

# Four Validities as Pathways to Scientific and Societal Impact in Environmental Psychology

## Vier Validitäten als Wege zu wissenschaftlicher und gesellschaftlicher Wirkung in der Umweltpsychologie

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## Abstract

Environmental psychology researchers are often urged to increase their scientific and societal impact when addressing sustainability challenges. However, there is not much advice for how they can enhance different types of impact. Here, we propose why and how four well-established validities can serve as pathways for enhancing impact: construct validity, internal validity, external validity, and statistical conclusion validity. We explain how these validities apply to environmental psychology research and other applied fields and outline the key validity threats to scientific and societal impact. Based on the methodology literature from psychology and related fields, we provide guidelines for addressing validity and increasing impact. Those guidelines can be used by researchers, journal editors, funding agencies, and practitioners for evaluating and increasing scientific and societal impact.

## Impact statement

This article highlights why and how addressing four validities in research, namely construct, internal, external, and statistical conclusion validity, can serve as pathways to the scientific and societal impact of environmental psychology. By identifying threats to these validities and proposing concrete guidelines to overcome them, we provide researchers with a pathway for producing robust, applicable, and transformative insights. For practitioners, it illustrates how and when to make use of scientific insights, by adopting well-validated measures for psychological measures and by implementing rigorously tested interventions to design effective, evidence-based policies and initiatives. The suggested guidelines have been established across diverse research contexts. They help bridge the gap between science and real-world change. We hope that this article helps to conduct research that supports stronger basic science and applied outcomes such as accelerating the sustainability transition.

## Keywords

Scientific impact, societal impact, validity, measurement, open science

## Zusammenfassung

Umweltpsycholog:innen werden häufig dazu angehalten, den wissenschaftlichen und gesellschaftlichen Impact ihrer Forschung zu reflektieren und zu erhöhen, um zur Nachhaltigkeitstransformation beizutragen. Welche Strategien können sie anwenden, um den Impact ihrer Forschung zu steigern? Hier schlagen wir vor, dass vier etablierte Forschungsvaliditäten dabei helfen können, die Grundlagen für Impact besser zu verstehen und idealerweise, zu erhöhen: Konstruktvalidität, interne Validität, externe Validität und statistische Validität. Für alle vier Validitäten beschreiben wir zunächst Barrieren, dann Strategien, um diese Barrieren zu adressieren, sowie Möglichkeiten, dadurch wissenschaftlichen und gesellschaftlichen Impact zu verändern. Dafür leiten wir aus der interdisziplinären psychologischen Methodenliteratur etablierte Strategien ab. Diese können Forschenden, Herausgeber:innen, Förderorganisationen und Praktiker:innen dabei helfen, Impact besser zu verstehen und idealerweise zu steigern.

## Schlüsselwörter

Wissenschaftlicher Impact, gesellschaftlicher Impact, Validität, Messverfahren, Open Science

## Impact-Statement

Unser Artikel zeigt, warum und wie vier Forschungsvaliditäten, nämlich Konstruktvalidität, interne Validität, externe Validität und statistische Validität, helfen können, den wissenschaftlichen und gesellschaftlichen Impact der Umweltpsychologie zu steigern. Wir beschreiben Barrieren, die diesen Validitäten entgegenstehen, sowie praktische Strategien, um diese Barrieren zu überwinden. Damit möchten wir ermöglichen, robuste und anwendbare Forschungsergebnisse zu produzieren. Praktiker\*innen soll dieser Artikel dabei unterstützen, robuste, validierte Maße beispielsweise für umweltfreundliches Verhalten in ihrer Arbeit zu berücksichtigen, sowie empirisch geprüfte Interventionen umzusetzen. So kann nachhaltiges Verhalten wirksam und evidenzbasiert gefördert werden. Wir möchten Forschung in der Umweltpsychologie und benachbarten Feldern dahingehend unterstützen, dass sie nicht nur bestehendes Wissen erweitert, sondern in der Praxis dazu beiträgt, Nachhaltigkeit zu fördern.

# 1 Introduction

Societal transformation towards sustainability depends on changes in human individual and collective behaviors, in addition to large-scale technological, institutional, and economic change. The social sciences, including environmental psychology, contribute to better understanding the psychological processes necessary for a sustainability transition (Creutzig et al., 2022; Clayton et al., 2016). Environmental psychologists focused on conservation study peoples' thoughts and actions, including individual consumption behaviors as well as policy support. Such researchers examine how thoughts and actions are shaped by social and physical context, how individuals in turn shape those contexts, and study interventions for motivating sustainable behaviors (Steg & De Groot, 2018; Gifford, 2014). Much of environmental psychology focuses on how this interplay between person and the environment contributes to tackling global challenges such as climate change, biodiversity loss, and resource depletion (Gifford, 2014). This applied focus on sustainability differentiates environmental psychology from social, cognitive, and political psychology. At the same time, environmental psychology shares theories and methods from these adjacent fields.

Environmental psychology research has grown rapidly in recent decades (Gifford, 2014), in terms of conference participants, publications, journals, and visibility. At the same time, scholars have questioned the field's impact. In addition to critical calls to focus more on high-impact sustainability behaviors (Nielsen et al., 2021), impact as a field also includes to what extent research influences theories, practices and policies outside of environmental psychology (e.g., Bamberg et al., 2021; Clayton et al., 2016; Nielsen et al., 2024). Sharing these concerns, some scientists (Creutzig et al., 2022; de Vries et al., 2021; Bandola-Gill, 2019; Nielsen et al., 2021; Weiss & Shanteau, 2021) and scientific societies (American Psychological Association, 2022; Wirsching et al., 2020; Wissenschaftsrat, 2019) have called for environmental psychology to increase both its scientific impact (its contribution to knowledge accumulation within and beyond psychology) and its societal impact (its contribution to addressing environmental and sustainability challenges). These calls suggest that impact is not guaranteed by topic relevance alone. Psychological research on sustainability can have low impact if findings do not replicate, if they do not generalize outside psychological research labs, or if they do not address impactful behaviors (Nielsen et al., 2024). To help environmental psychology researchers follow these calls for impact, this article discusses pathways towards increasing scientific and societal impact of environmental psychology.

Validity involves both the robustness and the generalizability of empirical findings. Robustness captures whether findings are accurate, well supported, and replicable under varied analytical decisions. Generalizability captures whether findings extend beyond a specific sample or setting to other populations, contexts, or time periods. Here, we thus suggest that four well-established validities in psychological science can also guide as pathways towards impact of environmental psychology research: Construct validity, internal validity, external validity, and statistical conclusion validity (Vazire et al., 2022). Research that maximizes these four validities may be more likely to be trusted by scholars from other fields, be adopted by practitioners and policy makers, and thus generate more impact. We first define scientific and societal impact. Next, we identify guidelines derived

from empirical research in meta-science, measurement, and replication, as well as from conceptual work such as the methodological frameworks from Vazire et al. (2022), and Matthey and Glymour (2020). Table 1 summarizes guidelines to increase validity for scientific and societal impact. By linking scientific and societal impact with the four validities, we aim to provide a clearer understanding of what impact is, how to address validity threats, and how to boost impact.

## 1.1 Scientific impact

How much do new insights spread in scientific fields? Scientific impact is typically measured through citation metrics such as the h-index or citation counts (Siudem et al., 2020; Fortunato et al., 2018; Ravenscroft et al., 2017) of publications, software, or journals (Schönbrodt et al., 2022). These metrics reflect how often research is discussed within the scientific community. Scientific impact also occurs when insights from environmental psychology are integrated into theories about sustainability from other fields (Bamberg et al., 2021; Clayton et al., 2016; Johnson, 2012; Fortunato et al., 2018). When findings are credible, clearly defined, and robust across contexts, they are more useful for other researchers and can be synthesized in meta-analyses or systematic reviews (Siddaway et al., 2019).

## 1.2 Societal impact

How much do scientific insights contribute to societal, technological, and environmental approaches towards sustainability (Fortunato et al., 2018)? Societal impact reflects how much findings are used outside psychological research labs, e.g., for facilitating the sustainability transition. Findings can support practitioners, policy makers, entrepreneurs, non-governmental organizations as well as the public. Findings can contribute instrumentally by shaping or evaluating policy, regulation, or legislation (Holmberg et al., 2019). Findings may also contribute conceptually, e.g., to better understanding policy options or outcomes, to reframing policy debates, or to capacity building (Holmberg et al., 2019), which constitutes technical, knowledge and skill development (Ijzerman et al., 2020; Holmberg et al., 2019; Ravenscroft et al., 2017). One indicator for societal impact is citation in major policy reports, such as from the Intergovernmental Panel on Climate Change. Another indicator is how much the design and evaluation of policies reflects insights and methods from environmental psychology. This impact often requires a dialogue with practitioners and policy makers to communicate insights from environmental psychology. Achieving societal impact thus also requires environmental psychologists to cooperate closely with practitioners to identify their needs and knowledge gaps and ensure that insights can be meaningfully applied in real-world settings (Baulenas et al., 2023; Fecher et al., 2021; Nowotny et al., 2001).

# 2 Different validities as pathways to scientific and societal impact

## 2.1 Construct Validity

The core argument of our paper is that four types of validity can serve as pathways towards both scientific and societal impact. Construct validity reflects how precisely a measured variable captures the intended target construct (Flake et al., 2017;

Vazire et al., 2022). Environmental psychology researchers have discussed several threats to measurement including measurement error (Lange & Dewitte, 2019), the reliance on behavioral proxies such as intentions (Dablander et al., 2025; Lange, 2022), and the use of self-report (Kormos & Gifford, 2014; Lange & Dewitte, 2019). For instance, self-report measures contain substantial bias and error because of order effects in surveys (Lange & Dewitte, 2019), social desirability (Koller et al., 2023; Hertwig & Ortmann, 2001) or imperfect memory (Lange, 2022). Moreover, in field settings, behavioral trace data such as from electricity or water meters are typically household rather than individual level (Lange, 2022; Lange & Dewitte, 2019). Construct validity can also be low when a measure is not reliable, but a highly reliable measure can still have low construct validity if it consistently assesses the wrong attribute. Overall, measures with low construct validity can spuriously correlate with other variables for unintended reasons (Rohrer, 2018), increasing the risk of biased or misleading conclusions. When construct validity is low, findings may appear meaningful while failing to reflect the psychological, behavioral, or social process that researchers or practitioners aim to understand.

Construct validity increases when researchers use well-established, well-validated measures (Flake et al., 2017; Flake & Fried, 2020; Lange, 2022, Frederiks et al., 2016) because measures with higher validity reduce irrelevant variability (Mischel, 2009; Fiske, 1987). Achieving validity requires precise specifications of measured constructs (Vazire et al., 2022), as well as the behavioral context including who is involved, what choices are available, and any performance-based payoffs (Hertwig & Ortmann, 2001; Majer et al., 2022).

Here, we argue that construct validity supports scientific impact (Table 1). Research with high construct validity contributes to cumulative scientific knowledge and theory development. High-validity measures also facilitate systematic comparisons of interventions (Milkman et al., 2021), e.g., in systematic reviews or meta-analyses (IJzerman et al., 2020; Haddaway & Macura, 2018; Berrang-Ford et al., 2015), particularly when researchers follow established guidelines for evidence synthesis (Haddaway & Pullin, 2014).

Construct validity also links to societal impact (Table 1). Research with high construct validity enables practitioners to change key psychological and behavioral factors rather than using less targeted or effective interventions (de Vries et al., 2021). This impact requires collaborating with practitioners to better understand dynamics in specific contexts by developing reliable and context-sensitive measures (Lange & Dewitte, 2019; Table 1). Other fields offer examples of such collaborative successes. For instance, climate services research involves the systematic analysis of user types and needs in a co-production format where scientists and practitioners continuously interact to ensure that generated knowledge is both credible and usable for practitioners (Baulenas et al., 2023).

Table 1. *Validities as Pathways to Impact of Environmental Psychology Research*

Validity		Further reading
<b>Construct validity</b>		
<i>Scientific impact</i>	1. Use well-validated behavioral and self-report measures rather than ad-hoc and/or single items.	Lange, 2022; Hertwig & Ortmann, 2001; Majer et al., 2022
	2. Specify actors, choices, and payoffs clearly; pretest measures for reliability and discrimination.	
<i>Societal impact</i>	3. Collaborate with practitioners to co-develop measures that capture variability in real-world settings. Include user-testing of items and pilot studies in target settings.	Lange & Dewitte, 2019
<b>Internal validity</b>		
<i>Scientific impact</i>	4. Test competing causal theories by explicitly comparing alternative models (e.g., alternative mediators and moderators). Experimentally manipulate mediators for causal inference.	Rohrer, 2018; Matthay & Glymour, 2020; Grosz et al., 2020
	5. Reduce confounding variables through random assignment, counterbalancing, and/or statistical controls, especially in longitudinal or field research.	
	6. Use clear graphs and precise language that specify justified causal inference strength. Report assumptions and describe causal claims transparently (e.g., avoid “plays a role in”).	
<i>Societal impact</i>	7. Validate causal mechanisms across heterogeneous real-world settings and populations. Work with practitioners to identify mechanisms that are feasible and relevant in target settings.	Bryan et al., 2021
<b>External validity</b>		
<i>Scientific impact</i>	8. Use multi-site studies or crowdsourced research insights to understand sources of heterogeneity across settings. Account for socioeconomic, cultural, or infrastructural variables in study design.	Bruine de Bruin & Bostrom, 2013; Klein et al., 2018
<i>Societal impact</i>	9. Integrate practitioners’ context knowledge into study procedures. Adapt interventions to local infrastructures and constraints and document contextual factors for transferability.	Nielsen et al., 2021
<b>Statistical conclusion validity</b>		
<i>Scientific impact</i>	10. Use statistical methods that compare competing hypotheses and are robust to violated assumptions. Include sensitivity analyses, model checks, and robust inference techniques.	Haefffel, 2022; Vazire et al., 2022; García-Pérez, 2012;
	11. Employ Registered Reports and open-science practices to reduce analytic flexibility and increase transparency. Pre-register hypotheses and share data, code, and materials.	Matthay & Glymour, 2020; Chambers & Tzavella, 2022
<i>Societal impact</i>	12. Work with practitioners to identify meaningful effect sizes.	Vazire et al., 2022;
	13. Communicate results in interpretable formats such as natural frequencies and success rates and use clear visualizations.	McDowell et al., 2016

*Note.* The guideline examples may address multiple impact types. The references represent empirical examples or guidelines on implementation.

## 2.2 Internal validity

Internal validity reflects how much the study findings allow for causal inference (Bryan et al., 2021; Shadish et al., 2002; Vazire et al., 2022). Threats to internal validity arise when confounding variables bias the estimated effect of an intervention onto an outcome (Matthay & Glymour, 2020; Rohrer, 2018). For example, selective attrition in experimental groups (Rohrer, 2018) can bias treatment effects (Matthay & Glymour, 2020). Further threats arise when studies test a single causal explanation rather than comparing alternative causal models (Grosz et al., 2020), examine only a small set of potential mediators (Vazire et al., 2022), or rely on a single method for evaluating an intervention (Lange & Dewitte, 2019). Internal validity is also threatened when correlational relationships are described as causal, which can inflate the apparent importance or policy relevance of findings (Grosz et al., 2020; Rohrer, 2018). When internal validity is low, researchers or practitioners may build on incorrect causal relationships and design ineffective interventions.

Internal validity increases when researchers systematically compare competing causal models, e.g., with alternative mediators (Matthay & Glymour, 2020). Internal validity is increased further through study designs that experimentally manipulate a potential mediator. This allows for much stronger inferences about causal processes (Spencer et al., 2005; van der Linden, 2021). A central threat to internal validity are ad-hoc measures or tasks. Ad-hoc methods have unclear validity and vary substantially between studies, and it is less clear what they measure compared to better-validated tools. This lack of specificity makes evidence synthesis challenging (Lange, 2022).

Considering all of these points, we argue that internal validity directly supports scientific impact (Table 1). When causal relationships are well known, researchers from other fields can integrate these findings into broader models of behavior and social change (de Vries et al., 2021). This increases the likelihood that environmental psychology research contributes to interdisciplinary cumulative evidence, including theory building. Also, measures with high internal validity can more easily be adapted by researchers from other fields who aim to study individual psychological outcomes related to sustainability.

Next, internal validity supports societal impact (Table 1) because practitioners are more able to adopt interventions when the underlying causal mechanisms are credible and clearly described (Grosz et al., 2020). Heterogeneity across diverse samples and settings is a valuable test of causal inference (Lange, 2022; Table 1). Also, transparency in reporting evidence quality helps practitioners to understand and adopt psychological insights (IJzerman et al., 2020). Internally valid measures and interventions can be applied by governmental institutions in large-scale randomized control trials, for example on policy support. Examples include groups such as *Wirksam Regieren* in the German chancellor's office (Presse- und Informationsamt der Bundesregierung, 2024) and the UK Behavioral Insight Units. In sum, internally valid research can be more easily translated into interventions that shape policy and practice.

## 2.3 External validity

External validity reflects how much a finding generalizes beyond a specific sample (Henrich et al., 2010), study setting, place, or time (Vazire et al., 2022). External validity is threatened when conclusions are drawn from single studies that rely on small or biased samples (Elhoushy & Lanzini, 2021). Such samples may not represent other populations and settings. Replications may fail because the study context or sample changes (Vlasceanu et al., 2024). In other words, external validity is threatened when unrecognized context- or time-specific factors change key outcomes.

External validity is strengthened when researchers in independent labs conduct the same study and compare results (Moshontz et al., 2018). This encourages systematic comparisons of contexts, measurement invariance, differences in target groups, as well as how cultural or political factors link to variables of interest (Vazire et al., 2022; Bryan et al., 2021; Table 1). Transparency in research materials, procedures, and analyses, including relevant effect sizes (Frederiks et al., 2016) further allows other researchers to evaluate robustness and relevance of findings, and to replicate studies for testing external validity (Munafò et al., 2017). External validity should be examined in settings that are as close as possible to target settings outside the lab (IJzerman et al., 2020). One pathway is large-scale randomized control trials (Frederiks et al., 2016; Hahn & Metcalfe, 2016; Bruine de Bruin & Bostrom, 2013). These help ensure that findings are not only replicable but also useful for a wider scientific audience.

Research with high external validity links to scientific impact (Table 1) because it produces results that are robust across different target settings and populations (Bamberg et al., 2021; Bruine de Bruin & Bostrom, 2013; Lange & Dewitte, 2019; Bodemer & Ruggeri, 2012; Grosz et al., 2020).

Research with high external validity links to societal impact (Table 1) because practitioners can translate findings into interventions that reliably achieve change across different settings, time periods, and populations. Assessing evidence readiness levels (IJzerman et al., 2020) or adopting guidelines for clearly communicating scientific uncertainties (Mastrandrea et al., 2010), help determine whether external validity is yet uncertain or sufficiently high for findings to be applied in policy or practice. Exchanges about insights and their quality can also be facilitated through science-policy networks, such as the Behavioral Science Connect (2024) network in Germany or international and interdisciplinary policy reports, such as from the Intergovernmental Panel on Climate Change, or the Intergovernmental Panel on Biodiversity and Ecosystems Research. When interventions or behavioral insights are shown to generalize, practitioners can apply them with greater confidence and effectiveness.

## 2.4 Statistical conclusion validity

Statistical conclusion validity reflects whether the statistical evidence supports a given interpretation. Statistical conclusion validity is threatened when the assumptions of statistical modeling techniques are violated (García-Pérez, 2012) or when random outliers are misinterpreted as meaningful patterns (Matthay & Glymour, 2020). Additional threats include underpowered samples that limit the precision

of estimates (Milkman et al., 2021), imprecise or overly flexible predictions, and the practice of specifying hypotheses only after observing statistical differences (HARKing; John et al., 2012; Simmons et al., 2011). Incomplete or imprecise analysis reports also reduce statistical conclusion validity because they make it difficult for others to assess whether the evidence justifies the stated conclusions (Vazire et al., 2022). When statistical conclusion validity is low, both false positive and false negative errors obscure the stability and size of effects.

Statistical conclusion validity increases when researchers systematically compare competing hypotheses using methods that explicitly evaluate evidence, such as Bayesian inference (Wagenmakers et al., 2018). Also, sufficiently powered samples allow for precise estimates (Moshontz et al., 2018). Transparent reporting of uncertainty, including confidence intervals and effect sizes (van der Linden, 2019) also facilitates the integration of results into systematic reviews and meta-analyses (Berrang-Ford et al., 2015), even though they can still be misinterpreted (Wagenmakers et al., 2018). Statistical conclusion validity is further strengthened through preregistration and Registered Reports, which reduce undisclosed flexibility in data analysis and decrease the likelihood of false positive results (Vazire et al., 2022; Table 1). In sum, statistical conclusion validity underpins reliable inference by ensuring that estimated effects reflect their true direction and magnitude within known uncertainties. This reliability is essential for replication, synthesis across studies, and the accumulation of evidence that informs theory and intervention design.

High statistical conclusion validity also supports societal impact (Table 1) by allowing practitioners to examine effect sizes as well as uncertainties when designing and interpreting interventions (Vazire et al., 2022). Based on effect sizes, practitioners can evaluate whether it is worth translating an intervention into real-world change, given the associated costs (Anvari & Lakens, 2021). Statistical findings need to be communicated in formats that support comprehension among diverse user groups (Kause et al., 2020; McDowell et al., 2016). This includes formats that are intuitive for non-scientists, such as changes in success rates or simple likelihoods of improvement (Mastrich & Hernandez, 2021; Brooks et al., 2014). Scientific units such as kWh for energy use or liters of water are also immediately interpretable by non-psychologists (Frederiks et al., 2016). When statistical findings are accurate and clearly communicated, practitioners can make more informed decisions about which interventions to adopt and how to implement them.

### 3 Conclusion

We outlined how four different validities (Vazire et al., 2022) can help understand and strengthen the scientific and societal impact of environmental psychology. We aim to strengthen this research and related fields that address individual and collective responses to sustainability challenges such as climate change, biodiversity loss, and pollution. We further argued that boosting validity will support practitioners who apply psychological insights in practice, as well as funding agencies who want to maximize scientific and societal impact. Our perspective complements existing best-practice frameworks for methodological rigor (Groves & Lyberg, 2010; Frederiks et al., 2016) by incorporating four types of validity into a

unified account of how research quality supports cumulative knowledge and societal impact.

In the following, we outline several avenues for future work that can advance a more systematic understanding of impact. First, a better understanding of scientific and societal impact requires further developing criteria for validities in environmental psychology research, including tradeoffs. These criteria should also reflect whether insights from environmental psychology specifically contribute to sustainability transitions (Bornman, 2013; Schönbrodt et al., 2022). For example, such criteria could represent the impact of an intervention on a specific behavior and the downstream impact of the changed behavior on environmental resources or indicators. Validity criteria could help researchers evaluate when and to what extent an intervention works and the strength of causal inferences about key processes. We hope that Table 1 provides a starting point for discussions about such evaluation criteria.

Second, open science practices support the transparent assessment of all four validities. Transparent and replicable evidence syntheses can partially address the credibility and impact of findings in practice (Lasser et al., 2022), whether studies rely on validated measures (Lange, 2022), and whether studies build on established theories of environmental psychology or related fields (Haeffel, 2022; van Valkengoed et al., 2021). Evidence syntheses support high validity when they follow established systematic review reporting standards such as ROSES or PRISMA (Haddaway et al., 2018).

Third, environmental psychology would benefit from more systematically studying practitioners' needs and decisions (Bruine de Bruin & Bostrom, 2013). Practitioners vary in how they conceptualize the societal impact of a policy intervention or psychological outcome; for example, their perceptions may include environmental outcomes but also social influences or economic outcomes. Co-producing research with practitioners, including user engagement and iterative feedback, is one way to make assumptions and targets explicit (Baulenas et al., 2023; Hahn & Metcalfe, 2016). Scientific institutions and funding agencies can support similar efforts by enabling sustained collaboration. Field studies, designed in collaboration with practitioners, have potential for societally relevant causal inferences based on randomized controlled trials. Such field studies help clarify when and how causal evidence can be generated through effective collaboration with practitioners (Hahn & Metcalfe, 2016).

Fourth, environmental psychologists sometimes face tradeoffs between validities because of paradigm-based, field-specific, institutional, policy, or resource constraints. It is often observed that internal and external validity appear to be in tension (e.g., Cartwright, 2007). However, recent research questions this tension and highlights the synergistic and integrative potential of internal and external validity (Trafimov, 2023). Studying such trade-offs empirically could help researchers identify when advances in scientific understanding are most likely to translate into societal benefits and when additional context or stakeholder engagement is needed.

Taken together, we suggest that the four validities provide a practical and conceptual approach to help understand and boost impact. Ultimately, focusing on specific validities may support researchers within and outside environmental psychology in contributing to scientific progress and rapid transitions toward sustainability.

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