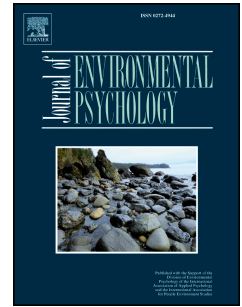# Accepted Manuscript

Perceptions of scientific consensus predict later beliefs about the reality of climate change using cross-lagged panel analysis: A response to Kerr and Wilson (2018)

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Perceptions of scientific consensus predict later beliefs about the reality of climate change
using cross-lagged panel analysis: A response to Kerr and Wilson (2018)

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—To the Editors—

In a recent study, Kerr and Wilson (2018) claim to provide a failed test of the Gateway Belief Model (GBM) using a cross-lagged panel analysis with 356 college students. Although we applaud the authors' effort to extend scholarly work on the GBM, we point out several mischaracterizations of our work and present evidence that contradicts their findings.

First, we are puzzled by the authors' main conclusion that; "in a more ecologically-valid setting, consensus beliefs do not have a strong influence on personal beliefs over time" (Kerr & Wilson, 2018, p. 7). Cross-lagged correlations can be used to assess causal relationships in the GBM, but actual experimental tests of the GBM path relationships provide much stronger evidence for the direction of causality because random experimental assignment ensures that the consensus treatment *causes* a change in personal beliefs and not vice versa (van der Linden et al., 2015). Moreover, the authors do not provide a full test of the GBM as claimed, as none of the other causal path relationships (such as worry and support for action) were measured or fitted to the data. The authors also suggest that their results bolster other findings that show that increasing perceived consensus does not mediate impact on personal beliefs (p. 3). Yet, the two studies cited do not support this claim. For example, Dixon et al. (2017) did not measure perceived scientific consensus and van der Linden et al. (2015) *did* find significant effects on personal beliefs.

Second, while the authors mention a "change in consensus estimates" between Time 1 and Time 2 (p.5), examination of the pre-post means reveals that no change actually occurred in the authors' data for consensus ($M_{preconsensus} = 77.98$, $M_{postconsensus} = 78.73$) or beliefs ($M_{prebelief} = 5.16$, $M_{postbelief} = 5.18$). Thus, we are unsure what "change" the authors are measuring. Moreover, we strongly question whether the authors' sample of undergraduate psychology students in New Zealand (78% female, 36% liberal)—with high pre consensus and climate beliefs—exhibited enough variation to allow for a reliable cross-lagged analysis.

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Accordingly, to improve ecological validity, we conceptually replicate the analysis on a nationally representative (U.S.) within-subject panel of respondents, surveyed 6 months apart (Maibach et al., 2015), similar to the 5 months lag used by Kerr & Wilson (2018). This dataset included the same measure of perceived scientific consensus ("To the best of your knowledge, what proportion of climate scientists think that global warming is caused mostly by human activities?" 0% - 100%) and a relevant climate belief item (ranging from, 1 = "global warming isn't happening" to 4 = "caused mostly by human activities"). The first wave of data was collected in March of 2015 ($n = 1,263$) and the second wave in September of 2015 ($n = 905$) via GfK's KnowledgePanel$^{©}$ using national probability sampling. The methods and panel attrition rate (28%) are fully described in Maibach et al. (2015).

Similar to Kerr and Wilson (2018), we found positive and significant correlations between perceived consensus and belief in climate change at each time point ($r_1 = 0.37$, $p < 0.001$, and $r_2 = 0.41$, $p < 0.001$). Perceived consensus and climate change beliefs slightly increased over the period ($M_{preconsensus} = 64.71$, SD = 23.13, $M_{postconsensus} = 67.44$, SD = 23.37, $M_{prebelief} = 3.24$, SD = 0.93, $M_{postbelief} = 3.27$, SD = 0.89). We estimated the cross-lagged model using STATA 14.2 and found an acceptable fit to the data ($\chi^2(1) = 17.85$, $p < 0.001$, CFI = 0.98, TLI = 0.90, RMSEA = 0.11, [90%CI: 0.06-0.16]). Unlike Kerr and Wilson (2018), however, we found a significant relationship between perceived scientific consensus at Time 1 and belief in climate change at Time 2 ($\beta = 0.24$, $p < 0.001$). We also found a significant path from belief in climate change at Time 1 to perceived consensus at Time 2 ($\beta = 0.16$, $p < 0.001$), albeit marginally weaker ($\Delta\beta = -0.08$, $p = 0.06$). In contrast to Kerr & Wilson (2018), our analysis further found that the effect of perceived scientific consensus at Time 1 on belief in climate change at Time 2 held for both liberals ($\beta = 0.35$, 95%CI; 0.20, 0.50) as well as conservatives ($\beta = 0.18$, 95%CI; 0.08, 0.28).
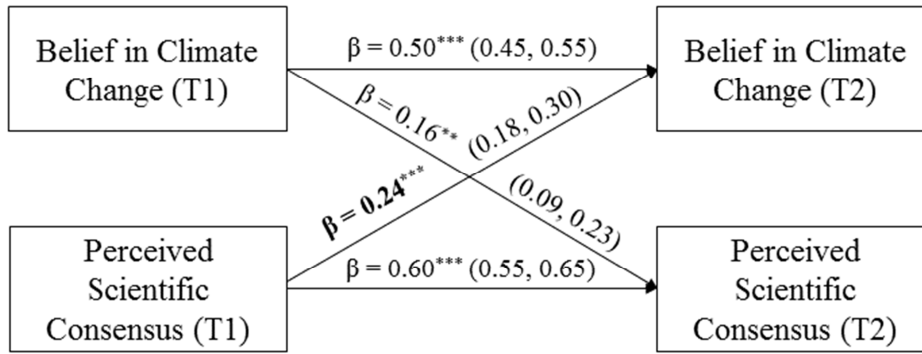
Figure 1. Standardized coefficients between personal beliefs and perceptions of the scientific consensus ($r = 0.37$) over time (T1, T2). *Note*: ***$p < 0.001$, **$p < 0.01$. Missing data were estimated with Full Information Maximum Likelihood (FIML, see Enders & Bandalos, 2001). 95% confidence intervals are provided in parentheses (bootstrapped 1,000 times).

In short, Kerr and Wilson's findings conflict with conclusions from multiple experimental studies as well as a cross-lagged model analysis using a nationally representative panel of respondents. This raises serious questions about the authors' claims. Although it is certainly possible that consensus perceptions and climate beliefs can dynamically influence each other over time, we caution against strong and inappropriate inferences drawn from partial tests on non-representative observational data. Lastly, it is interesting to note that in both studies the correlations between perceived consensus and belief in climate change at Time 1-2 were stronger than their respective cross-lagged correlations, which could suggest a common method factor. For these reasons, we encourage future research to use experimental (field) studies to test the predictions of the GBM.

References

Dixon, G., Hmielowski, J., & Ma, Y. (2017). Improving climate change acceptance among US conservatives through value-based message targeting. *Science Communication*, *39*(4), 520-534.

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457.

Kerr, J.R., & Wilson, M.S. (2018, in press). Perceptions of scientific consensus do not predict later beliefs about the reality of climate change: A test of the gateway belief model using cross-lagged panel analysis. *Journal of Environmental Psychology*.

Maibach, E., Leiserowitz, A., Roser-Renouf, C., Myers, T., Rosenthal, S. & Feinberg, G. (2015). *The Francis Effect: How Pope Francis Changed the Conversation about Global Warming*. George Mason University and Yale University. Fairfax, VA: George Mason University Center for Climate Change Communication

van der Linden, S. L., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. (2015). The scientific consensus on climate change as a gateway belief: Experimental evidence. *PloS One*, *10*(2), e0118489.

- Using a national panel sample, this study provides a cross-lagged test of the GBM
- We fail to replicate findings presented by Kerr & Wilson (2018)
- We clearly find that perceived consensus predicts later personal climate beliefs
- These findings hold for both liberals and conservatives