Original Article

Behavioral Interventions for Climate Mitigation in Developing Countries: Overview and Prospects

The Journal of Environment & Development
2023, Vol. 0(0) 1–20

DOI: 10.1177/10704965231190118
journals.sagepub.com/home/jed
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Abstract

Behavioral interventions are increasingly being considered as useful complements of traditional climate-policy instruments. These interventions are so far mostly being studied and applied in high-income countries. Here, we examine their application to achieve carbon emissions reduction in low- and middle-income countries. This involves synthesizing evidence from meta-analyses and systematic reviews from developed countries and deriving general insights for developing countries. We also review evidence from primary studies in developing countries, organizing insights by major world regions. We discuss context dependence of findings, as well to what extent behavioral interventions are complementary to, and create synergies with, other policy instruments. We hope that the present overview serves as starting point to expand the currently small evidence base on climate-relevant behavioral interventions in developing countries. Suggestions are made how to move this research forward.

Keywords

information, nudge, climate change, behavior, global south

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Introduction

In recent decades, a large body of human behavioral research has emerged. To complement pricing and other traditional instruments, this research has examined how new policy instruments built around behavioral insights can contribute to address societal problems, including climate change. Various terms exist to label these instruments, such as information provision and "nudges," where the latter denote subtle changes in individuals' choice architecture. Here, we use the broader term "behavioral interventions" to encompass both approaches.[1] Such interventions intend to trigger demand-side changes that contribute to climate change mitigation (Creutzig et al., 2018), but they may also be applied to change organizational business decision-making (e.g., Liebe et al., 2021).

In 2021, the UN secretary-general provided a guidance note on behavioral science, stating that "in the UN System, interventions leveraging behavioral science are already being piloted and applied" (UN, 2021). Despite much research and public recognition, it appears as if behavioral interventions, compared to structural, country-wide policies, are not yet frequently implemented in actual climate-relevant policy making. This holds especially true for developing countries (Mundaca et al., 2019). Moreover, it should be noted that behavioral interventions are typically implemented at a small or even project scale, such as in cities, communities, or companies. To inform policy decisions on behavioral interventions, here we will summarize evidence on their effects on behavioral change and associated emissions reduction. This pays attention to general aspects of behavioral interventions for climate policy such as information provision and nudges, and their actual and potential application to developing countries. While there are several review articles (mentioned in the second section) for high-income countries, to our knowledge there is no summary and discussion of evidence for middle- and low-income countries. Here, we will fill this gap.

The remainder of this overview article is organized as follows. The second section discusses the role of behavioral interventions, introduces general features of these instruments, and summarizes evidence on effectiveness as assessed by various meta-studies. The third section deals with assessment of experiences and impacts for distinct world regions. The fourth section discusses context dependence of findings and examines potential systemic impacts as well as positive and negative synergies of instruments. The final section draws conclusions and makes general suggestions for future research.

Evidence for Effectiveness of Behavioral Interventions

Several meta-analyses and quantitative reviews have summarized the effects of behavioral interventions. We focus here on more recent papers, that is, approximately from the last five years. While these have paid only scant attention to developing countries (mainly due to lack of data), they can nevertheless provide a useful overview of the types and effects of such policy instruments. One meta-analysis of residential energy use includes 360 effect sizes from 122 studies for 25 countries whose samples

add up to over 1 million participants (Khanna et al., 2021). The three most common types of interventions in the included studies were some form of feedback (63%), information (e.g., energy saving tips; 48%) and social comparison (38%). While most summarized findings are from the US and Europe, the authors note that "the number of effect sizes from studies in Asia has increased recently and constitutes 10% of the sample, with the remaining 10% coming from Australia, Latin America, Africa and the Middle East." The study finds that interventions such as information, motivation, feedback, or social comparison on average reduce energy use of households by 6%, and that monetary incentives have a slightly more pronounced effect. Some combinations can reduce energy use even further, while others can even create negative synergies. Overall, the author estimates that these interventions deliver an average global reduction of 0.35 $GtCO_2$ per year. Furthermore, the authors find no substantial differences across regions (Asia, continental Europe, UK, US, and "others"). Nevertheless, they conclude that "it is reasonable to expect that interventions in energy demand can temper the rapid growth of energy demand in developing countries in Asia and sub-Saharan Africa, leading to higher savings in emissions." Another meta-analysis by Nisa et al. (2019) analyzes randomized controlled trials testing feedback, social comparison, choice architecture and other interventions from 83 studies on energy consumption, transport choices, water use or recycling. Overall, the study finds very small effect sizes (Cohen's $d = -0.093$). It should be noted, though, that other authors have re-estimated the data and arrived at somewhat higher effect sizes (van der Linden & Goldberg, 2020). Nevertheless, the findings also show that studies with bigger sample sizes and less biases in respondent selection have lower effect sizes. Furthermore, and in line with the meta-analysis cited before by Khanna et al. (2021), the results indicate that more recent primary studies show lower effect sizes. Reasons for this may be that earlier studies were less well-designed or that changing practices towards pre-registration protocols reduces publication bias for positive results (Warren, 2018). Finally, about 80% of the studies covered by Nisa et al.'s meta-analysis are from North America or Europe, and only one study (focusing on water consumption) is from a developing country (Costa Rica). While this meta-analysis does not examine geographic differences in detail, its moderation analysis indicates that effect sizes for Europe and US/Canada are slightly higher than those for remaining countries.

Next, a meta-analysis of "information-based" interventions comprises 117 studies and finds an average reduction of resource consumption by 6.24% (Nemati & Penn, 2020). Most studies again are from the US and Europe. It is noteworthy that the mean effect sizes in the domain of household electricity use are positive (and highest) in China, meaning that information here on average increased (not decreased) electricity use. However, this result is based on just one study. Evidence from Ecuador and India are more in line with the average finding of reduction, but to a lesser extent. Again, due to a very limited number of covered studies from developing countries, these findings should be viewed with great caution. Another meta-analysis from Mi et al. (2021) covers 63 energy conservation studies testing interventions such as social norms (51% of the sample) next to feedback and goal setting. It estimates an average small-to-medium Cohen's effect size of $d = 0.44$. Importantly, the analysis did not uncover any

significant difference in effects between studies from Eastern and Western countries. Other studies explicitly focus on developed countries, such as the one by Buckley (2020), who estimates a 1.9–3.9% reduction of energy consumption from interventions such as feedback, saving tips and social norms. The study further finds that effect sizes are at the lower end the higher is the quality of primary studies in terms of random treatment assignment, existence of control group and variables, and avoidance of selection bias. To justify the restriction on developed countries, the author argues that strong differences in countries' climate and average consumption leads to strong differences in energy use and scope for reductions. Table 1 provides a summary of the presented meta-analytical insights.

Finally, we consider four summaries of additional evidence, which are somewhat distinct in scope from the ones described before. The first is a very recent second-order meta-analysis of behavioral interventions for climate change mitigation (Bergquist et al., 2023). It synthesizes ten meta-analyses and derives average emission reductions of 2 to 12 percentage points achieved by behavioral interventions. This is fairly consistent with findings from Table 1. The second is a quantitative review of interventions comprising 40 studies, with over 90% of them conducted in industrialized countries (Wynes et al., 2018). Instead of estimating effect sizes or percent changes of behaviors, this review estimates actual emission reductions from interventions, and then expressed them as the percent of the average American's emissions. Its results suggest that effective interventions amount to a 3.2% emission reduction for personal vehicle use (translating into 571 $kgCO_2e/yr$), 0.3% for meat consumption (51 $kgCO_2e/yr$) and 0.8% for electricity use (149 $kgCO_2e/yr$). The other two additional synthesis studies are distinct in the sense that they cover a wider range of behavioral interventions and domains, including environment/energy, health, financial decisions and others. The most recent study of this type covers more than 200 primary studies. It finds small-to-moderate effect sizes on average (Cohen's $d = 0.45$) (Mertens et al., 2022; see also Maier et al., 2022 for a reanalysis), including for the environment domain ($d = 0.43$), and a considerably higher effect for the food domain ($d = 0.72$). Moreover, the study finds that interventions work independent of geographic location, measured here rather broadly as a distinction between US vs. non-US. The finding about strong responsiveness of decisions in the food domain, which were not clearly linked to climate change in the meta-analysis by Mertens et al., is important for future research, because there seems to be no research available on interventions for climate-relevant food consumption and waste from Asia, South America or Africa (Reisch et al., 2021), despite rising meat consumption in major countries like China and India. Finally, a review by Hummel and Maedche (2019) synthesizes 317 effect sizes from 100 primary studies from different domains, finding 62% of the analyzed studies to report a statistically significant effect. While the relative median effect size is 21% behavior change compared to control group, about one third of all studies show insignificant differences. Effect sizes in the category "environment" tended to be somewhat higher than the median effect size, and lower for "energy." But since both environment and energy are only subdomains with relatively few included studies (19 and 10, respectively), these effect sizes should probably be viewed with some caution.

Table 1. Summary of Insights From Meta-Analyses of Behavioral Interventions.

Study	# Included studies	Main findings	Interventions (from most to least effective)	Insights about country/ regional differences
Buckley (2020)	52	1.87% average reduction in energy use	Real-time feedback > monetary information > social norms > personalized feedback > injunctive norms > individual feedback > saving tips > pricing strategies	Not available
Khanna et al. (2021)	122	6.24% average reduction in energy use (corresponding to a Fisher's Z score = 0.16)	Monetary incentives > information > feedback > social comparison and motivation	No substantial differences in the effectiveness of interventions across regions
Mi et al. (2021)	63	Cohen's d = 0.444	Social influence > monetary information > self-regulatory interventions (e.g., self-contract feedback) > monetary incentives	No significant difference in effects between studies from Eastern and Western countries
Nemati and Penn (2020)	116	6.24% average reduction in consumption of electricity, gas, and water	Public visibility > appliance-level feedback > peer monetary feedback > technical information > monetary incentives > tips > pricing information > use feedback > simple comparative feedback > efficient comparative feedback	Interventions increase electricity use in China, whereas in most other (developed) countries energy use is reduced
Nisa et al. (2019)	83	Cohen's d = 0.093[a] (0.204)[b]; Probability that intervention reduces emissions = 6.6%	Choice architecture/ nudges > appeals > engagement > social comparison > information	Effect sizes from Europe and US/Canada are slightly larger than those from remaining countries

[a]Nisa et al. (2019) reports the effect size using a negative sign of the d-value to express that "an intervention reduces the use of natural resources." Here, we report the d-value with a positive sign to allow for easier comparison with other meta-analyses.
[b]van der Linden and Goldberg (2020) use the data of Nisa et al. (2019) to re-estimate effect sizes and arrive at d = 0.204 (using "Empirical Bayes" technique).

Overall, we have seen that behavioral interventions currently produce small to moderate reductions of energy use or other environmentally relevant behavioral change. One consideration is that reported findings are averages, meaning there is variation of effects, for example, across types of instruments. In fact, despite acknowledging the usefulness of meta-analyses, researchers studying the details of this particular method have raised several issues about it, such as combining studies with too distinct measures and characteristics (Simonsohn et al., 2022). To illustrate that behavioral interventions can be much more effective than reported averages, consider the case of default effects in the choice of renewable electricity tariffs. This intervention has been shown to create dramatic effects in a large-scale field experiment, decreasing shares of households having fossil-fuel based electricity tariffs from over 90% down to less than 20%, when renewables-based tariffs are set as the default option (Liebe et al., 2021). Apart from generally strong effects of default-choice interventions (see also Mertens et al., 2022), there is no clear pattern yet what type of interventions work best. The fourth column of Table 1 indicates which interventions are found to be relatively effective, but no consistent picture arises from the distinct meta-studies. The only intervention feature that comes out high in multiple studies is monetary information/feedback (namely, in four of the five studies, while the fifth did not assess it). To illustrate that the described meta-analytical evidence does not offer consistent insights, note that while one study suggests social comparisons/norms to be the most effective type of intervention (Mi et al., 2021), another indicates it is the least effective among several options (Khanna et al., 2021). This suggests that interventions' effects may be sensitive to a number of moderating variables, both on a substantive and methodological level. For example, the famous OPOWER energy conservation programs using social norm information seem to have been more effective when they were implemented in areas with above-average pro-environmental orientations of neighbors (Alcott, 2015). It may even be possible that some primary studies are coded in distinct categories by each meta-study. For example, the provision of feedback may contain social information, which could then end up in a norm or feedback categorization. Differences may also occur because primary studies sometimes combine distinct interventions and not every meta-study may disentangle such effects. It is difficult and not the purpose here to give a complete overview of such moderating influences, but it is reassuring that a research agenda has been set in motion to gather more knowledge about these issues (Bryan et al., 2021).

Moreover, as noted before, several meta-analyses have shown that effect sizes tend to be lower for studies with higher quality, due to, among others, avoidance of self-selection bias. In addition, contrary to intuition, interventions with longer duration have smaller effects (Nemati & Penn, 2020; Khanna et al., 2021; Mi et al., 2021) suggesting, for instance, that initial enthusiasm may not lead to new (or conflict with old) habits over time. Taken together, this means that one should probably focus on the lower values of effect sizes reported in Table 5 and interpret these as lower bounds of interventions' effectiveness. This insight is consistent with another recent summary of randomized controlled trials (DellaVigna & Linos, 2022). This study's importance derives from the comparison of academic studies with findings from typically larger

non-academic trials conducted by actually existing "nudge units" in the US. It shows that large-scale trials conducted by practitioners show results that are considerably smaller than those from academic studies, namely, 1.4% compared to 8.7% of behavioral change. One important reason for the differences is that academic studies often do not have sufficient statistical power, with n = 484 being the median sample size of academic studies versus n = 10,006 in the nudge unit sample. Another reason is that academic studies are published selectively, leading to underreporting of smaller or nil effects. More generally, there is a growing literature on why behavioral interventions fail or even backfire (Sunstein, 2017; Osman et al., 2020). While this research is not necessarily focused on the environmental domain, or on developing countries, its findings are worth taking into consideration. Sunstein (2017) offers a broader discussion of why nudges can fail, paying attention to strong antecedent preferences, counter-nudges, or compensating behavior leading to nil effects. To illustrate the latter point, consider the rebound effect. While a behavioral intervention may initially conserve energy of a household, the resulting monetary savings may lead to purchases of new devices which in turn may undo some or all of the energy savings. Regarding counter-nudges, an example would be that a social norm intends to influence consumers towards a low-carbon choice in the presence of commercial advertising for a high-carbon alternative (Castro et al., 2023). In addition, it may simply be that interventions are based on inaccurate or incomplete understandings of the target behaviors. Conclusions by Sunstein (2017) are that nudges need further refinement and testing, but also that other measures may be needed. Osman et al. (2020) provide a comprehensive and nuanced taxonomy of eight types of failures, which includes, among others, both interventions producing no or opposite effects, or with no treatment effects but positive side effects. The basic purpose of their framework is improving trial design, systematizing the analysis of outcomes and underlying conditions, and ultimately increasing the chance of policy success.

It is worth mentioning that all these meta-analyses use slightly distinct statistical approaches to examine effectiveness, which complicates comparison. Moreover, it is likely that despite some overlap of covered primary studies, the selection criteria and, hence, covered types of behavioral interventions and applied domains differ, which might explain distinct results. While some meta-studies include (actual or hypothetical) monetary incentives or cover the food domain, others do not. Despite all these issues, one can conclude that behavioral interventions have a modest potential to contribute to climate change mitigation. This requires further learning about what works and what doesn't work and especially how to upscale such interventions. Existing reviews highlight the strong focus of this type of research on developed countries and suggest a need for future research to test whether these interventions can play a similar or possibly larger role in developing countries. One element that has already received attention is that instruments should be judge in combination as they may have negative or positive synergy (van den Bergh et al., 2021). This may receive further attention in the future, especially since there is no specific research here focused on the context of developing countries.

Insights About Behavioral Interventions for Distinct World Regions and Countries

We now continue with a more detailed discussion of primary studies from developing countries, organized by world regions. Studies on household electricity use are the most common here. Note also that while many studies do not directly relate to greenhouse gas emissions, some general lessons can be derived from them that may turn out useful for understanding the application of behavioral interventions in climate mitigation policy.[2]

We start with findings from *Asia*. A study for *China* examines whether participation in a voluntary pilot program on household waste separation has lasting effects on recycling behavior (Zhang & Wang, 2020). Over 13,000 survey respondents of a representative survey are examined to see whether people are more likely to recycle in those cities that implemented the program. It reports that the pilot program has a moderate effect on household waste sorting: respondents in pilot cities exhibit 0.243 points higher frequency of waste sorting compared with those in nonpilot cities (on a three-point scale). Furthermore, the study identifies two mechanisms of how the program changes behavior, namely, through increasing knowledge about waste types and sorting as well as by fostering social interaction among households. The findings indicate that changes in waste separation are sustained even thirteen years after the program was introduced.

In a field experiment on electricity use in *India* (Sudarshan, 2017), 484 households were exposed to one of two treatments: (a) weekly energy reports showing their own electricity use and those of their neighbors or (b) the same reports combined with monetary incentives. In the latter treatment, participants were endowed with an initial budget, which they could lose when they had an above-average electricity use, or further increase when they showed a lower-than-average electricity use. When using only energy reports, the study finds a significant reduction of electricity use by 7% on average. In contrast, no reduction was found for the instrument mix, suggesting that a combination of information and incentive resulted in negative synergy to the point of backfire (van den Bergh et al., 2021). Another study for India on household electricity use conducts a randomized controlled trial (Chen et al., 2017). It finds that messages that framed electricity consumption in terms of environmental and health impacts were more effective than messages emphasizing the monetary savings of lowering electricity consumption. A strong feature of this study is that captures to what extent people actually engaged with the provided information, stating that over the course of several months there were 375,805 fifteen-minute electricity readings. Interestingly, engagement with the provided messages had an opposite effect than intended: it led to more energy conservation in the treatment on environmental and health impacts, while reading more about the financial savings from conservation led to higher electricity use. Additional interview data indicates that respondents perceived the monetary savings as too low. A caveat regarding the study's finding is that it contains only 19 participants. A final study for India is worth mentioning. It examines social spillovers and network effects in the adoption of cleaner cooking fuels among thousands of urban and rural

households (Srinivasan & Carattini, 2020). The method involves analyzing cross-sectional and panel data from thousands of urban and rural households over a time period of various years. One key finding is that households belonging to business, development and religious groups, unions, women's associations, etc. are more likely to adopt cleaner fuels, while controlling for other factors such as income. The authors conclude that "interventions leveraging social spillovers should be part of the battery of instruments used by governments with the goal of helping the population switching to cleaner fuels."

One of the few studies on the adoption of electric motorcycles was done for *Nepal* among 2500 participants of a randomized controlled survey experiment (Filippini et al., 2021). It reports findings on the effects of three informational nudges that were supposed to influence the choice between a petrol-fueled and an electric motorcycle: (a) distinct running costs, (b) distinct air pollution effects, and (c) an emotional image related to air pollution, but without a clear link to one of the two vehicles. All interventions increase stated preferences for electric vehicles, but only options b and c do so in a statistically significantly way. The study finds that having a low level of education is associated with a slightly more positive response to the third treatment (c), leading the authors to speculate that emotional stimulation may promote electric motors among those with less awareness of health effects. The findings suggest that communicating co-benefits of low-carbon options can be relevant for those developing countries that struggle with health problems due to local air pollution. As the authors suggest, such information could be provided through some kind of product labeling.

There are only some studies deal with countries from other world regions. One large-scale field experiment on electricity use for a *Latin American* country, namely, *Ecuador*, involving over 27,000 households tests a social norm intervention (Pellerano et al., 2017). It finds that the descriptive social norm reduces electricity use by 1% relative to a control group. Moreover, adding a communicated financial incentive to the norm treatment did not contribute to further reductions, which the authors interpret as a crowing-out mechanisms leading to a change of the frame from a pro-social to a monetary reasoning. Using a similar social norm intervention but applied in a different domain, a study for *Colombia* reports results from a field ($N = 1311$) aimed at increasing residential water savings (Torres & Carlsson, 2018). It finds that the households in the treatment group reduced their water use by 5.8% and 6.8% in the 6 and 11 months, respectively, after the information provision. These effects were stronger among households in older and rented dwellings. In general, Latin American and Caribbean countries seem to develop an interest in behavioral interventions. The Inter-American Development Bank recently created a repository of behavioral interventions conducted in this world region (Rojas, 2021). While most interventions seem to be from domains such as taxation, health and education, the interested reader can also find information related to environment, energy and agriculture. Similarly, UNDP has a frequently updated repository, including interventions in environmental and non-environmental domains (UNDP, 2020).

Only little is known from *African* countries. A study for *South Africa* tests behavioral interventions in a non-residential office building setting including 24 floors

and about 1000 occupants (Klege et al., 2022). There were two treatments: (a) office workers on one floor receive regular emails on how to save electricity and how they compared with other floors and (b) people received the same emails, but also had a peer leader assigned, that is, someone advocating for energy reduction. Both treatments led to significant reduction, namely, by 8% and 13%, respectively. This is noteworthy given that compared to the usual studies for households, the study participants here had no financial incentive to reduce energy use. Post-intervention interviews revealed some mechanisms. First, some employees worked as a team to reduce energy use. Second, peer leaders especially advocated to save energy outside of office hours (e.g., by unplugging devices), which confirmed the study's quantitative results.

Finally, we want to highlight a study from *Eastern Europe*, specifically from *Moldova*. It tested the influence of a social comparison intervention among 120,000 households (Kim & Kaemingk, 2021). To motivate their study, the authors use two competing hypotheses about the effects of social norms. On the one hand, they draw on the theoretical "tightness-looseness" framework which refers to variations in the strength of social norms and deviation in tolerance for norm across societies. "Tighter" societies, such as Moldova, are said to have stronger norms and punishments of norm violations. One can therefore expect strong positive effects of a norm intervention. On the other hand, social norms arguably may not work well in a post-Soviet country given the controversy around instructions to conform. The authors find that framing social comparisons either in kilowatt per hour-units or as monetary values both led to a reduction of electricity use by 1.7–2.1%. This effect also persisted over time. A noteworthy consideration is that Moldova, just like other LMICs have an electricity use that is lower than that of richer countries. It is thus noteworthy that electricity use can be reduced by the same relative amount compared with richer countries. Table 2 summarizes the key results from developing countries.

Discussion

Context Dependence

One insight to derive from the reviews and meta-analyses covering studies of mostly developed countries is that they often do not find considerable differences across countries. On the one hand, this could mean that behavioral interventions may also work to the same extent in other regions of the world. On the other hand, the distinctions made by meta-studies are often very crude, such as comparing US versus non-US countries. More importantly, some researchers have pointed out problems with generalizing behavioral findings from WEIRD (Western, educated, industrialized, rich and democratic) to non-WEIRD societies (Henrich et al., 2010). Again others highlight that human diversity goes far beyond such (non-)WEIRD dichotomies (Ghai, 2021). The latter suggests that researchers should exhibit stronger care when generalizing from their studies, not just between but also within study countries.

Being careful about generalizing results is also consistent with the conclusion of a recent review of behavioral development economics regarding the reasons for conflicting findings

Table 2. Summary of Primary Studies on Behavioral Interventions From Developing Countries.

Study	Country	N	Domain	Intervention	Main findings
Chen et al. (2017)	India	19	Household electricity use	Environmental/ health message	18.4% electricity use reduction (measured over one-year period using 375,805 intra-individual data points)
Filippini et al. (2021)	Nepal	2176	Adoption of electric motorcycles	Two experimental treatments: (a) air pollution effects; (b) air pollution + images	Both treatments increase stated willingness to adopt, considering probit regression coefficients: (a) 0.313; (b) 0.280
Kim & Kaemingk, 2021	Moldova	127,760	Household electricity use	Social comparison	Reduction of energy use by 2.1%
Klege et al., 2022	South Africa	1008	Energy use in office building	Two treatments: (a) social comparison; (b) social comparison + peer leader	Reduction of energy use by (a) 8% and (b) 13%
Pellerano et al., 2017	Ecuador	27,634	Household electricity use	Descriptive norm	Average monthly electricity use is approximately 1.36 kWh (~1%) lower (based on post-treatment observation in a cross-sectional setting)
Srinivasan and Carattini (2020)	India	Up to 104845 (depending on survey and year)	Adoption of liquefied petroleum gas (LPG; considered in this study a "clean cooking alternative")	Learning from household's neighbors, social network or friends	A one unit increase in the average village/ urban-block LPG adoption rate increases the probability that a household adopts LPG by about 0.825 units
Sudarshan (2017)	India	484	Household electricity use	Descriptive norm	7% reduction in energy use (considering the linear model)
Torres and Carlsson (2018)	Colombia	1311	Household water use	Descriptive norm	5.8% reduction in water use

(continued)

Table 2. (continued)

Study	Country	N	Domain	Intervention	Main findings
Zhang and Wang (2020)	China	11,193	Waste sorting	Pilot scheme promoting waste collection	0.243 points higher frequency of waste sorting compared with those in nonpilot cities (using a probit adapted OLS technique)

in this literature (Flechtner, 2023). It argues that research on (policy-related) behavioral interventions in developing countries need to better study the social and cultural conditions under which behavior takes place. This calls for comparing the effects of interventions across various levels and dimensions, including where one may not expect to see differences at first sight. For example, (non-environmental) nudges have been shown to work well in Nigeria, but turned out to be ineffective in neighboring Niger (Dalton, 2018). Context dependence also suggests that before carrying out behavioral interventions, it would be useful to conduct pilot tests and collect local information from government agencies, community organizations, consultancies, etc. (Sovacool & Griffiths, 2020). Researchers can also benefit from new types of conceptual frameworks: one that assists in comparing research findings cross-culturally (Deffner et al., 2022); another that improves tailoring behavioral interventions to the needs of specific groups embedded in complex social-ecological systems (Lambe et al., 2020). In fact, a whole new line of research may be emerging that focuses on the question of how to best adapt and apply existing interventions in different contexts (Hallsworth, 2023).

Context is not only relevant as to how treated subjects respond to an intervention, but also as to the chances of the implementation of the intervention. Political will, governance structures, and institutional capacities play a crucial role in implementing behavioral interventions. Understanding the political and institutional landscape of a country is essential to design effective interventions. For example, while nudges receive public support in Western countries, research demonstrates significantly less approval in non-Western country contexts (Kasdan, 2020). In sum, there is need for future research to better test to what extent behavioral interventions can play a similar role in developing as developed countries. Given the diversity between and within developing countries, it follows almost logically that such research efforts should pay attention to questions of context-sensitivity.

Instrument Synergies and Systemic Impacts

Behavioral interventions are generally not employed in isolation but in combination with other measures, such as policies based on economic incentives. This may create positive synergistic effects (van den Bergh et al., 2021). Some of the aforementioned meta-analytical evidence finds that interventions combining monetary incentives with

social comparison and feedback are more effective to reduce energy use than individual interventions (Khanna et al., 2021). However, another review focusing exclusively on this topic concluded that there is currently little evidence for positive synergies (Drews et al., 2020). To some extent, the latter has to do with methodological shortcomings (e.g., missing experimental control groups). In addition, while it is often reported or suggested that economic incentives can crowd-out people's intrinsic motivation to engage in certain behaviors (see, for example, an example for Ecuador by Pellerano et al., 2017), Drews et al. argue it is possible but less studied that behavioral interventions can have similar crowding-in/out effects and in turn increase or reduce the overall effect of an instrument combination. The evidence base for such effects is however relatively small, especially for developing countries. Given that economic incentives may have stronger effects in developing countries due to lower incomes, it becomes even more relevant to examine potentially negative synergetic effects between instruments. Here, it is also worthwhile to mention energy rebound, the control of which is arguably best achieved through carbon pricing. It may, however, be complemented by behavioral interventions adapted to deal with the specific effects of bounded rationality, social influence and limited willpower (Exadaktylos & van den Bergh, 2021).

While most studies on behavioral interventions analyze individuals in their roles as consumers (e.g., of electricity, material goods), there is some initial efforts made that seek to understand how interventions can be applied to companies. For example, Liebe et al. (2021) examine the effects of default nudges applied by electricity companies to small- and medium-sized business customers. Specifically, electricity supplier A and B of their experiment have 1139 and 7633 business clients, respectively. Changing the default from a tariff of conventional energy to a slightly more expensive one that is based one renewables leads to remarkable shifts. 97% of business customers of supplier A had conventional energy when it was the default, but changing the default to renewables caused 75% of businesses accepting the green tariff. Among the larger pool of businesses supplied by electricity company B, the default change even led to 84.5% accepting the green tariff. Another example is the use of behavioral interventions by companies to change the commuting behavior of their employees (Kristal & Whillans, 2020). Except for the earlier mentioned study by Klege et al. (2022) showing that office workers in South Africa can be motivated to use less energy, there is little evidence from developing countries in this regard. There is thus a clear need for more research here. This could cover interventions in company or other organizational settings, as well as target individuals in their roles as investors or role models in their community (Nielsen et al., 2021). Interventions could as also be related to the policy-making process itself, including decision-making, policy implementation, enforcement, and measurement. There is initial work in this direction, such as on how to best present evidence to policymakers (Brick & Freeman, 2021).

As we argued elsewhere (Drews & van den Bergh, 2022), in addition to behavioral interventions aimed directly at emission reductions, we think that behavioral insights could play an indirect but potentially more crucial role though promoting sociopolitical feasibility of arguably more effective policies. For example, real-world carbon

pricing schemes have faced considerable public resistance in some countries, reducing their stringency or chances of implementation (Carattini et al., 2019; Maestre-Andrés et al., 2019). One way often proposed to overcome resistance is a strategic use of the revenues of carbon pricing, for which multiple options exist. While several studies have identified preferences for different revenue uses (Maestre-Andrés et al., 2021), there is still much potential to draw even more from behavioral research to tailor the design and communication of carbon pricing revenues so that they accommodate citizens' needs and perceptions. For example, some developing countries—notably in Latin America—show relatively low trust in public institutions (Perry, 2021). To increase policy acceptance, this could mean that carbon pricing revenues are best redistributed visibly through direct transfers to households instead of adding them to the general state budget or using them for green spending (or at least some kind of combination of household transfers and other uses). More research synergies between behavioral insights and structural solutions would be of great help.

Conclusions and Ways Forward

Our review behavioral interventions for climate policy indicate that they have currently a modest potential to contribute to climate change mitigation. While it is difficult to draw general lessons, from Table 1 we derive that among the various interventions monetary information/feedback is found to perform relatively well by most meta-analyses, whereas some other interventions appear high only in few studies. Regarding remaining features of interventions, the picture is less consistent or clear. Especially assessments of the effects of social norms show considerable variety. The meta-analytical evidence almost exclusively is from developed countries. While this evidence indicates some generalizability of findings across these countries, it remains unclear how they can be transferred to developing countries. In fact, we have argued that not only is more research from the Global South needed, but also that context dependence should be taken more seriously.

In closing, we make several suggestions on how the community of research on behavioral interventions in developing countries could move forward and expand. First, it may be useful if some researchers take initiative to show how certain perspectives from developing countries are underrepresented in the growth of scientific fields. For example, Aruta (2023) has illustrated how the body of knowledge in environmental psychology could be enriched by insights from the Philippines. This could create opportunities for research collaborations within a country, as well as trigger interest by researchers in developing countries. The latter might establish research linkages between Global North and South, which may help to overcome shortages of funding.

A second direction is exploring synergies in cooperation with international organizations that apply behavioral science systematically, as recently summarized in a World Bank report (Manning et al., 2020). According to the report, these organizations are increasingly building evidence bases, which not only involves desk research but also draw upon workshops, knowledge dissemination and networking activities.

Academic behavioral researchers in developing countries could try to build connections to these activities, and more generally with formal behavioral science units or departments within international organizations. This too may offer opportunities for resource utilization, and research funding. For example, the United Nations host a "Behavioural Insights Group" whose work is implemented in collaboration with academic researchers. Such partnerships would also be helpful to share knowledge, and increase the impact of behavioral interventions and the chance of their implementation and scale-up beyond narrow tests in academic settings. A positive example to mention is the Bursura center, a non-profit organization which has been applying behavioral insights—notably related to poverty issues—in over 500 projects across 25 countries from Africa, South America and Asia (Bursura Center, 2023). Thus, it is building a community of researchers, practitioners, and policy-makers in the Global South. In addition, Bursura has set in motion a research agenda on replicable research methods and cross-cultural validation (Mughogho et al., 2021). Such collaborations from distinct developing countries and regions can contribute to the call for coordinated multi-site studies in order to better understand the role of distinct contexts, as discussed in the previous section.

A third point is the challenge to bridge epistemological tensions. Researchers have noted that while some NGOs and governments have adopted behavioral insights, skeptics in developing countries worry about manipulation and long-term effectiveness of behavioral interventions (Velez & Moros, 2021). A common argument is that that behavioral interventions, or behavioral science more generally, does not tackle underlying structural issues and power dynamics related to environmental (and other) problems. Nevertheless, as we pointed out above, one way of overcoming such tensions could be to use behavioral insights to make structural solutions more effective and popular.

Acknowledgments

This study was requested and funded by the UNDP. We thank Ivan Savin for useful comments.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the United Nations Development Programme.

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Notes

1. Some researchers use even broader conceptions of behavioral interventions, including, for example, economic measures such as taxes (Marteau et al., 2021). While there are many classifications of policy instruments in the climate policy literature, information and nudges are usually considered as category separate from carbon pricing or adoption subsidies (e.g., van den Bergh et al., 2021).
2. Note that we do not report here all studies from developing countries that were covered in the meta-analyses and reviews cited in the second section, because some of these primary studies are not clearly about climate change mitigation but other applications (e.g., water consumption).

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