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Review

What's next for the psychology of science rejection?

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The last decade has seen a surge in research on science attitudes, trust in science, and science rejection. As a result, our understanding of the psychology of science rejection has substantially improved. This is important, because science rejection is a pernicious problem that can obstruct potential solutions to various pressing societal and environmental challenges. At the same time, this field of inquiry is limited in—at least—two important ways. First, much of the work conducted is descriptive in nature and not sufficiently guided by theory. Second, research has largely and disproportionately focused on a limited range of science domains, resulting in narrow and/or fuzzy conceptualizations and operationalizations of 'science'. In this article, we argue that for the field to move forward it needs to pay more attention to theory and validity.

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Psychologists and social scientists increasingly recognize that the relationship between the public and science is important for the prosperity and well-being of individuals and society. This relationship is complex and, unfortunately, often fragile, as evidenced by the growing prevalence of anti-science discourses over the past decade. In 2017, *Nature's* editorial warned that "anti-science forces are on the march." [1] More recently, Peter Hotez has raised concerns about the escalating global anti-science movement [2]. The COVID-19 pandemic further underscored the fragile nature of public trust in science.

Science rejection can be defined as the unwarranted dismissal of well-established scientific knowledge and evidence, and/or a distrust of science as an institution [3]. Survey research shows that such rejection is real: even when general trust in science is modest to high, public opinion is often at odds with the scientific consensus across various domains [3–5]. To illustrate, 87 % of US biomedical scientists agree that childhood vaccines should be required, in contrast to 68 % of the public [6]. Even stronger differences are observed for genetically modified food safety [7]. Other domains of science where striking differences between public opinion and scientific consensus exist are climate science and biological evolution. Understanding these gulfs between public opinion and scientific consensus is important, because a certain level of community buy-in is needed for a successful implementation of science-based solutions to some of the most urgent societal problems of our time (e.g., climate change, pandemics, malnutrition, inequality).

As a result of a surge in research on science attitudes, trust in science, and science rejection[1] conducted over the last ten years or so, our understanding of the psychological underpinnings of science rejection has substantially improved; for recent reviews of this literature see Refs. [3,8]. However, the literature is a patchwork of research lines with different foci, scattered across disciplines. This applies both to the correlates and the operationalization of science rejection. While initial work was heavily influenced by the information deficit model of science communication and thus focused on lack of information as a key correlate, later research started to look at political ideology in particular as an important correlate of science rejection. Disproportionate emphasis was not only placed on political ideology, but also on a limited array of topic-specific manifestations of science rejection; mainly climate science denial. In our earlier work on the heterogeneity of

[1] One part of the fuzziness in how science rejection is operationalized in the literature is the interchangeable use of terms such as negative science attitudes, science skepticism, science rejection, and (dis-)trust in science [3,12]. These can but do not necessarily refer to the same construct. We revisit this issue throughout this article.

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science rejection, we address this issue by putting forward the idea that 'not all skepticism is equal' [9]. In that and following papers—including a cross-national study [10]—we applied the concept of heterogeneity to the correlates of science rejection as well as the science domain. What this line of research shows is that science rejection varies in degree and kind: some science domains are more contentious than others (e.g., astronomy vs. virology) and the more contentious domains differ in their ideological antecedents. For example, an antivaxxer does not have to be a climate denialist [11].

The current patchwork state of the field can be attributed to (at least) two important limitations that in our view hamper further progress in this field. First, much of the research in the field is either descriptive in nature and not sufficiently informed by theory, or it is lacking theoretical integration. At any rate, there is no overarching theory or framework that guides research efforts aimed at understanding the psychology of science rejection. The resulting siloed specialization consisting of separate literature on specific correlates of specific science topics—as well as specialized or narrow conceptualizations and operationalizations of 'science'—had led to a literature riddled with disparate and sometimes contradictory findings requiring explanation and integration.

Second, insufficient attention has been paid to how science rejection is (or should be) conceptualized and operationalized. This does not only apply to science *domain*, but also to which *facet* of science is targeted [3,4,12]. Earlier sociological work already pointed to the importance of distinguishing trust in science as an institution from trust in the scientific method [12], but this distinction has rarely been considered in the literature we review here [13]. Recent surveys also point to the importance of doing so [4,5].

To be clear, these limitations are interrelated, and both theoretical and methodological [11] advances are needed to integrate findings and provide better explanations for them [14]. To move forward, the field should 1) become more theory-driven and 2) more precisely conceptualize and operationalize science-related outcome variables, and expand the range of science domains studied.

Theory

We are not suggesting that all work on science rejection so far is entirely uninformed by theory. Some research programs on science rejection draw on existing theories in (social) psychology and political science. For example, the Attitude Roots model [15] builds on motivated reasoning and additionally incorporates elements from moral psychology and cultural theory of risk [3]. Other lines of research build on threat compensation theories, showing that science can—in some cases—provide order and meaning [16] but it can also threaten these perceptions [17,18]. Work on consensus information and misinformation effects draw on information deficit and science comprehension approaches, with the Gateway Belief Model more explicitly building on dual-process theories of persuasion [19]. More recently, the Psychological Distance to Science model builds on Construal Level Theory [20].

However, in applying these different theoretical perspectives to understanding science rejection, these research programs tend to be quite modular in focusing on specific individual difference correlates and—in many cases—on a limited set of specific science domains (e.g., climate science). This has resulted in grab bag of evidence for a plethora of motivational and cognitive factors involved in topic-specific science rejection, sometimes accompanied by unhelpful either/or debates in the literature as to which factors should be ascribed the most weight. Elsewhere some of us have made the case that various factors need to be considered, and integration is needed [3]. In short, for the field to move forward, an integrative theoretical approach is needed that is specifically geared towards a better understanding of how people evaluate science across *domains* and *facets* of science. Such an effort might build on—and hone—the various specific insights relevant to science rejection obtained by using existing theories, and integrate these in one framework.

By shifting gears towards research programs that test theory-informed hypotheses, we hope that the field gradually works towards an overarching theory of science rejection. Such a theory should be able to *integrate* previous—sometimes conflicting—findings, establish *mechanisms* via causal tests of the theory, and *predict* science attitudes across science domains and facets.

Validity

There are important limitations to the construct validity of research conducted so far. We make two main points here. The first point pertains to science *domain* and *conceptualization* of 'science'; as described earlier, research has largely and disproportionately focused on a limited range of (contentious) science domains, with special emphasis on climate science. At the same time, various research efforts gauge trust in science generally, but these often lack a clear conceptualization of science or are unclear about what research participants think 'science' is [3,21].

The second point concerns the specific *facet* of science that is targeted; science is a broad concept, but research tends to focus either on scientific evidence, science as an institution, or on scientists. A smaller segment of the

literature focuses on science as a method, or on science as a worldview [3,8]. Finally, science as input for policy interventions has to our knowledge not been an explicit focus of psychological research. This is an important lacuna, given that policy measures can result in backlash against scientists [22,23]. All this has resulted in a body of literature consisting of diverging—and sometimes narrow—conceptualizations and operationalizations of 'science'.

In sum, next to lack of theory, conceptual and operational fuzziness is an additional contributor to the patchwork state of the field. Based on the above considerations, we propose three—interrelated—routes to improvement. The first two improvements relate to *conceptualization* and *operationalization*. It is important to note that there is a dearth of research examining what people think science *is* in the first place [3,21,24]. This seems particularly problematic given the psychological distance to science that many people experience; if people are not acquainted with scientists or have no idea how to approach them (i.e., social distance [25]), or when science is viewed as an opaque endeavor without any relevance to daily life (i.e., hypothetical distance [25]), how can researchers assume that people evaluate 'science' as an attitude object in the intended way? [3] Second and related to conceptualization, improvements as to how science is operationalized are needed. Importantly, what *facet* of science is focused on should ideally be guided by theoretical considerations (e.g., via theory-informed hypotheses). For example, is the researcher interested in science as a worldview, in people's trust in the scientific method, or in a evaluations of specific scientific finding?

Some recent work offers useful insights for conceptualization and operationalization. For example, a 2024 survey among a representative sample of the Dutch population has found that people most often associate science with "research", "knowledge", "facts", "innovation", and "progress" [5]. In another line of work, when groups of participants from the US and the UK were asked to generate as many scientific occupations as they could, the resulting bottom-up generated lists are spearheaded by the natural sciences exclusively. Moreover, these scientific occupations were subsequently rated as the most prototypical for science [21]. These results suggest that when using a broad operationalization of science or scientists, respondents might in reality be evaluating the natural sciences specifically.

The third improvement we propose is to extend the range of science domains. As mentioned earlier, research on domain-specific science rejection for the most part covers a handful of science domains. While these are worth studying given their relatively contentious nature with public opinion diverging from scientific consensus, we believe that topics studied in the social sciences in particular should be given more attention in this field for the following reasons. First, many of the topics that social and behavioural scientists study are relevant to our understanding of major contemporary challenges. Yet, the social sciences tend to be overlooked in informing policy [26,27]. Second, these topics are often close to people's daily lives, and so potentially associated with lay intuitions and ideological motivations [8,28,29]. For example, research on diversity and (in)equality revealing gender bias in the workplace can have implications for people's working life. People might know cases of successful women and are therefore inclined to disregard the research and/or research findings. Alternatively, employees might be worried that potential policy changes in response to such research findings might affect their chances for promotion. Indeed, results of a recent survey that did include social science domains show that trust in research on discrimination and inequality was lower than any of the other science domains included [5]. Finally, behavioural scientists are perceived as less competent than those working in the natural sciences [21]. In sum, to more fully understand science rejection a more representative range of science domains needs to be incorporated in research designs.

Conclusion

In this article we take stock of the expanding body of work on the psychology of science rejection. The progress that has been made in the last decade is encouraging, but at the same time we observe that field is limited in two important ways. These limitations are interrelated, and we therefore hope that improvements in theory and validity will prove to be mutually reinforcing in moving the field forward toward a theory-informed and integrated database of the psychology of science rejection.

Author contributions

BR

- Conceptualization
- Writing – original draft

RL

- Conceptualization
- Writing – review and editing

RS

- Writing – review and editing

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could

have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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- • of special interest
- •• of outstanding interest

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Further information on references of particular interest

3. •• Review that discusses different lines of research into science rejection and calls for integration.

9. • One of the first papers showing that science rejection is heterogenous with correlates varying by science domain.

12. • Paper that distinguished trust in science as a method vs. institution.

13. • Provides a critical look on what direct trust measures capture. Provides suggestions for researchers for designing surveys on trust in science.

21. •• This paper assesses how various types of scientists are evaluated.