

Exploring cognitive and motivational barriers to carbon competence

Mario Herberz^a, Lukas Engel^b, & Tobias Brosch^a

^a Department of Psychology and Swiss Center for Affective Sciences, University of Geneva, Switzerland

^b Department of Psychology, University of Basel, Switzerland



Abstract

Accurate knowledge of the mitigation potential of climate actions (i.e., carbon competence) is a necessary condition for individuals to engage in high impact actions. We argue that cognitive and motivational barriers additionally prevent carbon competence, and that understanding these processes can help design corrective behavioral interventions. In two representative U.S. online samples ($N_{\text{total}} = 1704$), we investigated the influence of cognitive accessibility, numeracy, adoption of a behavior, and environmental values on mitigation potential estimates and the corrective effects of two boosting and one information provision interventions. **Our results support the influence of both cognitive and motivational barriers, which none of the three interventions was able to reduce.**

Theory & Hypotheses

Psychological processes, such as the use of inappropriate heuristics and the influence of motivated reasoning may obstruct the development of carbon competence. Moreover, insights into these processes can inform the design of behavioral interventions that guide individuals to estimate mitigation potential more accurately.

We formulated the following pre-registered hypotheses:

H1: Heuristics and motivated reasoning predict mitigation potential estimates

(cognitive accessibility, engaging in a behavior, and environmental values positively; numeracy negatively)

H2: Boosting and information provision interventions increase estimation accuracy

Methods

Outcome: Participants estimated the percentage of the average person's carbon footprint that could be mitigated by 34 individual climate actions ranging from recycling waste (lowest impact) to avoiding air travel (highest impact).

Interventions (Study 2): To reduce cognitive and motivational barriers, perceived behavioral costs and perceived prevalence (i.e., social norm) of climate actions were selected as boosting interventions. Participants were assigned to a control or one of three intervention groups (see below).

Behavioral costs heuristic

For each action, think about whether it requires more time, reduces your comfort or convenience, or costs more money. Actions with **low behavioral costs** are probably **much less effective** than you initially think. Actions with **high behavioral costs** are probably **much more effective** than you initially think.

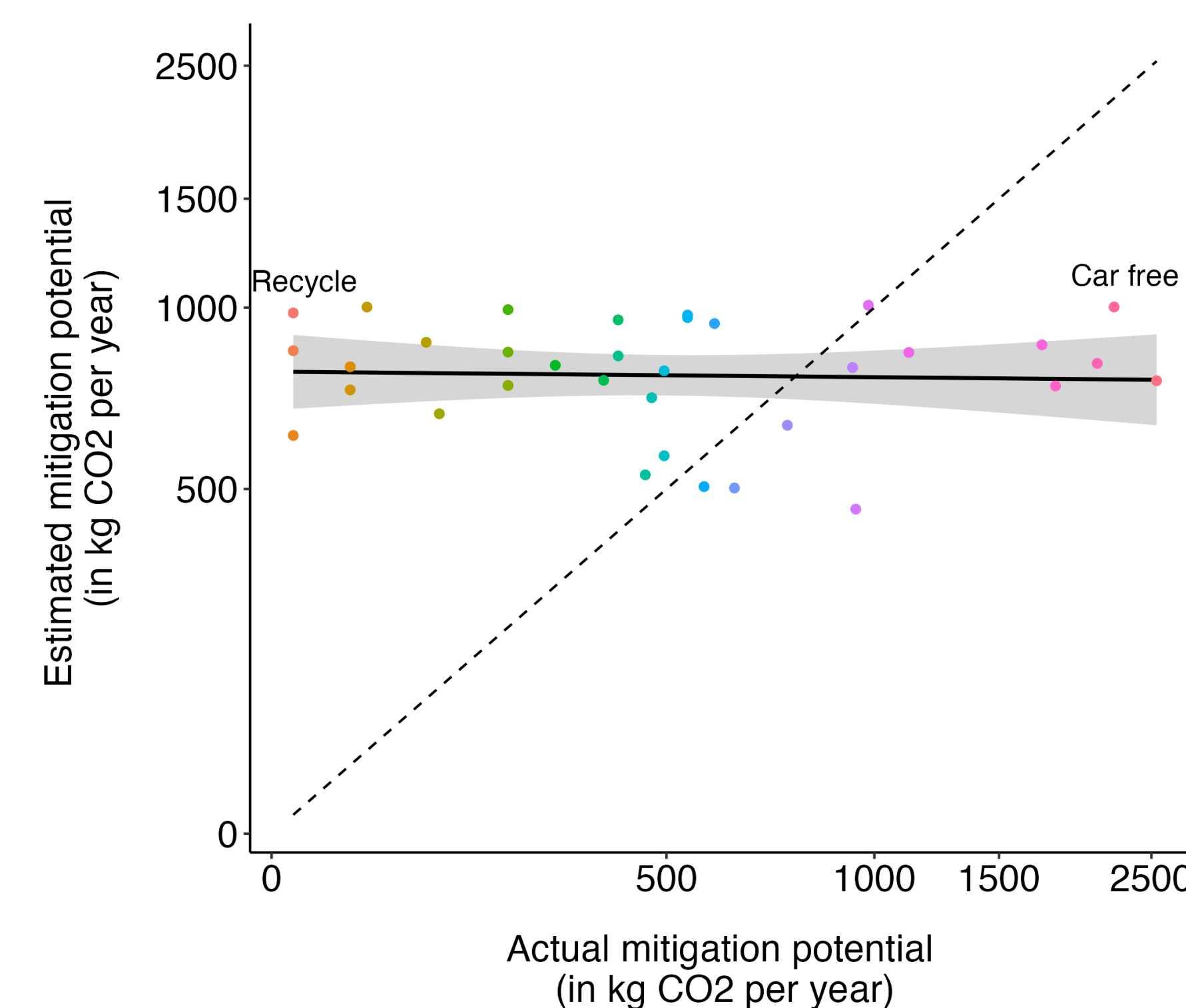
Social norm heuristic

For each action, think about whether many people you know are doing it or not. Actions that **many people are taking** are **much less effective** than you initially think. Actions that **few people are taking** are probably **much more effective** than you initially think.

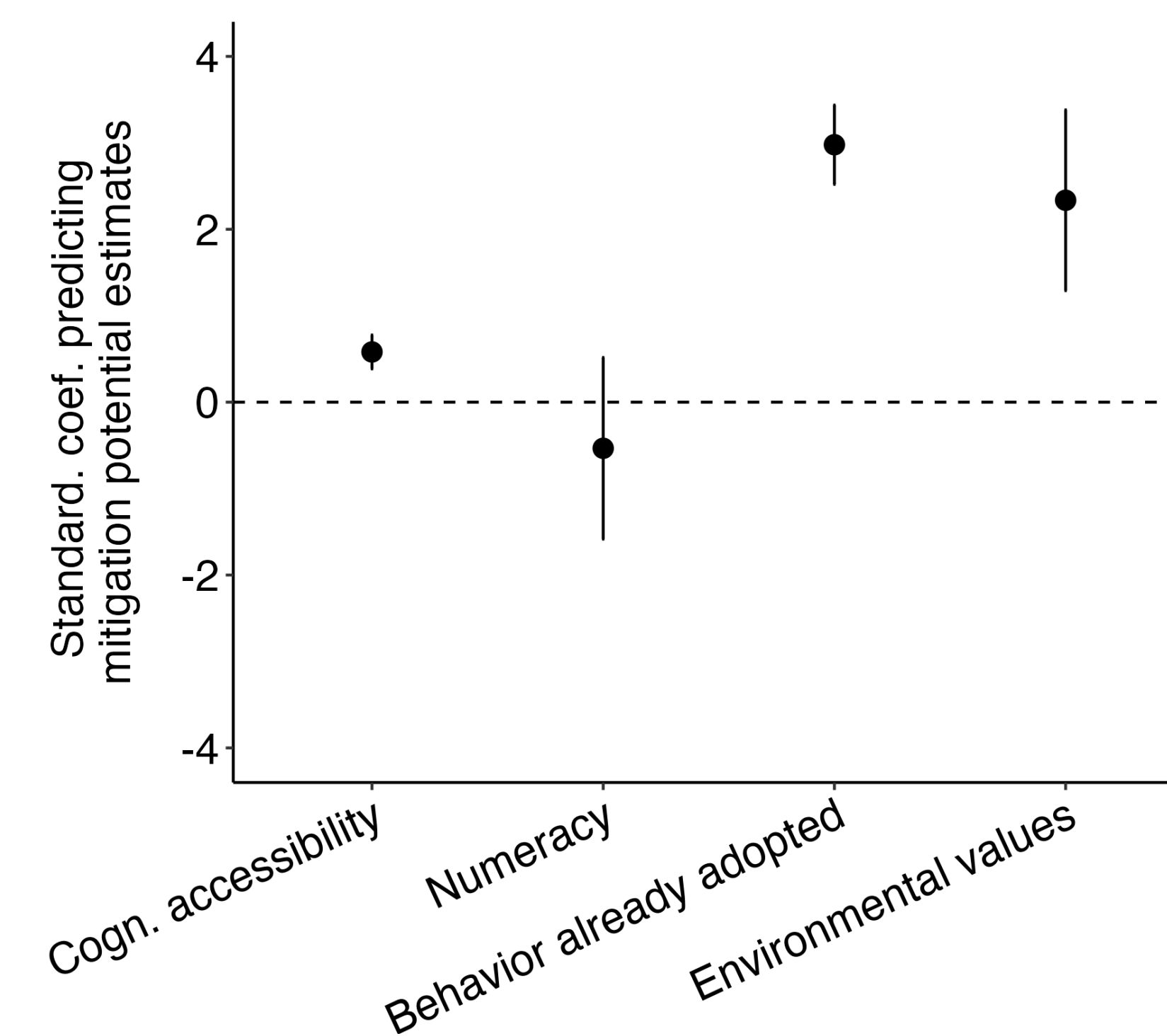
Top 4 intervention

We know that the **most effective actions** that people can take to avoid emissions are: **purchase renewable energy, avoid travelling by airplane, shift to an all-electric vehicle, and live car free.**

Results Study 1 (N = 503)

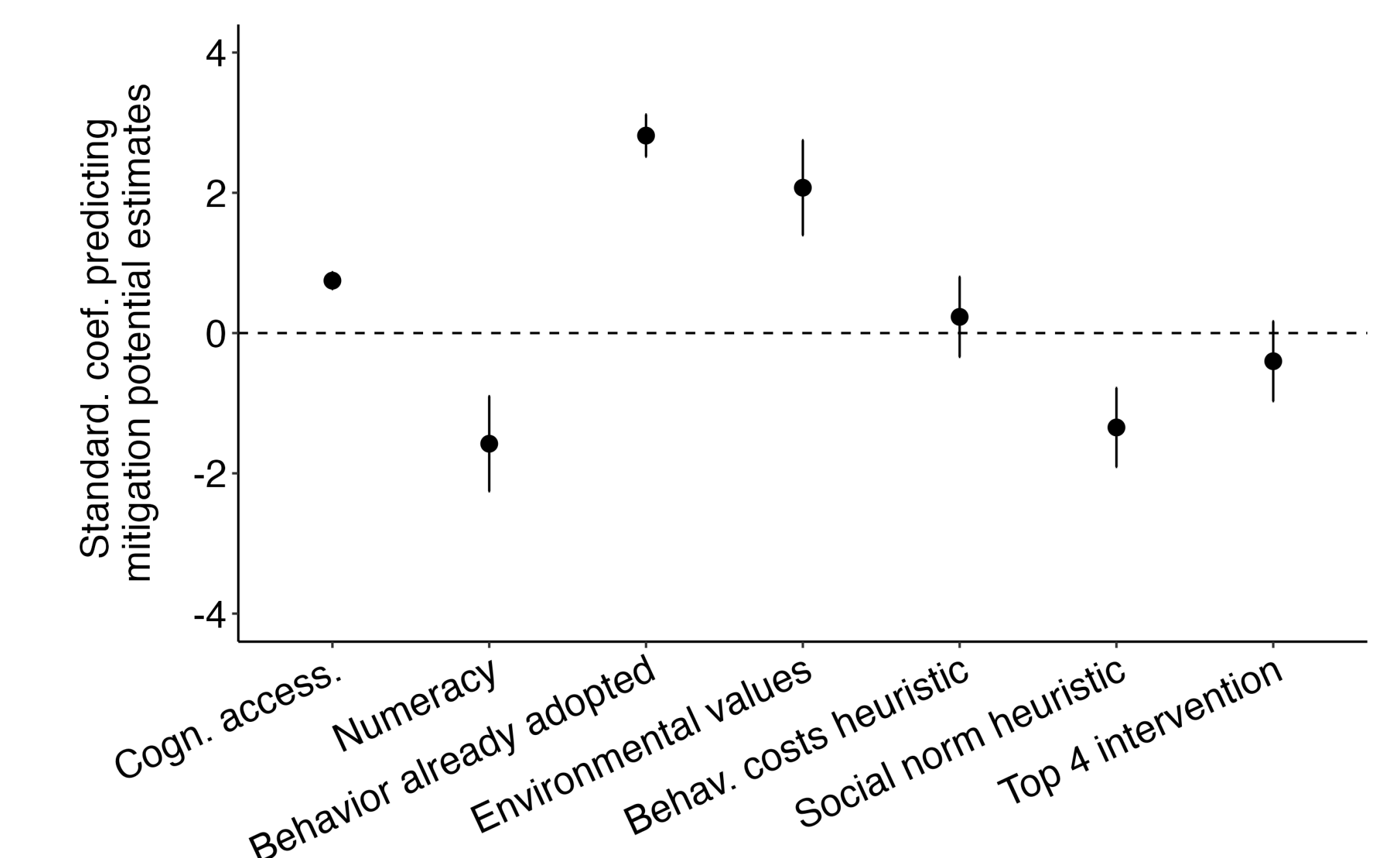


Low levels of carbon competence. Mean mitigation potential estimates by actual mitigation potential for 34 climate actions (scales are \log_{10} transformed) with linear regression line. Grey area shows the 95% confidence band.



Cognitive and motivational influences on estimates. Standardized regression coefficients of a multi-level linear mixed-effects model with mitigation potential estimates as outcome. Error bars show the 95% confidence intervals.

Results Study 2 (N = 1201)



Replication of findings from Study 1 and no positive effect of interventions on estimate accuracy. Standardized regression coefficients of a multi-level linear mixed-effects model with mitigation potential estimates as outcome. The coefficients for the interventions reflect their interaction with actual mitigation potential (i.e., slope). Error bars show the 95% confidence intervals.

Discussion & Conclusions

- We found **pervasively low levels of carbon competence** in two representative samples of U.S. citizens
- Higher **cognitive accessibility**, already engaging in an action and higher **environmental values** were associated with **higher mitigation potential estimates** (H1)
- Two boosting interventions aimed at replacing erroneous with **more appropriate heuristics** and **providing information** on the most effective climate actions did not increase estimation accuracy (H2)
- Future research should account for **heterogeneous intervention effects** and investigate the causal relationship of increasing carbon competence on **behavioral outcomes**