error bars: 95% CIs.

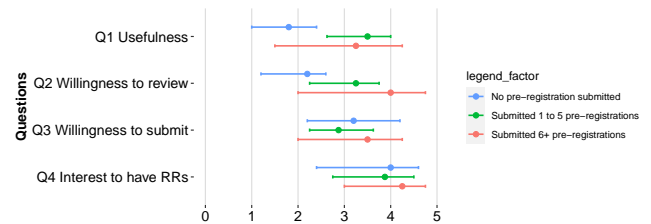


Figure 3: Mock-up of mean responses to the four attitude questions depending on the number of pre-registrations previously submitted. Error bars: 95% CIs.

attention to the number of comparisons made and the resulting risk of false positives [2, 12].

Qualitative Analysis: Our survey gives respondents the opportunity to provide additional explanations about the four attitude questions. We will conduct a thematic analysis of these answers. Two coders of the author team will analyze responses independently to categorize them based on their themes. A third coder will be involved to resolve non-matching categorization of answers. We will then report on the number of participants providing answers on specific themes and potentially quote some interesting or thought-provoking statements from the respondents. This analysis will be updated after the workshop with the new data.

5 CONCLUSION

We introduced and motivated the use of Registered Reports as a publication model for visualization studies, and reported on a survey attempting to better understand visualization researchers' attitudes towards them. This article itself takes the form of a *quasi* Registered Report, which shares most of the characteristics of Registered Reports except the alt.VIS reviewing workflow has not been designed with Registered Reports in mind. Despite the widespread adoption of this new publication model in a range of disciplines and the tremendous benefits it can provide to all actors involved in research (authors, reviewers, journal editors), the adoption of Registered Reports in visualization is currently zero. We hope this article will encourage journal editors, conference organizers, and authors in visualization to adopt Registered Reports as an additional publication format, and help them understand the opportunities and challenges in implementing it.

ACKNOWLEDGMENTS

We want to register our thanks to our future participants for their time and valuable answers.

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