Environmental Psychology Open

Peer review process documentation

of the article

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

by

Astrid Kause, Johann M. Majer & Cameron Brick

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Review Round 1

Comments by Reviewer A

In their article, the authors describe four types of validity (content, internal, external, and statistical), what threatens these types of validity, but also how these types of validity would promote the scientific and societal impact of environmental psychological research.

The article has the potential to make a beneficial contribution to the field of environmental psychology. For any research to make real-world impact, it is crucial that researchers strive to understand and unravel the true mechanisms at work in the natural environment (such was what drives human behavior in the context of climate protection). In the current state, however, I think the article falls short on making this as strong a claim as it could be.

Currently, the article lacks a narrative, a "common thread" that ties all pieces of the text together. Surprisingly, the authors never clearly state WHY validity is important for impact. They state that, when validity is threatened, impact is threatened as well, but the readers never learn why this is the case. Throughout the article, the writing jumps from one argument to the other, but never explores anything in depth. For example, looking at the introduction: "social scientists can and must help mitigate climate change" [p. 3, l. 87] Really? Why "must" scientists do this? Isn't the first and foremost responsibility of scientists to create knowledge about the workings of the world? "Although environmental psychology research flourishes, scholars have seriously questioned its impact" [l. 88f]. This is interesting. How can a research field flourish while at the same time having questionable impact? What does "flourish" mean then? Why do scholars question environmental psychology's impact? What exactly is wrong with environmental psychology? I could go on like this throughout the introduction. I am not saying that the authors need to explore all these questions in detail; I mean to illustrate the issue that I am having with touching all these issues briefly without going into detail on what is going on. The most important missing detail in the article for sure is an in-depth argument for the connection of validity and impact.

The article could also benefit from simply using "organizing statements". Something to guide the reader through the structure of the different chapters. Right now, the article reads like a list of points without anything tying them together.

My second major concern is about the Section "Construct Validity" (p. 4). I find it unfortunate that the concept of construct validity is presented rather confused with reliability and not clearly differentiated from it. For example, the definition that the authors give of construct validity is "Construct validity reflects how reliably a measure captures the environmentally significant behavior, rather than something else … Construct validity is threatened through measurement error …" (l. 130ff). I think the authors would agree that an unreliable measure is, first and foremost, low on reliability (how consistent a measure can assess the same thing). Low reliability for sure threatens construct validity (that the thing that is consistently assessed is in fact the psychological attribute that psychologists aim to assess with the measure), but it does the concept of validity a disservice to confuse it with reliability or to not make clear the difference between validity and reliability. I think a clearer definition of construct validity that avoids confusion with reliability would be, for example, that the scores of a psychological measurement instrument "reflect the target construct" (Flake et al., 2017; p. 370; this article is also an interesting read concerning scientific impact of construct validity). For this whole section, I would recommend to be clearer on what validity entails and avoid any confusion with reliability (potentially even make an explicit statement about the difference and relationship between the two).

Environmental Psychology Open

Some minor issues:

1. I find the reference to Table 1 on Page 3 misplaced with Table 1 being shown on Page 7f. I think this section could do without the reference to the table.
2. In the Conclusions, the authors suggest "developing transparent criteria for assessing the impact of environmental psychology research and its potential to promote sustainability transitions" (p. 8, l. 300ff). I am not sure what the concrete recommendation is here. Are the authors asking for a criteria catalogue? And who would use that and how would it actually improve research? I am a bit doubtful whether such a thing would actually help addressing the issue. Again, going into more depth would help here.
3. In the following paragraph (p. 8, l. 307ff), the authors state that "future research needs to address whether principles of open science have been adopted". To me, that first sounds like a bureaucratic exercise and not like a research question. Again, I would suggest to go into more depth on what this suggestion actually entails and how it could help address the issue of scientific and societal impact.
4. The reference list needs checking. Some article titles are wrongly capitalized.

Reference:

Flake, J. K., Pek, J., & Hehman, E. (2017). Construct validation in social and personality research: Current practice and recommendations. *Social Psychological and Personality Science, 8*(4), 370-378. https://doi.org/10.1177/1948550617693063

Comments by Reviewer B

This article presents a framework arguing that improving four types of validity: construct, internal, external, and statistical conclusion validity, can enhance both scientific and societal impact of environmental psychology research. The manuscript is well-structured and the idea of such a framework is of course theoretically interesting. The paper also attempts to provide first ideas on how to tackle improvements on issues. The clear, structured way of presenting the validity types is helpful, as is the table with practical suggestions.

Unfortunately, there are several major flaws that limit the contribution this paper might make to the field. I list them below.

1. The paper does not outline what environmental psychological research is. It starts with citing one example, i.e., mitigating climate change, but does not provide further boundary conditions or inclusion criteria. It does not separate EP from other disciplines - where does it split off from disciplines such as social psychology? Political psychology? Climate science? If this is not properly done, impact cannot be truly identified.
2. The paper does not review other guides or frameworks that should be mentioned as inspirations and discussed in their relevance (Frederiks et al., 2016 best practice guidelines; Groves & Lyberg, 2010 total survey error framework, only to list two)

Environmental Psychology Open

3. The paper does not review other literature on the impact of environmental psychological research (such as Gifford, 2014, Nielsen, 2021 (is cited briefly), Hahn & Metcalfe, 2016) and while a rudimentary attempt is made to define impact, the sections are quite weak and only superficially list metrics instead of giving it a proper go of identifying what it would actually mean to have impact (how do field research vs survey research compare? How well is environmental psych doing compared to other areas, point is related to 1)

4. There is no acknowledgement to the trade-offs between the validities. The paper also does not more clearly discuss whether there are different types of research that suffer particularly from one or others, and how to address this in depth, rather tries to generically propose one-fits-all solutions. It does not clearly distinguish between confirmatory and exploratory work, field, experimental or survey work.

5. The paper would benefit from some examples or small case study descriptions for all validity sections, specifically to help shape what impact truly means in these sections. It should specify whether own suggestions are based on empirical validation or conceptual reasoning.

6. Operationalizations or at least examples are missing in the suggestions for improvement, they are very generic.

7. I struggled understanding the argument behind many of the cited references, which seem listed in a very perfunctory way, without critically engaging with those sources or synthesizing how they build a coherent argument for the framework. As a result, some parts of the paper feels more like a literature listing than a theory-building exercise it should be.

8. Core scientific terms or constructs are not explained. Terms like “environmentally significant behavior” or “experimental standards” are taken as self-evident. This is problematic when, as often is the case with such theoretical contributions, the goal is to challenge an interdisciplinary readership.

9. Finally, I did not feel that this work sufficiently discusses limitations of applicability such as differing institutional contexts, cultural relevance of constructs, or resource constraints.

In light of the many major issues identified above, I would unfortunately have to recommend rejection. I do believe it’s possible to implement all the suggestions I gave, but it would, in my opinion, be a completely different paper in a lot of ways.

Authors’ Response to the Reviewers Round 1

Dear Dr. Röderer,

We sincerely thank you for your detailed guidance and for the opportunity to revise our manuscript, now entitled (“How Research Validities Shape the Scientific and Societal Impact of Environmental Psychology”). We would like to thank you also for the extension of the deadline which was instrumental in helping us complete the revision and resubmit a completely revised manuscript.

Following your instructions, we have carefully addressed all comments raised by the two reviewers and yourself. Specifically, we have:

- Strengthened the "common thread" throughout the whole manuscript including Table 1 and...
- Addressed WHY validity is important for impact.
- Specified the definition of construct validity and disentangled it from reliability.
- Integrated a more in-depth discussion of our positional arguments and provided more concrete examples and actionable recommendations.

We greatly appreciate your guidance and have taken this invitation to revise and resubmit as an opportunity to clarify and specify our arguments while keeping the manuscript concise to be accessible for a general readership and to stimulate discussion in the field.

We hope that the manuscript now meet the journal's publication requirements, and we thank you again for your time and consideration.

Sincerely,

Astrid Kause and Johann M. Majer (corresponding authors)

on behalf of the authors

Comments of the Editor in-Chief:

Comment 1:

"Dear Johann Majer, Astrid Kause, Cameron Brick,

Thank you very much for submitting your manuscript "Validity drives the scientific and societal impact of environmental psychology research" to Environmental Psychology Open.
I was fortunate to obtain high-quality reviews of your manuscript from experts in the field. You can find their comments below. Based on these comments and my own reading of your manuscript, we request that you make (major) revisions before your paper can be considered for publication.
I followed the suggestion of Reviewer 1 here, because I think that your manuscript has the potential to really make a valuable contribution to the field. However, the issues both reviewers had require thorough consideration and revision. I hope that you decide to revise the paper and look forward to the revised version.
Please note that a revision is no guarantee of eventual acceptance and that your revision may be sent to the same or additional reviewers again. If you decide to revise your submission, please upload your revised manuscript as a new file within one month, together with a point-by-point response to the comments made in the review process (if meeting this timeline is difficult for you, please just let me know using the "Review Discussions")."

Response: We thank the Editor for the opportunity to revise our manuscript and for the constructive guidance provided in the decision letter. We appreciate the careful evaluation by the reviewers and fully acknowledge the need for substantial revisions. Following the reviewers' recommendations, we have thoroughly revised the manuscript to strengthen the narrative, clarify the conceptual contribution, and provide more detailed and

actionable recommendations throughout. We also substantially expanded the explanation of why validity is essential for scientific and societal impact, clarified the definition of construct validity, revised the introduction and conclusion for coherence, and significantly improved Table 1 to offer more operational guidance. All reviewer comments have been addressed point-by-point in the responses below, and all corresponding changes have been incorporated in the revised manuscript. We are grateful for the opportunity to resubmit and hope that the revised version meets the expectations of the Editor and reviewers.

Comments of Reviewer #1:

Comment 1: *"In their article, the authors describe four types of validity (content, internal, external, and statistical), what threatens these types of validity, but also how these types of validity would promote the scientific and societal impact of environmental psychological research. The article has the potential to make a beneficial contribution to the field of environmental psychology. For any research to make real-world impact, it is crucial that researchers strive to understand and unravel the true mechanisms at work in the natural environment (such was what drives human behavior in the context of climate protection). In the current state, however, I think the article falls short on making this as strong a claim as it could be."*

Response: We thank the reviewer for this encouraging and insightful view. We agree that the paper needed a clearer and more compelling articulation of why validity is foundational for both scientific and societal impact in environmental psychology, and a clear focus on societal impact. We appreciate the reviewer's guidance, which helped us sharpen the conceptual contribution of the paper.

We made several targeted revisions throughout the manuscript to strengthen this central claim and copied the revised sections below for your convenience:

1. We revised the introduction to more carefully introduce and differentiate scientific and societal impact. We assume that the latter refers to what the reviewer describes as "real world" and "natural" environments. We also point to reflections from within and outside the field addressing its' low impact.

"Sharing these concerns, scientists (Creutzig et al., 2022; de Vries et al., 2021; Bandola-Gill, 2019; Nielsen et al., 2021; Weiss & Shanteau, 2021) and scientific societies (APA, 2022; Wirsching et al., 2020; Wissenschaftsrat, 2019) have called for environmental psychology to increase both its scientific impact, understood as its contribution to cumulative knowledge within and beyond psychology, and its societal impact, understood as its contribution to overcoming environmental and sustainability challenges. These calls suggest that impact may not be guaranteed by topic relevance alone. Psychological research on sustainability and cli-mate change can still 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, we seek to address how scientific and societal impact of environmental psychology can be better understood, and ideally, increased." (p. 4)

2. We introduce more explicitly that validities can potentially help understanding impact:

"Here, we thus suggest that four well-established psychological research validities (Vazire et al., 2022) can also guide our understanding of impact of environmental psychology research: Construct validity, internal validity, external validity, and statistical conclusion validity (Vazire et al., 2022). Research that reflects these four validities may be more likely to be trusted by other disciplines, be adopted by practitioners and policy makers and thus also have more impact." (p. 4)

3. We also describe external validity with a more explicit focus on the "real world":

"External validity reflects how much a finding generalizes beyond a specific sample (Henrich et al., 2010), beyond a particular study setting, place, or point in time (Vazire et al., 2022) and beyond psychological laboratory settings." (p. 10)

4. We rewrote the section on societal impact. It now reflects a clearer focus on how useful findings are for practitioners outside psychological research labs:

"How much do insights contribute to understanding as well as overcoming societal, technological, and environmental barriers towards sustainability (Fortunato et al., 2018)? Societal impact reflects how well findings help understanding what drives sustainable behaviors inside and outside psychological research labs. Findings can support practitioners such as policy makers, entrepreneurs, non-governmental organizations as well as the public by increasing their knowledge or general skills, by motivating relevant behavior change, or through evaluating the effectiveness of policies (Ijzerman et al., 2020; Ravenscroft et al., 2017). One indicator for societal impact may be how prominently findings are mentioned in large-scale policy reports, such as those of the Intergovernmental Panel on Cli-mate Change. Another indicator may be how much the design as well as the evaluation of policies reflects insights and methods from environmental psychology. To achieve this, environmental psychology researchers must engage in the dialogue with practitioners and policy makers to communicate their insights. Achieving societal impact may thus require environmental psychologists to cooperate closely with practitioners, for identifying their needs and knowledge gaps and for ensuring that insights can be meaningfully applied in real-world settings (Baulenas et al., 2023; Fecher et al., 2021; Nowotny et al., 2001)." (p. 5)

5. We added concluding sentences to each validity section to show not only *what* threatens a validity but also *how* threats may limit impact:

E.g. in section 2.1: "When construct validity is low, findings may appear meaningful but may at the same time not reflect the individual or collective behavior that researchers or practitioners aim to understand." (p. 6)

6. We rewrote the conclusion to highlight more clearly how focusing on the four validities can strengthen environmental psychology in generating knowledge that contributes to scientific progress as well as sustainability transitions.

Comment 2: *"Currently, the article lacks a narrative, a "common thread" that ties all pieces of the text together. Surprisingly, the authors never clearly state WHY validity is important for impact. They state that, when validity is threatened, impact is threatened as well, but the readers never learn why this is the case. Throughout the article, the writing jumps from one argument to the other, but never explores anything in depth. For example, looking at the introduction: "social scientists can and must help mitigate climate change" [p. 3, l. 87] Really? Why "must" scientists do this? Isn't the first and foremost responsibility of scientists to create knowledge about the workings of the world? "Although environmental psychology research flourishes, scholars have seriously questioned its impact" [l. 88f]. This is interesting. How can a research field flourish while at the same time having questionable impact? What does "flourish" mean then? Why do scholars question environmental psychology's impact? What exactly is wrong with environmental psychology? I could go on like this throughout the introduction. I am not saying that the authors need to explore all these questions in detail; I mean to illustrate the issue that I am having with touching all these issues briefly without going into detail on what is going on. The most important missing detail in the article for sure is an in-depth argument for the connection of validity and impact."*

Environmental Psychology Open

Response: We thank the reviewer for this detailed and extremely helpful critique. We agree that the manuscript needed a clearer and more coherent narrative that explicitly links validity to scientific and societal impact, and that the introduction in particular needed to better motivate this relationship. We implemented the following changes:

1. We rewrote key parts of the introduction to clarify why environmental psychology is expected to contribute to climate mitigation and sustainability debates:

"Societal transformation towards sustainability depends on changes in human individual and collective behaviors, in addition to large-scale technological, in-stitutional, and economic change. Social sciences, including environmental psychology, contribute to better understanding these individual and collective behaviors (Creutzig et al., 2022; Clayton et al., 2016)." (p. 4)

2. We omitted the term "flourishing" and keep a more descriptive account of the fields' development, e.g., growth in publications, visibility, and methodological development, (p. 4, second paragraph)
3. We describe why scholars question the field's impact despite this growth, and which gaps persist between research output and real-world application.
4. Most importantly, we addressed your concern about WHY validity is important for impact, by making the link between impact and validity more explicit:

"Psychological research on sustainability and climate change can still 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, we seek to address how scientific and societal impact of environmental psychology can be better understood, and ideally, increased. Research validity involves both the robustness and the generalizability of empirical results. Robustness captures whether findings are accurate, well supported, and replicable under varied analytical decisions, while 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 psychological research validities (Vazire et al., 2022) can also guide our under-standing of impact of environmental psychology research: Construct validity, internal validity, external validity, and statistical conclusion validity (Vazire et al., 2022). Research that reflects these four validities may be more likely to be trusted by other disciplines, be adopted by practitioners and policy makers and thus also have more impact." (p.4)

5. We added explicit statements explaining *why* validity is foundational for impact.
   Throughout the revised manuscript, particularly at the end of the introduction and within each validity subsection, we now provide explicit reasoning on how:
   - low construct validity obscures what behavior or psychological process is actually being measured,
   - low internal validity weakens causal claims needed for policy and intervention design,
   - low external validity limits generalizability to real-world populations and settings,
   - and low statistical conclusion validity undermines confidence in effect sizes and decision-making relevance.
6. We improved the coherence and transitions between arguments.
   We added short guiding sentences in each section that describe how each of the four validities relates to the overarching theme of impact. These transitions help ensure that the manuscript reads as a unified argument rather than a list of disconnected points.

E.g. in section 2.4.1: "These practices enable other researchers to evaluate the robustness of analyses, which increases their likelihood of being cited as well as replicated." (p. 11)

7. We provided more depth as well as links to the main argument, where concepts were previously only mentioned briefly. Following the reviewer's example concerning the introduction, we refined also other passages that previously stated claims (e.g., about impact, about the responsibilities of scientists, about environmental psychology's current state) without enough context.
8. We clarified the central thesis of the paper. We made the statement explicit that the paper's core contribution is to argue that strengthening the four validities is a practical and conceptual pathway for understanding increasing both scientific and societal impact. We also made explicit that this benefits from current discussions around impact, as well as research methods. This central idea is now explicitly articulated at the end of the introduction:

"Here, we thus suggest that four well-established psychological research validities (Vazire et al., 2022) can also guide our understanding of impact of environmen-tal psychology research: Construct validity, internal validity, external validity, and statistical conclusion validity (Vazire et al., 2022)." (p. 4)

Comment 3: *"The article could also benefit from simply using "organizing statements". Something to guide the reader through the structure of the different chapters. Right now, the article reads like a list of points without anything tying them together."*

Response: Thank you - we fully agree that clearer organizing statements would improve readability and help improve argument. In response, we added several structural and narrative enhancements throughout the manuscript:

1. **Added guiding sentences at the end of major sections.**
   These statements now clearly signal:
   - the purpose of each section,
   - how each validity concept fits into the broader argument,
   - and how the sections relate to scientific and societal impact.

2. **Clarified the structure at the start of the introduction.**
   The introduction now briefly outlines:

   - the overall objective of the manuscript,
   - the role of the four validities as an organizing framework,
   - and what readers should expect in subsequent sections:

"In the remainder of this article, we first outline scientific and societal impact in the context of environmental psychology. We then describe each of the four validities in turn. This includes reviewing the 'threats' to validity that have been identified in environmental psychology and related fields (Vazire et al., 2022; Matthay & Glymour, 2020). We outline how strengthening each research validity can enhance both scientific and societal impact. We also integrate existing practical recommendations for studying environmental behaviors (Frederiks et al., 2016). By linking scientific and societal impact with the four validities, we aim to provide a clearer understanding of impact, strategies for overcoming validity threats and boosting impact." (p.5)

Comment 4: *"My second major concern is about the Section "Construct Validity" (p. 4). I find it unfortunate that the concept of construct validity is presented rather confused with reliability and not clearly differentiated from it. For example, the definition that the authors give of construct validity is "Construct validity reflects how reliably a measure*

captures the environmentally significant behavior, rather than something else … Construct validity is threatened through measurement error …" (l. 130ff). I think the authors would agree that an unreliable measure is, first and foremost, low on reliability (how consistent a measure can assess the same thing). Low reliability for sure threatens construct validity (that the thing that is consistently assessed is in fact the psychological attribute that psychologists aim to assess with the measure), but it does the concept of validity a disservice to confuse it with reliability or to not make clear the difference between validity and reliability. I think a clearer definition of construct validity that avoids confusion with reliability would be, for example, that the scores of a psychological measurement instrument "reflect the target construct" (Flake et al., 2017; p. 370; this article is also an interesting read concerning scientific impact of construct validity). For this whole section, I would recommend to be clearer on what validity entails and avoid any confusion with reliability (potentially even make an explicit statement about the difference and relationship between the two)."

Response: We thank the reviewer for this important comment. We fully agree that the initial wording blurred the distinction between validity and reliability. We appreciate the suggestion to use the framing from Flake et al. (2017), and we have revised the construct validity section substantially to address this concern. The key changes include:

1. **Clear conceptual distinction:** We edited the description of construct validity, now taking the description of Flake et al. (2017) into account:

"Construct validity reflects how precisely a measured variable captures the intended behavior (Vazire et al., 2022) or, more generally, the target construct, rather than unrelated attributes (Flake et al., 2017)." (p. 6)

2. We now explicitly differentiate reliability from construct validity, but describe that it can still threaten construct validity:

"Importantly, construct validity can be low when a measure is not reliable. That is, across studies, it does not capture the same variable. Yet a highly reliable measure can still have low construct validity if it consistently assesses the wrong attribute." (p.5)

3. We also improved the definition of construct validity: We revised the opening sentence of the section to reflect the reviewer's recommended framing that construct validity concerns whether a measure *"captures the intended behavior rather than something else,":*

"Construct validity reflects how precisely a measured variable captures the intended behavior (Vazire et al., 2022) or, more generally, the target construct, rather than unrelated attributes (Flake et al., 2017)." (p. 6)

4. We integrated literature suggested by the reviewer. While we already cited Flake (2017, 2020) elsewhere in the manuscript, we ensured the revised construct validity section reflects the conceptual clarity emphasized in Flake et al. (2017) and aligns our definitions and examples accordingly.

5. We aimed at a better organization of threats to validity and their implications. We restructured the section to discuss the definition, how threats arise in environmental psychology (e.g., social desirability, order effects, inappropriate levels of behavioral measurement), and how threats to construct validity lead to misleading correlations or biased conclusions.

Comment 5: Some minor issues:

1. *"I find the reference to Table 1 on Page 3 misplaced with Table 1 being shown on Page 7f. I think this section could do without the reference to the table."*

Response: We removed the early reference to Table 1 to improve clarity and flow. We placed Table 1 close to where it is mentioned first time.

2. *"In the Conclusions, the authors suggest "developing transparent criteria for assessing the impact of environmental psychology research and its potential to promote sustainability transitions" (p. 8, l. 300ff). I am not sure what the concrete recommendation is here. Are the authors asking for a criteria catalogue? And who would use that and how would it actually improve research? I am a bit doubtful whether such a thing would actually help addressing the issue. Again, going into more depth would help here."*

Response: We revised this passage to clarify what such criteria would assess, who would use them, and how they would support impact-focused research.

3. *"In the following paragraph (p. 8, l. 307ff), the authors state that "future research needs to address whether principles of open science have been adopted". To me, that first sounds like a bureaucratic exercise and not like a research question. Again, I would suggest to go into more depth on what this suggestion actually entails and how it could help address the issue of scientific and societal impact."*

Response: We rewrote this paragraph to explain how examining open science practices strengthens the credibility, transparency, and cumulative impact of environmental psychology rather than constituting a bureaucratic exercise.

4. *"The reference list needs checking. Some article titles are wrongly capitalized."*

Response: We reviewed the reference list carefully and corrected remaining capitalization inconsistencies.

Reference:
Flake, J. K., Pek, J., & Hehman, E. (2017). Construct validation in social and personality research: Current practice and recommendations. Social Psychological and Personality Science, 8(4), 370-378. https://doi.org/10.1177/1948550617693063"

Environmental Psychology Open

Comments of Reviewer #2:

Comment 1: *"This article presents a framework arguing that improving four types of validity: construct, internal, external, and statistical conclusion validity, can enhance both scientific and societal impact of environmental psychology research. The manuscript is well-structured and the idea of such a framework is of course theoretically interesting. The paper also attempts to provide first ideas on how to tackle improvements on issues. The clear, structured way of presenting the validity types is helpful, as is the table with practical suggestions. Unfortunately, there are several major flaws that limit the contribution this paper might make to the field. I list them below."*

Response: We thank Reviewer #2 for the overall positive evaluation, and for your critical comments. Based on the suggestions below, we aimed at improving the manuscript accordingly.

Comment 2: *"The paper does not outline what environmental psychological research is. It starts with citing one example, i.e., mitigating climate change, but does not provide further boundary conditions or inclusion criteria. It does not separate EP from other disciplines - where does it split off from disciplines such as social psychology? Political psychology? Climate science? If this is not properly done, impact cannot be truly identified."*

Response: We added a well-established definition of environmental psychology by Steg and colleagues (2016) to the introduction and carved out its unique distinctiveness from related disciplines:

"Environmental psychologists study peoples' beliefs and decisions, including individual consumption behaviors as well as policy support. They examine both how peoples' responses are shaped by individuals' behavioral contexts, how individuals shape those contexts, as well as interventions for motivating sustain-able behaviors (Steg et al., 2016; Gifford, 2014). Environmental psychology focuses on how this interplay contributes to tackling global challenges, such as climate change, biodiversity loss or resource use (Gifford, 2014). This problem-oriented environmental focus differentiates environmental psychology from social, cognitive and political psychology. At the same time, environmental psychology draws on theories and methods from these adjacent fields." (p. 4)

Comment 3: *"The paper does not review other guides or frameworks that should be mentioned as inspirations and discussed in their relevance (Frederiks et al., 2016 best practice guidelines; Groves & Lyberg, 2010 total survey error framework, only to list two)"*

Response: We are grateful for those references and included them into different text sections as follows:

INTRODUCTION: "We also integrate existing practical recommendations for studying environmen-tal behaviors (Frederiks et al., 2016). By linking scientific and societal impact with the four validities, we aim to provide a clearer understanding of impact, strategies for overcoming validity threats and boosting impact." (p.5)

STATISTICAL CONCLUSION VALIDITY (2.4.2): "Such numerical information also needs 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, simple

likelihoods of improvement (Mastrich & Hernandez, 2021; Brooks, Dalal & Nolan, 2014) or, in the case of energy use, kWh use per day/ month/ quarter (Frederiks et al., 2016).” (p. 11)

DISCUSSION: “Our recommendations complement existing best-practice frameworks (Groves & Lyberg, 2010; Frederiks et al., 2016) that emphasize the value of methodological rigor for producing impactful research.” (p. 12)

Comment 4: *“The paper does not review other literature on the impact of environmental psychological research (such as Gifford, 2014, Nielsen, 2021 (is cited briefly), Hahn & Metcalfe, 2016) and while a rudimentary attempt is made to define impact, the sections are quite weak and only superficially list metrics instead of giving it a proper go of identifying what it would actually mean to have impact (how do field research vs survey research compare? How well is environmental psych doing compared to other areas, point is related to 1)”*

Response: Thank you for pointing us to these important references. We included them in various sections of the paper, which we also sharpened accordingly.

- Gifford (2014): p. 4
- Nielsen et al. (2021): p. 4, 8
- Hahn & Metcalfe (2016): p. 10

We also describe more clearly that we go beyond the previous impact discussion within the field. We do so in several parts of the manuscript:

INTRODUCTION**:** “Beyond critical calls to focus more on the most impactful behaviors regarding sustainability (Nielsen et al., 2021) ‘impact’ also concerns asking to what extent research changes theories, practices, and policies, outside environmental psychological research labs (e.g., Bamberg et al., 2021; Clayton et al., 2016; Nielsen et al., 2024). Sharing these concerns, scientists (Creutzig et al., 2022; de Vries et al., 2021; Bandola-Gill, 2019; Nielsen et al., 2021; Weiss & Shanteau, 2021) and scientific societies (APA, 2022; Wirsching et al., 2020; Wissenschaftsrat, 2019) have called for environmental psychology to increase both its scientific impact, understood as its contribution to cumulative knowledge within and beyond psychology, and its societal impact, understood as its contribution to overcoming environmental and sustainability challenges. These calls suggest that impact may not be guaranteed by topic relevance alone. Psychological research on sustainability and climate change can still 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, we seek to address how scientific and societal impact of environmental psychology can be better understood, and ideally, increased.” (p. 4)

DISCUSSION: “Criteria may, for instance, address impact of an intervention on a specific behavior, as well as the sustainability impact of that behavior itself.” (p. 12)

Comment 5: *“There is no acknowledgement to the trade-offs between the validities. The paper also does not more clearly discuss whether there are different types of research that suffer particularly from one or others, and how to*

Environmental Psychology Open

address this in depth, rather tries to generically propose one-fits-all solutions. It does not clearly distinguish between confirmatory and exploratory work, field, experimental or survey work."

Response: We rewrote the discussion where we now acknowledge the tradeoff between different types of validities:

"First, a better understanding of scientific and societal impact requires further developing criteria for assessing validities (and tradeoffs between those; Table 1). These criteria should also reflect whether insights from environmental psychology contribute to sustainability transitions, specifically (Bornman, 2013; Schönbrodt et al., 2024). Criteria may, for instance, address impact of an intervention on a specific behavior, as well as the sustainability impact of that behavior itself. Criteria that reflect the validity of evidence can help researchers evaluate not only whether, when, and to which extent an intervention works, but also whether insights are exploratory, or whether they further build on established insights from a related body of evidence. From our perspective, Table 1 provides a useful starting point for deepening discussions about best practices and related evaluation criteria." (p. 12)

Comment 6: *"The paper would benefit from some examples or small case study descriptions for all validity sections, specifically to help shape what impact truly means in these sections. It should specify whether own suggestions are based on empirical validation or conceptual reasoning."*

Response: We thank the reviewer for this thoughtful suggestion. We agree that concrete illustrations help clarify how validity issues manifest in environmental psychology and how addressing them can enhance scientific and societal impact. In response, we made the following revisions:

1. **Added specific examples to each validity section.** We now provide brief, concrete illustrations in the construct, internal, external, and statistical conclusion validity sections (e.g., social desirability in self-reports, household-level energy meters masking individual behavior, manipulation of mediators, multi-site studies addressing heterogeneity, model checks for robustness). These examples clarify how validity threats arise and how improving validity strengthens impact.
2. **Expanded practical recommendations in Table 1.** We refined Table 1 to include more actionable strategies that show in practical terms what improving validity can look like in environmental psychology research. These additions serve as concise "mini-examples" of methodological improvements.
3. **Clarified the basis of our recommendations.** We added a sentence explaining that the proposed strategies draw on both empirical insights and conceptual reasoning derived from methodological frameworks, and established experimental standards.

INTRODUCTION: The recommendations we outline draw on both empirical evidence from meta-science, measurement research, and replication studies as well as conceptual reasoning grounded in methodological frameworks such as Vazire et al. (2022), Matthay and Glymour (2020), and established experimental standards. (p. 5)

4. **Maintained conciseness consistent with the format.** While we considered including case studies, we decided against this in order to keep the manuscript concise and focused, in line with the intended format of the article. Instead, we opted for targeted examples embedded in the text and more detailed action

points in the table, which address the reviewer's concern while preserving the scope and structure of the article.

Comment 7: *"Operationalizations or at least examples are missing in the suggestions for improvement, they are very generic."*

Response: As outlined in our response to the previous comment, Table 1 now includes more actionable strategies reflecting what improving validity could look like in environmental psychology research. In addition, references in Table 1 include more concrete guidelines or examples, as now specified in the table's note*:*
"*Note*: References include concrete examples or more precise guidelines on how to implement each guideline." (p.8)

Comment 8*: "I struggled understanding the argument behind many of the cited references, which seem listed in a very perfunctory way, without critically engaging with those sources or synthesizing how they build a coherent argument for the framework. As a result, some parts of the paper feels more like a literature listing than a theory-building exercise it should be."*

Response: In the introduction, we aimed to further clarify the goal of the article. Here, we explicitly outline that we review previous work and embed this theoretically. We hope to address your comment about references thus as follows:

"In the remainder of this article, we first outline scientific and societal impact in the context of environmental psychology. We then describe each of the four validities in turn. This includes reviewing the 'threats' to validity that have been identified in environmental psychology and related fields (Vazire et al., 2022; Matthay & Glymour, 2020). We outline how strengthening each research validity can enhance both scientific and societal impact. We also integrate existing practical recommendations for studying environmental behaviors (Frederiks et al., 2016). By linking scientific and societal impact with the four validities, we aim to provide a clearer understanding of impact, strategies for overcoming validity threats and boosting impact. The recommendations we outline draw on both empirical evidence from meta-science, measurement research, and replication studies as well as conceptual reasoning grounded in methodological frameworks such as Vazire et al. (2022), and Matthay and Glymour (2020)." (p. 5)

Comment 9: *"Core scientific terms or constructs are not explained. Terms like "environmentally significant behavior" or "experimental standards" are taken as self-evident. This is problematic when, as often is the case with such theoretical contributions, the goal is to challenge an interdisciplinary readership."*

Response: We added a more precise definition of the field to the introduction which hopefully also clarifies the type of behavior we are interested in:

"Environmental psychologists study peoples' beliefs and decisions, including individual consumption behaviors as well as policy support. They examine both how peoples' responses are shaped by individuals' behavioral contexts, how individuals shape those contexts, as well as interventions for motivating sustain-able behaviors (Steg et al., 2016; Gifford, 2014). Environmental psychology focuses on how this interplay contributes to tackling global challenges, such as climate change, biodiversity loss or resource use (Gifford, 2014)." (p. 4)

We also deleted the term "experimental standards", as well as the term "environmentally significant behavior". We also aimed to further revise the text regarding jargon, consistent use of terms, as well as long sentences.

Comment 10: *"Finally, I did not feel that this work sufficiently discusses limitations of applicability such as differing institutional contexts, cultural relevance of constructs, or resource constraints."*

Response: We agree with this point and thus changed the discussion as follows:

"Fourth, environmental psychologists often face tradeoffs between validities that are often shaped by paradigm-based, field-specific, institutional, policy, and resource constraints. Thus, validities and the related scientific and societal im-pact may sometimes align and sometimes diverge. Studying these relationships more systematically can 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." (p. 12)

Comment 11: *"In light of the many major issues identified above, I would unfortunately have to recommend rejection. I do believe it's possible to implement all the suggestions I gave, but it would, in my opinion, be a completely different paper in a lot of ways."*

Response: We still aimed to implement your very helpful suggestions and hope that they still improved the manuscript.

Environmental Psychology Open

Review Round 2

Reviewer A

I thank the authors for engaging with my feedback. I think that especially the introduction really improved, and the whole article benefits greatly from the extended introduction. My comments are only minor.

Overall, I am a bit confused about the organization of the chapters in Section 2. The chapters "How does … validity increase scientific/societal impact?" include an answer to the question in the header, but they also deal with how findings from previous research or the public can help improve this type of validity. I find these headers, therefore, a bit misleading.

Some other small issues in order of appearance:

1. The impact statement starts with "our research highlights". This article, in my view, is more of an opinion piece. I would refer to it as "This article" or something along these lines.
2. The German translation of the abstract and the impact statement read "Denglisch" to me, meaning that they are VERY close to the English original, and some wordings sound a bit odd in German. Some sentences in the German translation are also very long with a lot of nominalizations. Just as an example: "Unsere Empfehlungen, wie die Zusammenarbeit mit Praktiker:innen zur Präzisierung von Messinstrumenten und die Sicherstellung, dass Interventionen in verschiedenen Kontexten getestet werden, tragen dazu bei, die Lücke zwischen wissenschaftlichen Erkenntnissen und realen Anwendungen zu schließen." Eleven nouns on three predicates is way too noun-heavy of a sentence to still be understandable.
3. On Page 3, ll. 101f, it says: "'impact' also concerns asking to what extent research changes theories, practices, and policies, outside environmental psychological research labs." Is "changes" the right word here? If other sciences are already on the right track, then "influences" might be a better word.
4. On Page 3, ll. 122ff, there are two references to Vazire et al. in one sentence. One reference to the same source would be enough.
5. On Page 5, ll. 176f, it says: "Construct validity reflects how precisely a measured variable captures the intended behavior" à But measurement instruments in environmental psychology do not solely deal with behavior (I would actually assume, that most often they do not). Maybe a word such as "construct" would be more general?
6. On Page 5, ll. 196ff, it says: "High construct validity contributes to knowledge accumulation, and thus, scientific progress. This is because construct validity increases when researchers use well-established, validated measures". The "because" in the second sentence does not make a lot of sense. It does imply that an increasement in construct validity causes the fact that high construct validity contributes to scientific progress.
7. I would properly introduce Table 1, as it is at the heart of the article. So maybe, when first referring to it, the authors could use a whole sentence, such as "Table 1 summarizes guidelines to increase validity for impact."
8. On Page 11, l. 392, the authors refer to "ROSES" and "PRISMA" with no further explanation. What is this? I would at the very least include references, so that naïve readers can look them up.
9. I stand by my comment from the first review that the reference list needs checking. In article or book titles, we do not capitalize words according to APA-Style. For example: "Fiske, D. W. (1987). Construct

Invalidity Comes from Method Effects. Educational and Psychological Measurement, 47(2), 285-479. https://doi.org/10.1177/0013164487472001", needs to be: "Fiske, D. W. (1987). Construct invalidity comes from method effects. *Educational and Psychological Measurement, 47*(2), 285-479. https://doi.org/10.1177/0013164487472001." And of course, journal names and book titles need to be in italics (but I am not sure whether the lack of italics was caused by the submission system).

Reviewer B

Summary

This conceptual paper reviews and synthesizes recommendations to increase scientific and societal impact of environmental psychology with regards to four different types of validities

Abstract / impact statement:

- Concisely written abstract
- 28/L.67: Do you not in a first instant address researcher? Please clarify, to me it should read: For researchers, this roadmap…aren't they the ones to adopt and use measures and interventions

Introduction:

- in general, a well written introduction that drives home the relevance of the topic
- 88: response to what? In this general sense wouldn't it make more sense to talk about how the environment shapes people's behaviour?
- I am not a social nor a political psychologist, but I think both of those groups would contest L94-95, how are these fields NOT problem-oriented and environmentally focused?
- "Cumulative knowledge" à do you mean the accumulation of knowledge / scientific insight?
- I would refrain from the expression "research validity" as a general concept, as you outline correctly, there are all these different types of validities that could hardly be subsumed, Perhaps "Validity in research…"
- 126 also generate more impact?
- Scientific impact: I would include one or two sentences about the importance of review and meta-studies that outlie these reliable and robust findings over time and contexts, so I would even argue the mere existence of meta-analyses in a field is sign for scientific impact, in general this chapter is super short, I would not mind a more detailed look onto what scientific impact means beyond simple citation metrics
- Societal Impact:
    - 156 "Barriers" is a forgone conclusion, not all challenges in sustainability issues are to do with barriers that have to be overcome, perhaps sometimes it is to do with lack of vision and imagination, I would talk about "solving or facing challenges" to invite a broader array of examples
    - Can you please include other examples of real-world impact, not only policy related? I would think of perhaps intervention approaches in educational settings, or the application of nudging approaches in public places or infrastructures, alt metrics (science communication) etc..

Addressing Impact:

2.1.2 /2.1.2 this is more an explanation on how to increase construct validity (established measures, precise specification) and not so much as for why construct validity increases scientific impact, please reformulate with the impact question in mind: better comparisons, more reliable effects, more robust summaries in meta-studies, same goes for 2.1.2 this is more a "how to" and not a "why" or change headings into: How to ensure CV to increase impact"

I find most of your subchapters "how does…" a bit misleading as half of the text is about "how to increase validity x,y,z" which is not the same thing. As you list all the "how to increase" in your Table 1, perhaps name them only shortly in the text and emphasize a bit more how this relates to the different impact types. Or abandon the distinction between the different impacts and just list all the strategies how to increase a certain type of validity and in the text outline how this is good for each impact type in the end (l 250-255 is an excellent example of a well-drawn conclusion for scientific impact). I find it questionable if all of your strategies could be clearly ascribed to one of the two different impact types only, e.g. number 7. Why would proven mechanisms across heterogenous settings and populations not also be good for scientific impact? Nr. 9 also, documentation of contextual factors would also increase scientific impact (à meta-studies)

Conclusions:

- 364 how do you complement existing frameworks? Please expand, your paper isn't only about methodological rigor.
- 366/67: Through this lens / repeated twice…
- Second,…: how does open science relate to validated measures? I am not sure what the main point of this paragraph is
- Fourth: can you give examples for aligning and diverging validities? I can guess, but I think this point deserves a bit of extra attention, too

General remarks:

- Language: the paper seems to have been written by non-native speakers (the German summary makes more sense than the English one)
- g. L. 142: typical example of a German inspired sentence structure, please overhaul, is it about spreading insights in general or cross-inseminate adjacent research fields
- Table 1: "Example reference" reads like you referenced papers that have done well in a certain validity aspect, but from the references I am guessing it is conceptual papers that raise that issue, too. So I would drop the "Example" or name it "further reading"

Summarizing remark:

This is a well-written manuscript with helpful recommendations for environmental psychology researchers and practitioners. Most of my remarks concern language and expressions and thus can be easily redeemed. Whether the authors want to retain or dissolve the distinction of impact types in the table is their decision in the end. I recommend publication with minor revisions.

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Authors' Response to Reviewers Round 2

Dear Dr. Röderer,

Thank you very much for your guidance on addressing the remaining points identified by the two reviewers. We are grateful for this opportunity to revise our manuscript, now entitled "Four Validities as Pathways to Scientific and Societal Impact in Environmental Psychology".

We have now implemented all required changes in the revised version of the manuscript. We briefly summarize our major changes below:

- **Sharpening language and expressions**: We refined the language and improved our phrasing, including through the efforts of the native-speaking co-author.
- **Reorganizing validity sections**: To streamline the validity sections and maximize accessibility, we now employ the same structure in each of the four sections.
- **Clarification**: Where requested, we now provide more detailed examples.
- **Triple-checking references**: We thoroughly checked the references for completeness, coherence, and consistent use of APA guidelines, and corrected them where appropriate.

We appreciate your guidance and the reviewers' comments which we feel have greatly improved our manuscript. We hope you share our impression that the manuscript now satisfies the remaining concerns, ensures accessibility for a general readership, and stimulates further discussion in the field.

We hope that the manuscript now meets *Environmental Psychology Open*'s publication requirements. Thank you again for your time and consideration.

Sincerely,

The Authors

Environmental Psychology Open

Environmental Psychology Open

Comments of the Editor in-Chief:

Comment 1: *"Dear Johann Majer, Astrid Kause, Cameron Brick, thank you very much for submitting your revised manuscript "How Research Validities Shape the Scientific and Societal Impact of Environmental Psychology" to Environmental Psychology Open.*
Again, I was fortunate to obtain high-quality reviews of your manuscript from experts in the field. You can find their comments below. Based on these comments and my own reading of your manuscript, we request that you make (minor) revisions before publication.

Many reviewer remarks mainly concern language and expressions which should be easily fixed. I am leaning strongly towards acceptance and encourage you to revise the manuscript. Please upload your revised manuscript as a new file within one month, together with a point-by-point response to the comments made in the review process. (Note that as part of our open peer review procedure, this response will be published together with the reviews if your submission is accepted for publication.) Please include a version of your revised manuscript with highlighted changes and one without highlighted changes, and make sure that your manuscript is formatted in line with our manuscript template (https://epo.publia.org/epo/authors). If meeting this timeline is difficult for you, please just let me know using the "Review Discussions"."

RESPONSE: Thank you for the overall positive evaluation of our revised manuscript. In this revision, we focused carefully on language and expression issues, as suggested by yourself and the reviewers. Please find our detailed responses to each of the reviewers' comments below.

Comments of Reviewer #1:

R1, Comment 1: *"I thank the authors for engaging with my feedback. I think that especially the introduction really improved, and the whole article benefits greatly from the extended introduction. My comments are only minor."*

RESPONSE: Thank you for the positive evaluation of the previous changes.

R1, Comment 2: *"Overall, I am a bit confused about the organization of the chapters in Section 2. The chapters "How does … validity increase scientific/societal impact?" include an answer to the question in the header, but they also deal with how findings from previous research or the public can help improve this type of validity. I find these headers, therefore, a bit misleading."*

RESPONSE: We think that this confusion may have originated from the headers and the text mixing insights about how to 'increase …validity' and justifications about how validity shapes impact (also see Reviewer 2, Comment 10). We decided to drop the sub-headers and to standardize the four validity sections. We now organize the paragraphs within each of the four validities along an identical structure without sub-headers:

a) Validity threats
b) Suggestions on how to overcome threats / increase validity

c) Link to scientific impact

d) Link to societal impact

R1, Comment 3: *The impact statement starts with "our research highlights". This article, in my view, is more of an opinion piece. I would refer to it as "This article" or something along these lines.*

RESPONSE: This has been changed as per your suggestion (p. 2).

R1, Comment 4: *The German translation of the abstract and the impact statement read "Denglisch" to me, meaning that they are VERY close to the English original, and some wordings sound a bit odd in German. Some sentences in the German translation are also very long with a lot of nominalizations. Just as an example: "Unsere Empfehlungen, wie die Zusammenarbeit mit Praktiker:innen zur Präzisierung von Messinstrumenten und die Sicherstellung, dass Interventionen in verschiedenen Kontexten getestet werden, tragen dazu bei, die Lücke zwischen wissenschaftlichen Erkenntnissen und realen Anwendungen zu schließen." Eleven nouns on three predicates is way too noun-heavy of a sentence to still be understandable.*

RESPONSE: Thank you for this input. We substantially shortened and simplified the abstract and the impact statement. They now read as follows:

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, psychometrics

Environmental Psychology Open

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, wie dies wissenschaftlichen und gesellschaftlichen Impact verändern kann. 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, Psychometrie

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 beispielweise 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."

R1, Comment 5: *On Page 3, ll. 101f, it says: "'impact' also concerns asking to what extent research changes theories, practices, and policies, outside environmental psychological research labs." Is "changes" the right word here? If other sciences are already on the right track, then "influences" might be a better word.*

RESPONSE: This has been changed as per your suggestion.

R1, Comment 6: *On Page 3, ll. 122ff, there are two references to Vazire et al. in one sentence. One reference to the same source would be enough.*

RESPONSE: We deleted the first reference.

R1, Comment 7: *On Page 5, ll. 176f, it says: "Construct validity reflects how precisely a measured variable captures the intended behavior" But measurement instruments in environmental psychology do not solely deal with behavior (I would actually assume, that most often they do not). Maybe a word such as "construct" would be more general?*

RESPONSE: Here and elsewhere, we followed the reviewer's suggestion and do not only refer to behavior anymore but psychological and behavioral factors more broadly, as per the introduction.

R1, Comment 7: *On Page 5, ll. 196ff, it says: "High construct validity contributes to knowledge accumulation, and thus, scientific progress. This is because construct validity increases when researchers use well-established, validated measures". The "because" in the second sentence does not make a lot of sense. It does imply that an increasement in construct validity causes the fact that high construct validity contributes to scientific progress.*

RESPONSE: Yes, we agree. This has been changed to "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), … " (p. 6)

R1, Comment 8: *I would properly introduce Table 1, as it is at the heart of the article. So maybe, when first referring to it, the authors could use a whole sentence, such as "Table 1 summarizes guidelines to increase validity for impact."*

RESPONSE: We now prominently mention Table 1 in the end of the introduction with a short paragraph:

> "We first define scientific and societal impact. Next, we identify guidelines de-rived 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 Matthay 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." (pp. 4)

We also mention it prominently in each paragraph discussing societal and scientific impact for each validity type; e.g.

> "Here, we argue that construct validity supports scientific impact (Table 1)." (p.6)

R1, Comment 9: *On Page 11, l. 392, the authors refer to "ROSES" and "PRISMA" with no further explanation. What is this? I would at the very least include references, so that naïve readers can look them up.*

RESPONSE: The revised text explains what these are and provides a reference: "Evidence syntheses support high validity when they follow established systematic review reporting standards such as ROSES or PRISMA (Haddaway et al., 2018)." (p. 11)

R1, Comment 10: *I stand by my comment from the first review that the reference list needs checking. In article or book titles, we do not capitalize words according to APA-Style. For example: "Fiske, D. W. (1987). Construct Invalidity Comes from Method Effects. Educational and Psychological Measurement, 47(2), 285-479. https://doi.org/10.1177/0013164487472001", needs to be: "Fiske, D. W. (1987). Construct invalidity comes from method effects. Educational and Psychological Measurement, 47(2), 285-479. https://doi.org/10.1177/0013164487472001." And of course, journal names and book titles need to be in italics (but I am not sure whether the lack of italics was caused by the submission system)."*

RESPONSE: We thank the reviewer for the carefully reading of our manuscript and apologize for this reoccurring issue in the reference list. In this revision, we now triple-checked the reference list for completeness, coherence, and consistency following APA citation guidelines, and corrected it where appropriate

Reviewer #2

Environmental Psychology Open

R2, Comment 1*: "28/L.67: Do you not in a first instant address researcher? Please clarify, to me it should read: For researchers, this roadmap…aren't they the ones to adopt and use measures and interventions."*

RESPONSE: The abstract and impact statements have been revised in line with your and Reviewer #1's suggestions (Comment 2), so that the impact statement now reads as follows:

> **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 guide-lines 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."

R2, Comment 2: *88: response to what? In this general sense wouldn't it make more sense to talk about how the environment shapes people's behaviour?*

RESPONSE: Thank you for this suggestion. The revised version now reads:

> "The social sciences, including environmental psychology, contribute to better understanding the psychological processes necessary for a sustainability transi-tion (Creutzig et al., 2022; Clayton et al., 2016)." (p.4)

R2, Comment 3*: I am not a social nor a political psychologist, but I think both of those groups would contest L94-95, how are these fields NOT problem-oriented and environmentally focused?*

RESPONSE: We reworded this in the following sentence:

> "This applied focus on sustainability differentiates environmental psychology from social, cognitive, and political psychology." (p. 4)

R2, Comment 4*: "Cumulative knowledge"– do you mean the accumulation of knowledge / scientific insight?*

RESPONSE: We revised this to "knowledge accumulation" (p. 4)

R2, Comment 5: *I would refrain from the expression "research validity" as a general concept, as you outline correctly, there are all these different types of validities that could hardly be subsumed, Perhaps "Validity in research…"*

RESPONSE: We changed this here and elsewhere to other terms, such as "validities in psychological science" (p. 4) or simply "validities" (e.g., in the title).

Environmental Psychology Open

Comment 6: *126 also generate more impact?*

RESPONSE: We adopted your suggestion.

R2, Comment 7: *Scientific impact: I would include one or two sentences about the importance of review and meta-studies that outlie these reliable and robust findings over time and contexts, so I would even argue the mere existence of meta-analyses in a field is sign for scientific impact, in general this chapter is super short, I would not mind a more detailed look onto what scientific impact means beyond simple citation metrics.*

RESPONSE: We adopted your suggestion for this paragraph. The second part now reads:

> "How much do new insights spread in scientific fields? Scientific impact is typi-cally 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 publica-tions, 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 re-searchers and can be synthesized in meta-analyses or systematic reviews (Sidda-way et al., 2019)."
> (p. 5)

R2, Comment 8: *Societal Impact: 156 "Barriers" is a forgone conclusion, not all challenges in sustainability issues are to do with barriers that have to be overcome, perhaps sometimes it is to do with lack of vision and imagination, I would talk about "solving or facing challenges" to invite a broader array of examples.*

RESPONSE: Agreed. We changed this to:

> "How much do scientific insights contribute to societal, technological, and envi-ronmental approaches towards sustainability (Fortunato et al., 2018)?" (p. 5)

R2, Comment 9: Can you please include other examples of real-world impact, not only policy related? I would think of perhaps intervention approaches in educational settings, or the application of nudging approaches in public places or infrastructures, alt metrics (science communication) etc.."

RESPONSE: Yes, we can see the relevance to these other fields. We prefer to keep the focus on environmental psychology though, so rather than using precise examples of other fields, we now describe more general pathways through which science can create impact. We hope that this satisfies your concern:

> "Findings can support practitioners, policy makers, entrepreneurs, non-governmental organizations as well as the public. Findings can contribute in-strumentally 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)." (p. 5)

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R2, Comment 10: *"2.1.2 /2.1.2 this is more an explanation on how to increase construct validity (established measures, precise specification) and not so much as for why construct validity increases scientific impact, please reformulate with the impact question in mind: better comparisons, more reliable effects, more robust summaries in meta-studies, same goes for 2.1.2 this is more a "how to" and not a "why" or change headings into: How to ensure CV to increase impact"*

RESPONSE: We thank Reviewer #2 for this helpful suggestion. In line with this, we reframed these sections, as outlined also in our response to Reviewer #1 Comment 1. For each of the four validities, we reorganized – and re-labelled the sections, and moved content in line with the following structure (now without sub-headers):

a) Validity threats
b) Suggestions on how to overcome threats/ increase … validity
c) Link to scientific impact
d) Link to societal impact

R2, Comment 11: *I find most of your subchapters "how does…" a bit misleading as half of the text is about "how to increase validity x,y,z" which is not the same thing. As you list all the "how to increase" in your Table 1, perhaps name them only shortly in the text and emphasize a bit more how this relates to the different impact types. Or abandon the distinction between the different impacts and just list all the strategies how to increase a certain type of validity and in the text outline how this is good for each impact type in the end (l 250-255 is an excellent example of a well-drawn conclusion for scientific impact). I find it questionable if all of your strategies could be clearly ascribed to one of the two different impact types only, e.g. number 7. Why would proven mechanisms across heterogenous settings and populations not also be good for scientific impact? Nr. 9 also, documentation of contextual factors would also increase scientific impact (à meta-studies)."*

RESPONSE: Thank you for your constructive proposal. We agree that specific strategies to increase validity may be linked to both societal and scientific impact, which are often interrelated. In the introduction, we argue that scholars are often urged to increase both scientific and societal impact, and sometimes these different outcomes are interpreted as a dilemma. Later, we argue that that specific strategies to increase validity can benefit both types of impact. Therefore, we would like to keep the distinction between types of impact in Table 1. However, we now differentiate more clearly between strategies for increasing validity in general, and how they link to scientific and societal impact (see also response to your previous comment). We also clarified this point in the Table Note:

> "The guideline examples may address multiple impact types. The references represent empirical examples or guidelines on implementation." (p. 7)

R2, Comment 12: *"364 how do you complement existing frameworks? Please expand, your paper isn't only about methodological rigor.*

RESPONSE: We focus on the applied impact of environmental psychology research, which is now described as follows:

> "We outlined how four different validities (Vazire et al., 2022) can help under-stand and strengthen the scientific and societal impact of environmental psy-chology. We aim to strengthen this research and related fields that addresses in-dividual and collective responses to sustainability challenges such as climate change, biodiversity loss, and pollution. We further argued that boosting validi-ty 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 methodo-logical 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." (pp. 10)

R2, Comment 13: *366/67: Through this lens / repeated twice…*

RESPONSE: This has been fixed.

R2, Comment 14: *Second, …: how does open science relate to validated measures? I am not sure what the main point of this paragraph is*

RESPONSE: We rewrote this to make the aim of this paragraph clearer:

> "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)." (p. 11)

R2, Comment 15: *Fourth: can you give examples for aligning and diverging validities? I can guess, but I think this point deserves a bit of extra attention, too"*

RESPONSE: Thank you for highlighting this point. A common example for the divergence of validity types is the commonly assumed tension between internal and external validity (e.g., Cartwright, 2007). However, more recent research highlights the synergistic and integrative potential of internal and external validity (Trafimow, 2023). Although the potential alignment and divergence of validities are not the focus of the current paper, we now specify and include the example of internal and external validities:

> "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." (p. 11)

R2, Comment 16: *Language: the paper seems to have been written by non-native speakers (the German summary makes more sense than the English one); e.g. L. 142: typical example of a German inspired sentence structure, please overhaul, is it about spreading insights in general or cross-inseminate adjacent research fields*

Environmental Psychology Open

RESPONSE: In this revision, we did a thorough rewrite of all sections to improve precision and clarity. That process included sentence-level editing of the German text (by a German native) and the English text (by an English native).

R2, Comment 17: *Table 1: "Example reference" reads like you referenced papers that have done well in a certain validity aspect, but from the references I am guessing it is conceptual papers that raise that issue, too. So I would drop the "Example" or name it "further reading".*

RESPONSE: This has been changed as per your suggestion.

R2, Comment 18: *"This is a well-written manuscript with helpful recommendations for environmental psychology researchers and practitioners. Most of my remarks concern language and expressions and thus can be easily redeemed. Whether the authors want to retain or dissolve the distinction of impact types in the table is their decision in the end. I recommend publication with minor revisions."*

RESPONSE: Thank you for the helpful guidance and positive evaluation.