

**A Review of Determinants of Behavior and their Efficacy as
Targets of Behavioral Change Interventions**

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Abstract

Unprecedented social, environmental, political, and economic challenges, from pandemics and epidemics to environmental degradation to community violence, require taking stock on how to promote behaviors that benefit individuals and society at large. In this review, we synthesize multidisciplinary meta-analyses of the individual and social-structural determinants of behavior (e.g., beliefs and laws, respectively) and the efficacy of behavioral change interventions targeting changes in each type of determinant. We find that, across the board, in order of increasing impact, interventions designed to change individual determinants can be ordered as those targeting knowledge; general attitudes; beliefs; emotions; general skills; behavioral attitudes; behavioral skills; and habits. Interventions designed to change social-structural determinants can be ordered as legal and administrative sanctions; interventions to change injunctive norms; monitors and reminders; programs to increase institutional trustworthiness; descriptive norm interventions; social support provision; incentive use; and policies to increase access to a particular behavior. We find similar patterns for health and environmental behavioral change.

INTRODUCTION

During the last five years, humanity has been confronted with extraordinary social, environmental, political, and economic challenges, from pandemics and epidemics to threats to our habitat and climate to community, state, and police violence. As human behavior is central to solving these crises, the science of behavior change must illuminate the way forward and identify efficacious interventions to change behaviors intended to benefit individuals and society. For example, we need to understand the degree to which correcting misinformation, modifying cultural beliefs, or changing norms or legal and administrative sanctions will increase vaccination or decrease energy usage. Up to this point, however, researchers have only estimated the efficacy of interventions in specific domains (e.g., health¹ or climate change²) or provided taxonomies of the arsenal of tools available to change behavior³⁻⁵. Thus, the goals of this paper are to review the efficacy of interventions to change behavior across domains and to generate a framework that organizes intervention approaches based on their efficacy.

Up to this point, the literature has not considered the impact of different behavioral determinants or the efficacy of different targets of change across a diverse set of behaviors. Although estimates of specific intervention targets do exist⁶⁻⁹, their efficacy has not been compared with other possible interventions. For example, past reviews of the efficacy of implementation intentions or normative appeals^{6,10-14} are valuable but have not compared the efficacy of implementation intentions with the efficacy of its close relative, behavioral skills training, or the efficacy of normative interventions with programs to increase the trustworthiness of institutions such as government or health care providers.

Second, past reviews of the comparative efficacy of interventions to change

knowledge, attitudes, norms, and behavioral skills have been circumscribed to specific behavioral change areas, such as HIV (Human Immunodeficiency Virus) prevention and care¹⁵⁻¹⁷. In contrast, this review concerns the efficacy of a comprehensive set of behavioral interventions across all domains of behavioral change (e.g., health, environmental, financial, social, marketing, justice, and organizational domains). One reason for the traditional focus on single behaviors is that research funding is often allocated by problem, as illustrated by the disease-specific organization of the National Institutes of Health, the main health research funding agency in the United States. Another is that researchers are often trained in silos and assume that each issue is unique. Our review, however, considered empirical evidence *across* any behavior that has received research attention. From a theoretical standpoint, understanding a broad spectrum of behaviors is critical to a generalizable model of behavioral change. From a practical standpoint, new behavioral change challenges will continue to surface. For example, before the COVID-19 pandemic, no research had examined how to promote widespread masking, social distancing, or adherence to lockdown measures. In these situations, reviewing cross-domain targets of behavioral change is essential for well-informed public health decisions in unprecedented situations.

In addition, this review goes beyond creating a taxonomy of behavioral change techniques, which has been done before. For example, Michie et al.^{18,19} used a review and expert judgments to identify behavioral-change interventions, determine whether they were based on behavioral change principles, and then organize them into various displays that allow practitioners to visualize possible tools at their disposal. Despite its value, this taxonomy has not addressed the critical question of the relative *intervention efficacy* of the approaches, as an intervention based on “behavioral change principles” does not guarantee success. Therefore,

our goal was to review intervention efficacy based on a parsimonious set of behavioral determinants and intervention targets and then organize targets of change into a framework of relative efficacy.

A synthesis of disparate bodies of research can facilitate decisions about what behavioral-change targets to choose when designing an intervention. For example, how do we decide whether to change behavior by increasing the population's knowledge or trust in authorities? As we describe presently, we proceeded by defining a parsimonious set of individual and social-structural determinants of behavior based on important past theories, supplemented by a major review of the literature. We consider knowledge, beliefs, attitudes, emotions, skills, and habits. We also examine institutional trustworthiness, injunctive and descriptive norms, social support, financial incentives, monitors and reminders, legal and administrative sanctions, as well as policies designed to increase access to the resources needed to perform a behavior (e.g., health insurance for healthcare seeking). Next, as detailed in the coming sections, we evaluate correlations between each naturally occurring determinant (e.g., knowledge in a sample) and behavior, as well as experimental and quasi-experimental tests of the efficacy of behavioral interventions relying on each target of change (e.g., policies to increase access). We included any identified meta-analysis of behavior prediction or intervention efficacy, gathering diverse syntheses of health, educational, environmental, consumer, financial, and organizational, among others. We then visualize the range of associations and impact of interventions tapping, for example, emotions or beliefs on behavior²⁰, and summarize our results into a model of intervention efficacy for behavioral change. This summary is presented for all behaviors, to provide a picture of general principles that can inform intervention decisions for new or understudied behaviors. It is also presented

for health and environmental behaviors, as a way of illustrating findings while maintaining type of behavior constant.

In reviewing the intervention literature, we concentrate on what targets might be most effective, which is a first critical question to design an effective program to change behavior. For example, deciding whether to instill pro-vaccination norms, combat conspiracy theories about vaccination, or add vaccination sites, is essential to the public health management of a pandemic. However, once one decides on a target of change, implementing interventions brings up a different set of questions that are outside the scope of this review. Although we will briefly describe what interventions often do, readers should review the primary research literature to determine what the most successful interventions within a given target look like. After all, reviewing intervention manuals is critical to a faithful implementation of a program²¹⁻²³.

In the coming sections, we explain how we identified behavioral determinants and intervention targets through a combination of theories about behavioral prediction and change and our extensive literature review. We also discuss the rationale for capturing behavioral prediction and change broadly and how we summarized our review, including how we classified effects as negligible, small, medium, and large. We also discuss some of the caveats that must be considered when considering the evidence at hand. After that, we present and illustrate our review findings, present our summary empirical models, and discuss the findings and limitations of our review.

BEHAVIORAL DETERMINANTS AND TARGETS OF BEHAVIORAL CHANGE

Both understanding the causes of behavior and identifying targets for behavioral change

require defining a finite number of dimensions. Determinants were selected in a hybrid, top-down/bottom-up way by considering factors that have been shown to be promising within broad, multi-factorial theoretical models and literature reviews, as well as making adjustments as we reviewed the literature.

Individual factors have been at the center of behavioral prediction and change models such as the reasoned action approach^{24–31}, the information-motivation and behavioral-skills model^{15,24,25,32–37}, and social cognitive theory^{31,38–40}. These models collectively suggest considering knowledge, beliefs, general and behavioral attitudes, emotions, specific and general skills, and habits. Knowledge is a collection of facts about an object of behavior, typically held with certainty, even though they may be factually incorrect⁴⁰. Beliefs are probability judgments about an object, such as a virus, in connection with an attribute, such as being transmissible, or an outcome, such as leading to COVID-19 disease⁴⁰. Attitudes are evaluations, which pertain to objects (i.e., general attitudes), such as fruits and vegetables, or behaviors (i.e., behavioral attitudes), such as eating fruits and vegetables⁴¹. Emotions are visceral feelings, such as happiness or anger with an object or behavior⁴¹. Skills are routines, with general skills involving cognitive skills involved in self-control³⁸ and specific skills involving domain-specific cognitive or motor skills³⁸. Habits involving repeated, automated behaviors that continue even in the absence of rewards⁴².

Consider, for example, the role of knowledge and beliefs in the reasoned action approach²⁵ and the information, motivation, and behavioral-skills model^{30,33,38,43}. In the reasoned action approach, beliefs that performing a behavior will lead to various outcomes and the evaluations of those outcomes influence attitudes and then intentions to execute a behavior. In the information, motivation, and behavioral-skills model, attitudes and intentions are part of

motivation, whereas information entails knowledge about the behavior in question and behavioral skills encompass both routines that facilitate a behavior and the associated feelings of self-efficacy or perceived behavioral control. Emotions, habits, general attitudes, and general skills are part of the integrative model of behavioral prediction²⁵ and change and are connected to important empirical work on self-regulation²⁷. They are also incorporated as external variables within the reasoned action approach³⁵.

One problem with existing models of behavior-prediction and change is a relative neglect of **social and structural factors**^{4,44,45}. For example, even though the reasoned action approach posits that social norms influence intentions, intentions are still individual factors. Similarly, even though Bandura placed a premium on the impact of others as models of behavior, self-efficacy and personal agency prevail. Thus, our review contributes to our knowledge of behavioral change by integrating social and structural determinants and targets of change.

Like for individual determinants and targets, our approach to social and structural factors began by considering theory. First, we included Cialdini's⁴⁶ distinction between injunctive and descriptive norms and added social support due to a large literature on its impact on human behavior⁴⁷. Second, we considered Lowi's⁴⁸ theoretical distinction between regulatory and distributed policies, which led to adding legal and administrative sanctions as well as institutional trustworthiness⁴⁹. Third, we considered conceptualizations^{50,51} about interventions designed to increase the feasibility of a behavior by including access and defaults⁴ as well as monitors and reminders^{50,51}. Fourth, we considered material incentives due to the theoretical importance of structural factors that affect the motivation to perform a behavior^{52,53}.

In terms of definitions of social and structural factors, injunctive norms are defined as perceptions of the degree to which others support a person's behavior^{25,46}, whereas descriptive norms are defined as the frequency of a behavior in a particular population⁵⁴⁻⁵⁷. Social support is defined as informational, instrumental, or financial help to facilitate a particular behavior⁵⁸, and trustworthiness as justice or fairness within an organization or government entity, which increases trust and reduces vigilance⁵⁹⁻⁶¹. Legal and administrative sanctions are defined as legal and administrative instruments to prescribe, ban, or sanction a behavior. Monitors and reminders are defined as physical or digital instruments to track behavioral performance and alert users of the need to execute a behavior. Access is defined as material or logistic resources, and incentives as providing an added material benefit in the form of financial or non-financial rewards.

Following our definitions of determinants, each author verified that the ultimate groupings were meaningful, parsimonious, and relatively homogeneous. This assessment thus depended on the meta-analyses identified in our review and their fit within our classification of social-structural determinants. Determinants and targets of change were added, merged, or separated as the review progressed, and the ultimate distinctions we draw represent a unique conceptualization that represents the rich field of behavioral prediction and change. We believe this classification to be original in proposing a set of determinants and targets not previously articulated in this fashion. For example, this classification is more comprehensive and theory-based than classifications of nudges³ and considerably more parsimonious and theory-driven than classifications of techniques of behavioral change⁶².

Review Process

We proceeded by reviewing the behavior change literature broadly, beginning with determinants and targets of change highlighted by past theory. However, as explained presently, we also

searched for meta-analyses of the specific determinants and targets of change we defined. We then extracted effect sizes from each meta-analysis of behavioral prediction and intervention efficacy. We present these effect sizes in detail so that readers can parse the literature in alternative ways depending on their objectives.

Determinants and Targets of Change and Literature Search

The determinants and targets of change we review appear in Table 1. For each determinant/target, we restate the definition, present examples of measures, and include sample intervention strategies. Measures involve both self-report and records of structural factors (e.g., laws) and interventions vary by targets. For example, persuasive arguments designed to change beliefs about the outcomes of a behavior will discuss those outcomes, whereas normative interventions may describe societal approval of a behavior. Similarly, interventions targeting behavioral skills might provide opportunities to practice condom use with a physical model, whereas an incentive intervention might provide money if recipients remain sober for a period.

We approached our review by first conducting a multi-pronged literature search that included both broad and specific keywords to inspect records in Web of Science. We searched for “meta-analysis” and “behavior” combined with “knowledge or information or health education,” “belief,” “attitude,” “emotion or fear or anger or envy or guilt or happiness,” “behavioral skills,” “self-control,” “mindset,” “habit,” “acculturation or culture or cultural belief or religion or sexism,” “norm,” “policy,” “social support or social network,” and “environment.” We also repeated those searches with more specific keywords in popular areas, including “smoking,” “weight,” “physical activity,” “recycling or climate,” and “alcohol.” In addition, to cover research on behavioral change interventions more broadly, we also searched for “meta-analysis,” “behavioral change,” “intervention,” and “experiment or randomized

controlled trial.” These searches were supplemented with our preexisting knowledge of the literature and the top Google Scholar entries in more specific reviews of areas that seemed infrequently represented. For example, we searched for “trust” and “justice” on Google Scholar by combining those terms with “meta-analysis.”

We selected entries that included overt measures of behavior and reported comparable effect sizes for clearly identifiable measures and interventions. For comparability, effect sizes were obtained when analyses linked a *single* predictor or intervention strategy to a behavior, thus excluding effects obtained from analyses with multiple predictors (e.g., multiple meta-regression). For precision, we did not include effect sizes obtained for a combination of attitudes and beliefs as the predictor or a combination of intentions and behaviors as the outcome. Similarly, we excluded interventions that combined multiple components or whose strategies could not be clearly discerned. For example, we left out interventions described as “psychoeducation,” “cardiac rehabilitation,” “serious games,” “psychosocial intervention,” “brief intervention,” or “primary prevention.” We arrived at 145 research papers that comprise the main body of our review and report all relevant effect sizes within a particular review. For example, if a behavioral paper was identified when searching for “norms,” but effects sizes were also reported for “attitudes,” both effects are reported. Finally, we classify effects as negligible, small, medium, or large²⁰ and retain the reported effect size as well as all effects expressed as *ORs* (Odds Ratios). The *ORs* are calculated to indicate a positive relation between the factor and positive behavior or a positive effect of an intervention on positive behavior. For example, effect sizes originally reported as reductions of risk (e.g., less energy use) were reverse scored to reflect improvement in positive behavior (e.g., increase in energy conservation). When effect sizes were

not reported as *OR*, transformations were based on the formulas provided by Borenstein, Hedges, Higgins, and Rothstein⁶³.

Despite our attempts to include effect sizes based on clearly classifiable determinants, targets of change, and behavioral outcomes, some caveats are in order. Interventions designed to change a particular target are assumed to change that specific target¹⁵. However, any program to change behavior may exert an array of effects. For example, an intervention that communicates that one's neighbors use less energy is likely to influence not only descriptive norms but also positive attitudes toward conserving energy (i.e., behavioral attitudes)⁶⁴. Thus, even though those targets of change are clearly promising from an efficacy perspective, verifying all possible mechanisms of the effects was outside the scope of our review.

Furthermore, correlational designs present even further potential for confounds. For example, a correlation between norms and behavior may capture variance in attitudes as well. The validity of the correlational data is further threatened by incidental associations with demographic factors, which are absent in properly executed experimental or quasi-experimental designs. Correlational data also involve measures that are perceptual. For example, even though researchers may go through great lengths to measure social support as objectively as possible, self-report measures are, by definition, subjective. Therefore, even though neither experimental nor correlational designs are immune to validity threats, in this review, we weigh the results from the intervention meta-analyses more heavily.

Presentation and meaning of effect sizes. To facilitate comparisons while acknowledging heterogeneity, we provide average effect sizes as well as their ranges. Following Cohen's effect size classification⁶⁵, *ds* smaller than 0.2 are negligible, those equal to or larger than 0.2 and smaller than 0.5 are small, those equal to or larger than 0.5 but smaller than 0.8 are

medium, and those equal to or larger than 0.80 are large. Correspondingly, *r*s smaller than .1 are negligible, those equal to or larger than .1 but smaller than .24 are small, those equal to or larger than .24 but smaller than .37 are medium, and those equal to or larger than .37 are large. With our conversion⁶³, *OR*s smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those equal to or larger than 4.27 are large.

In comparing effect sizes, however, readers should keep in mind their meaning and interpretational limitations. For example, in a correlational study, a *OR* = 2 between knowledge and behavior implies that for each increasing unit in the measure of knowledge, the probability of behavior doubles. However, correlational studies do not inform the degree to which changing knowledge will produce a change in behavior. Similarly, in an intervention context, a *OR* = 2 implies that exposure to a knowledge-based intervention has twice the probability of executing the behavior relative to the control group. However, in both cases, the ultimate meaning of the effect size depends on the baseline probability of executing the behavior. An *OR* of 2 implies much greater savings in energy if 30% of the control group saves energy than if only 3% of the control does so.

Considering publication bias and behavioral diversity. In this review, we summarize associations with behavior and intervention efficacy estimates by taking a simple average of effects for each determinant and target of change. However, we recognize that meta-analyses are not without limitations⁶³. Any research synthesis is as good as the primary research that goes into it^{63,66}. For example, conflict of interest can bias the conclusions from research syntheses as much as it biases primary studies⁸, and inadequate methodological designs limit the conclusion of any research. In addition, meta-analyses are uniquely threatened by publication or inclusion

bias, which occurs when the sample of studies overrepresents positive results. This type of bias can be detected with display and inferential methods that analyze the relation between sample sizes and effect sizes. When a sample of effect sizes has excluded studies with negative or null results, it is often missing large negative effects with small sample sizes. Numerous methods of detection of inclusion bias exist in the literature⁶⁷⁻⁷⁵ and most journals require an assessment of this threat to the statistical validity of a synthesis. Therefore, in this review, we considered our conclusions based on the subsample of meta-analyses for which extreme publication bias had been ruled out. Readers, however, have access to all the data should they want to consider other meta-analyses as well.

Another important consideration is that behavior and intervention effects both vary due to factors we do not consider in this review. For example, many of the meta-analyses we review considered moderators that affected the results of studies in the area of concern. However, for the sake of space and given our research questions, we focus our analyses on variability by predictor or intervention target. The moderators typically examined are specific to the behaviors of interest and are described within the reviewed meta-analyses we review, which interested readers can consult.

A final note is that we begin with an integration of the evidence across all behaviors synthesized in the meta-analyses we gathered. However, researchers should be aware that some behaviors, as are populations and contexts, may be unique. Therefore, although we also illustrate our conclusions by separating interventions to change health and environmental behaviors, no review or meta-analysis can predict the result of an intervention across all contexts.

Overview. In the coming sections, we illustrate research findings from our correlational and intervention meta-analyses samples. As explained previously, Table 1 presents each behavioral determinant and target of change in the review, as well as definitions and illustrations. Tables 2-4 present all the effect sizes we obtained. Tables 2-4 present a description of the domain of the study and the behavior and the determinant or target, as well as the original effect sizes as well as comparable *ORs*. They also indicate if extreme publication bias was ruled out by performing some type of bias analysis in which no extreme bias was detected. When publication bias was not assessed, we indicate that information as not available and the effect sizes are not considered in the final integration of the review.

We discuss individual factors before social and structural ones and organize them in order of increasing efficacy as targets of change, which appears in Figure 1. Following this presentation, we summarize the findings from our review by creating a model that contains individual and social structural strategies as the horizontal axis, orders targets based on their efficacy, and groups them into negligible, small, medium, and large effect sizes. This model, presented for all behaviors, health behaviors, and environmental behaviors, is an intuitive, graphic display of the efficacy of different targets of behavioral change. We discuss these following the presentation of the effect sizes in Tables 2-4.

INDIVIDUAL DETERMINANTS AND INTERVENTIONS

Individual determinants of behavior, which include knowledge, beliefs, attitudes, emotions, skills, and habits (see Table 1 for measures and interventions) are assessed through correlational designs that measure a determinant along with the behavior in question (see Table 2). Behavior intervention programs based on these determinants (see Table 2) are typically tested using randomized controlled trials and quasi-experimental designs, although some have only

been investigated in the laboratory. They include communications⁷⁶, community programs, one-on-one counseling⁷⁶⁻⁷⁸, and behavioral training tasks done in the lab or the field⁷⁹.

Knowledge

Knowledge is a collection of facts about an object of behavior, which can include information about risk and consequences of a particular object or event, such as a virus or pollution. Knowledge links an object or behavior to an attribute or event with absolute certainty and is often formally imparted through educational efforts. For example, knowledge that a COVID-19 vaccine exists, or that human activity contributes to climate change is common to many individuals and endorsed by governments. Interventions in this area involve health education and other didactic interventions intended to reduce a knowledge deficit (see Table 1). The associations between knowledge and behavior have often been studied under the umbrella of “literacy,” which involves a body of facts and mental models in a particular domain (see Tables 1 and 2). For example, financial literacy, which is defined as a person’s financial knowledge^{80,81}, has been shown to correlate with desirable financial behaviors at $r = .29$ ⁸¹. However, the association between financial literacy and behavior is extremely small ($r = .09$) when the behavior is measured after time has elapsed after obtaining the measure of literacy.

Other domains with extensive research on the relation between literacy and behavior are health and the environment. Oral health literacy, for example, is associated $OR = 1.25$ with visiting the dentist⁸², and HIV knowledge correlates $r = .06$ with actual condom use⁸³, both negligible effects. Recycling literacy is associated $r = .20$ with recycling⁸⁴, and climate-change knowledge is associated $r = .14$ with climate-change-adaptation behaviors such as supporting environmentally friendly policies or relocating in response to climate change⁸⁵. One potential

explanation for the lack of a sizable correlation between knowledge and behavior is that the knowledge is only tenuously related to the behaviors being studied. For example, knowledge related to alcohol and its effects may be inconsequential if drinking is related to normative or other beliefs²⁵. The summary association for knowledge and behavior is $OR = 2.12$, which represents a small effect size.

Interventions in this area involve health education and other didactic approaches intended to reduce a knowledge deficit (see Table 1). Educational approaches introduce systematic instruction to either individuals or groups with the purpose of changing behavior by increasing knowledge about an issue. Looking at meta-analyses of behavioral effects within specific domains (see Table 3), educational approaches to climate change have an effect $d = .09^2$. Similarly, a meta-analysis of vaccination interventions showed that neither providing information in general nor attempting to correct misinformation increases vaccination uptake ($ORs = 1.19$ and 0.96)⁸⁶. The summary efficacy for knowledge interventions and behavior is $OR = 1.16$, which represents a negligible effect size.

An interesting observation concerns some differences between the correlational and intervention evidence in Figure 1. Although the differences are not dramatic, some of the effect sizes derived from the correlational evidence are larger than the largest effects obtained from intervention studies. Thus, the use of correlational evidence to make intervention inferences is likely to lead to the selection of ineffective programs. Even more critical is the fact that, as shown in the figure, the efficacy of knowledge as a target of change is negligible. From this standpoint, building a campaign or programs to increase knowledge is likely to leave policy makers and constituents disappointed.

General Attitudes

Attitudes, which, as mentioned, consist of evaluations of an object or behavior along a positive-negative dimension, have been another longstanding focus for behavioral scientists. One major research tradition considers whether general attitudes toward objects (e.g., attitudes toward recycling) predict behavior (e.g., actual recycling). An early narrative review found that, of 54 studies of the relation between general attitudes and behavior, 25 showed null results and those that showed significant results rarely exceeded an effect size of $r = .40$ ⁸⁷. More recently, several meta-analyses have estimated the strength of the association between general attitudes and behavior, with some suggesting that this relation is quite modest ($d = 0.22$ ⁸⁸ and $r = .14$ ⁸⁹) and others suggesting that the relation is much stronger ($r = .39$)⁹⁰.

An interesting wrinkle in the study of general attitudes entails the distinction between explicitly-measured attitudes (henceforth *explicit attitudes*), which are measured by directly asking participants to report their attitudes, and implicitly-measured attitudes (henceforth *implicit attitudes*), which represent relatively automatic evaluative responses and are gauged from participants' judgments or responses to a task⁹¹⁻⁹⁴. For example, the implicit association test is a task that measures implicit attitudes by comparing the time required to pair an object with the concept *good* with the time required to pair an object with the concept *bad*⁹⁵⁻⁹⁷. In the area of substance use, implicit attitudes toward legal and illegal psychoactive substances correlate $r = .27$ with substance use^{95,98}. However, all in all, the relations between general attitudes and specific behaviors are $OR = 2.58$ (see Figure 1), which is a medium effect size.

The volume of meta-analytic evidence regarding the impact of behavioral-change interventions targeting changes in general attitudes is modest relative to the correlational evidence linking general attitudes to behavior. For example, a meta-analysis of mass-media health-promotion campaigns revealed a small effect on behavior change ($r = .05$)⁹⁹. Additional

evidence about the impact of interventions to change general attitudes comes from the area of implicit bias. A meta-analysis of implicit attitude change techniques found that although a variety of techniques were able to shift implicit attitudes, these trainings had little effect on behavior. For example, interventions that aimed at weakening associations had a minimal influence on behavior ($g = -0.11$)¹⁰⁰. (See Forscher, Lai, et al.'s synthesis)¹⁰⁰ for additional behavioral change methods that do not rely on weakening associations, such as instilling goals and threats.)

Whereas the summary association between general attitudes and specific behaviors is $OR = 2.58$, the effect size corresponding to intervention efficacy is $OR = 1.32$, which is negligible. Clearly, people report general attitudes that correlate with their behaviors even though attempts at changing these attitudes have a much lower efficacy potential than the correlational evidence might suggest. It may be that people rationalize their behavior when they report general attitudes and values, as cognitive dissonance and self-perception research would suggest¹⁰¹⁻¹⁰³. Be that as it may, general attitudes are relatively inconsequential targets of change.

Beliefs

Like knowledge, specific beliefs about an object or behavior have positive relations to behavioral performance (see Table 2). In the area of recycling, a meta-analysis of the determinants of recycling showed that expectations of positive feelings if one recycles or negative feelings if one does not recycle correlate $r = .26$ with actual recycling⁸⁴ (Note that expectations of feelings are beliefs in the probability of experiencing particular emotions and not emotions.) In the domain of condom use, associations between specific beliefs about condoms and condom use are also small. For example, condom use correlates $r = .14$ with the perceived attractiveness of condoms, $r = .10$ with the belief that condom use protects people from HIV infection, and $r = -.05$ with the belief that purchasing condoms is embarrassing⁸³.

Another area in which specific beliefs have been investigated is conspiracy theories. Endorsing COVID-19 conspiracy theories would appear quite consequential, but the effects are not unlike those of knowledge and other beliefs (see Table 2). In fact, a meta-analysis of crossed-lagged correlations from 17 samples estimated the impact of conspiracy beliefs on risky COVID-19-related behavior at $\beta = 0.09^{104}$ with a reciprocal effect from behavior to beliefs of similar magnitude. Thus, even these dramatic beliefs appear to exert small effects on behavior.

Other commonly studied beliefs are cultural. These beliefs entail judgments that govern the behavior and way of life of a group, including interactions among them and with other groups^{105,106}. They include those surrounding religiosity, spirituality, fashion, food consumption, interpersonal relationships, and the relative standing of different social groups, among others. Some studies have found that cultural beliefs can act as barriers to action when the recommended behavior is incongruent with cultural beliefs. For instance, cultural beliefs can constitute roadblocks to participation in community-based health insurance when a culture views preparation for illness as a magnet for illness itself¹⁰⁷. Along the same lines, cultural beliefs about food consumption, which designate what foods are healthy or unhealthy, can act as a barrier to the management of diabetes when they conflict with recommendations provided by healthcare professionals¹⁰⁸.

Importantly, quantitative reviews have estimated the relation between different kinds of cultural beliefs and behavior. For instance, hostile sexism (i.e., a collection of negative beliefs about the role of women in society and their relation to men) correlates with male-to-female violence (r to $z = .26$), while benevolent sexism (i.e., a collection of beliefs that women have positive qualities but need to be protected) has a weaker relation with it (r to $z = .05$)¹⁰⁹. In the area of religious beliefs, greater religiosity correlates with lower engagement in criminal

behavior ($r = -.12$)¹¹⁰, whereas a combination of religiosity and spirituality correlates with less physical aggression ($r = -.12$) and less sexual aggression and domestic violence ($r = -.05$), albeit weakly¹¹¹. More generally, greater religious involvement has been found to predict less engagement in destructive behavior ($z = -.17$) and more engagement in constructive behavior ($Z = .20$)¹¹², although some Christian groups are philosophically opposed to what they consider unnecessary medical intervention, resulting in disparities in vaccination coverage across religions¹¹³.

Cultural beliefs have important implications for many behaviors^{114–117}. For example, in the US, Hispanics have the lowest rates of smoking among all racial and ethnic groups¹¹⁸. In this case, acculturation, defined as the degree to which minority individuals retain their native cultural language and values relative to those of the new, dominant culture¹¹⁹, likely contributes to lower smoking rates for Hispanics in the US¹²⁰. Furthermore, the prevalence of risky behaviors, including smoking, obesity, and unhealthy eating and drinking habits is higher among second generation Americans born in the US than immigrants born in other countries ($r = .01$ to $.28$). Apparently, individuals born in other countries, such as Mexico and China, have closer ties to their traditional cultures, which in turn promote healthier lifestyle choices¹²¹. Thus, the “immigrant paradox” characterizes the situation of immigrants who practiced healthy dietary behaviors in their home countries but abandon them as they acculturate to their new residence¹¹⁶.

When existing interventions fail to attract racial and ethnic minority groups, “culturally tailored” programs can be implemented by modifying content, language, mode of delivery, or other intervention components. Culturally tailored interventions are strategies that are included to reflect the cultural needs of the target population and can be developed in a top-down or bottom-up way. While the top-down approach entails adapting an existing intervention for a

subpopulation or different target population, the bottom-up one develops a new program by considering the cultural context based on the group's concerns¹²².

Whether culturally tailored interventions are more efficacious than others has been examined in some meta-analyses. However, their impact on health behaviors is variable ($g = 0.1$ to 0.20)¹²³. For example, interventions designed to address hypermasculinity (i.e., *machismo*) beliefs among Hispanic adolescents are successful at reducing the likelihood of engaging in HIV risk behavior by 32 percent relative to participants in the control groups¹²⁴.

Interventions to change specific beliefs have also been shown to have small effects on behavior. For example, confidence in one's ability to grow in a particular domain, known as a "growth mindset," has been associated with improved performance in academic settings¹²⁵⁻¹²⁷. Accordingly, interventions have been developed to change mindsets in the hope of also improving academic performance. In a meta-analysis of these interventions, experiments that had successfully altered the mindset had a $d = 0.04$ effect on behavior, and considering all experiments, the effect on behavior was $d = 0.05$ ⁸.

Importantly, the summary association between beliefs and behavior is $OR = 1.88$, which constitutes a small effect (see Figure 1). The summary effect of belief-based interventions is $OR = 1.38$, which constitutes a negligible effect (see Figure 1). As with knowledge, the effect sizes derived from the correlational evidence are larger than the largest effects obtained from intervention studies. In the end, however, the effects of belief-based interventions are clearly underwhelming.

Emotions

Emotions are visceral feelings associated with a particular object, such as happiness or sadness that one links to an object, person, or event (see Table 1). Experiencing fear of climate

change or disgust about a particular group of individuals is an example of emotion. Fear appeals and other emotional appeals are commonly used to sensitize audiences to their risks and include discussion of the threat posed by a problem or the audience's susceptibility to it¹²⁸. As emotions represent a fundamental topic of study for those wishing to understand the mind, they feature prominently in certain models that emphasize risk perceptions (e.g., the Health Belief Model^{129–131}). Negative emotions about COVID-19 (see Table 2), however, have small correlations with COVID-19 protective behaviors ($r = .24$ for fear and $r = .12$ for anxiety¹³²). Similarly, the association between perceived climate-change risk and past adaptation behavior is only $r = .10$ ⁸⁵, and the association between perceived HIV risk and condom use is only $r = .06$ ⁸³. Moreover, when other forms of perceived threat are measured, the results tend to be similar (see Table 2). For example, in the domain of condom use, the associations between worry or concern and perceived HIV severity are $r = .09$ and $r = .02$, respectively⁸³.

In a sense, all emotions are social because they can be triggered by the presence or actions of others, act as signals to others, and serve as inputs to social behavior¹³³. For instance, visiting a friend can trigger happiness, expressions of sadness can let a partner know that they have hurt us, and fear can make us evade a menacing person on the street. However, the emotions of pride, gratitude, guilt, anger, and envy serve primarily social functions and involve reactions to how the self is perceived by others^{133,134}. As such, these are referred to as *social emotions*^{133,134}.

Social emotions have garnered attention from behavioral scientists in many subdisciplines studying interpersonal behaviors. For example, people's tendency to experience anger while driving predicts speeding behavior modestly ($r = .12$)¹³⁵ and a composite of high-risk driving behaviors more strongly ($r = .39$)¹³⁶. As other examples, envy has a weak negative

relation with positive workplace behaviors such as help-seeking (r 's ranging from $-.21$ to $.05$; median $r = -.03$) and a stronger relation with negative workplace behaviors such as incivility (r 's ranging from $.27$ to $.33$; median $r = .29$)¹³⁷. Likewise, guilt predicts greater engagement in pro-environmental behaviors ($r = .30$)¹³⁸; gratitude predicts prosocial behavior ($r = .26$)¹³⁹; and even though social emotions do not consistently predict purchasing ($r_{\text{gratitude}} = .50$; $r_{\text{pride}} = .07$; $r_{\text{guilt}} = -.01$; $r_{\text{anger}} = -.19$), they have moderate to strong correlations with sharing behavior ($r_{\text{gratitude}} = .74$; $r_{\text{pride}} = .32$; $r_{\text{guilt}} = .54$; $r_{\text{anger}} = -.38$)¹⁴⁰. Notably, however, the strong associations with sharing behavior may partly be a function of the lower cost of this behavior as the source meta-analysis operationalized it as complaining and word-of-mouth, which stands in contrast to the higher cost purchasing behavior. Moreover, the affective experience of interpersonal attraction has been shown to correlate with a behavioral composite of amount of talking, head nodding, and sitting distance, among others ($r = .20$)¹⁴¹; and emotional prejudice predicts discriminatory behavior ($r_{\text{median}} = .35$) more strongly than do stereotypes and other beliefs¹⁴². As shown in Table 4, social emotions can achieve moderate associations with behavior, particularly generosity in interpersonal situations. In fact, the summary association is $OR = 4.78$, which is a large outlier.

At the most general level, a sweeping analysis of the emotion literature found that the induction of emotions influences behavior ($g = .31$)¹⁴³. However, negative emotions have been found to have no overall effect on food consumption ($g = .02$), although positive ones do increase food intake ($g = .24$)¹⁴⁴. Likewise, communicating to induce fear has typically modest effects (see Table 3). For example, communicating the level of genetic cardiometabolic risk to patients has no effect on dietary changes or weight loss whatsoever¹⁴⁵. Moreover, although typically the effect of fear appeals on behavior is positive¹²⁸, presenting risk information can sometimes backfire. For example, in Albarracin et al.'s¹⁵ meta-analysis of interventions to

increase condom use, arguments to increase risk had a negative impact on condom use ($\Delta = -0.21$)¹⁵. However, in Peters et al.'s¹⁴⁶ (but see¹⁴⁷) critical reanalysis of the literature and in a comprehensive meta-analysis of fear-appeals experiments¹²⁸, the effects of risk information and fear were respectively $d = 0.20$ and 0.14 . Furthermore, inductions of both anticipatory emotions (e.g., fear, worry; $d = .21$) and anticipated emotions (e.g., regret, guilt, shame; $d = .30$) produce positive changes in the enactment of behavior¹⁴⁸.

Many interventions have targeted social emotions to bring about behavioral change.¹⁶⁸ In the positive psychology literature, gratitude interventions have also proven popular. Interestingly, however, meta-analyses have found very modest effects of gratitude interventions on exercise ($d = 0.10$) and pro-social behavior ($d = 0$ and $d = 0.12$)¹³⁹, but a stronger effect on behaviors that express gratitude (e.g., writing a thank-you note; $d = 0.40$)¹⁴⁹. The summary intervention effect, however, is $OR = 1.49$, which is small.

As with attitudes, emotions appear to have stronger effect sizes in correlational than intervention studies. The available evidence suggests that emotions have large relations with behavior ($OR = 4.78$, see Figure 1) but concluding that they might be a desirable avenue for intervention could lead to underwhelming results. In fact, the efficacy of emotion-based interventions is small ($OR = 1.49$, see Figure 1).

Behavioral Attitudes

Behavioral attitudes are evaluations of behavior as good or bad (see Table 1). For example, whereas an attitude toward cars is general, an attitude toward driving a car for transportation is behavioral. This type of attitude is often referred to as “attitude toward a behavior”^{25,87,150–153}. Studies of attitudinal determinants also involve analyses of associations with behavioral attitudes, as well as indirect measures of behavioral attitudes, which are sets of

beliefs about behavioral outcomes weighted by the evaluations of those outcomes^{25,154,155} (see Table 1). A general meta-analysis of newly formed attitudes estimated the link between attitudes toward behaviors and actual behavior at $r = .58$ ¹⁵⁶. These findings have been supported by meta-analyses in other domains as well. For instance, attitudes toward sun-protection behavior correlate $r = .31$ with sun protection¹⁵⁷; attitudes toward exercise $r = .37$ with exercise¹⁵⁸; attitudes toward car use $r = .41$ with car use¹⁵⁹; attitudes toward consuming organic vegetables $r = .44$ with actual consumption of organic vegetables¹⁶⁰; and attitudes toward condom use $r = .38$ with condom use¹⁵⁵. Similarly, attitudes measured with beliefs about the outcomes of condom use weighted by their evaluations (i.e., indirect attitude measures) have been shown to correlate $r = .31$ with condom use¹⁵⁵. Thus, behavioral attitudes and clusters of behavioral beliefs weighted by evaluations are generally better predictors of behavior than general attitudes, knowledge, and specific beliefs (see Table 2). In fact, as shown in Figure 1, the summary effect size for this association is $OR = 3.91$, which is medium in size.

Media messages or in-person discussions of the benefits of changing a behavior are good examples of interventions targeting behavioral attitudes^{161,162}, as is motivational interviewing designed to reduce attitudinal ambivalence toward a particular behavior^{163,164}. However, interventions to change attitudes toward behaviors are generally comprehensive, including other strategies such as targeting norms and perceived behavioral control^{125,165}. As a result, many of those interventions provide little information on the impact of targeting behavioral attitudes. Laboratory experiments designed to impact behavioral attitudes as a way of influencing behavior have shown larger effects on behaviors ($ds = 1.10$ and 0.79)¹⁶⁶, but the effects of actual interventions are more modest (see Table 2). As shown in Figure 1, the summary effect for behavioral attitude intervention is $OR = 1.69$, which is small.

Much as we observed with general attitudes, even though effect sizes from correlational studies and effect sizes from intervention studies are not perfectly comparable, the differences between correlational and intervention studies are considerable^{101–103}. In particular, the behaviors with the strongest associations within correlational studies are measured in the lab¹⁵⁶ and entail behaviors that exist only in those contexts. These involve voting in support for a fictitious policy as part of the experiment and may lead to decisions that could only be based on the information the experimenter provided. As such, these experiments are poor representatives of the more complex decisions people make when attitudes coexist with other factors and these considerations carry the day.

General Skills

Individuals develop general skills, defined as cognitive or overt routines that allow individuals to carry out a variety of specific behaviors (see Table 1). They involve broad capacities such as controlling attention during tasks and being able to inhibit temptations when behaviors require high levels of self-control.

Broad behavioral and cognitive skills are often small predictors of behavior. In the area of social development, prosocial skills are not significantly correlated with obtaining employment during adolescence (overall OR: 1.03)¹⁶⁷. In the area of eating behavior, executive functioning skills, which comprise abilities of inhibitory control and cognitive flexibility, correlate only $r = -0.14$ with disinhibited eating¹⁶⁸. All in all, general skills have small associations with behavior (see Table 2). In fact, as shown in Figure 1, the summary association is $OR = 1.81$, which is small.

Many behavioral change programs have emphasized the need to train general skills that might aid individuals in controlling undesirable behaviors¹⁶⁸. However, the efficacy of training

global skills (see Table 3) such as executive functioning seems to be overall limited ($d = 0.30$) compared to training specific skills¹⁶⁹. Other interventions are based on mindfulness principles, with the rationale that mindfulness can reduce aggression and other impulsive behaviors. Accordingly, a meta-analysis of mindfulness interventions for children and adolescents has shown a $d = 0.21$ on reduction of negative behaviors¹⁷⁰. In fact, the summary intervention efficacy effect is $OR = 1.56$, which is small.

Specific Behavioral Skills

Behavioral skills are routines that allow people to execute a behavior^{30,153,171} (see Table 1). Behavioral skills include resource and help seeking or negotiating a particular behavior in the presence of opposition or competition within one's environment.^{13,75,77} The roots of studying behavioral skills can be traced to behaviorism¹⁷² as a way of understanding behavioral execution. Evidence abounds that specific behavioral skills are strongly correlated with actual behavior. For example, mothers who engage in conversations about birth control methods with their daughters are 5.69 more likely to have their daughters vaccinate against HPV (Human Papilloma Virus) than mothers who lack such communication skills¹⁷³. In addition, specific behavioral skills are often reflected in people's sense of the controllability of a particular behavior or *perceived behavioral control*^{29,165}. According to a meta-analysis conducted by Geiger and colleagues⁸⁴, perceived behavioral control is associated $r = .39$ with actual recycling; and according to a meta-analysis conducted by Plata et al.¹⁷⁴, confidence that one can refuse alcohol (i.e., refusal self-efficacy) is associated $r = -.35$ with frequency of drinking, $r = -.29$ with quantity of alcohol consumed, and $r = -.32$ with binge drinking. All in all, specific behavioral skills and perceived control are clearly associated with behavior (see Table 2 and Figure 1). In fact, the summary effect size is $OR = 3.31$, which is medium in size.

Behavioral skills interventions (see Table 1) involve receiving arguments about the execution of a set of skills, as well as observing a role model execute a behavior, practicing and receiving feedback on the behavior, and performing homework^{33,175}. Verbal arguments may instruct individuals to secure resources for and overcome obstacles to wearing a condom during sex¹⁶² and more practical behavioral-skill-training interventions can role-play the application of condoms. Teenagers may practice refusing invitations to smoke cigarettes or drink alcohol¹⁷⁶⁻¹⁷⁸, and adults may be taught to avoid drinking before or during sex or to monitor their emotional states and thus avoid risky sexual situations^{33,171}.

Our review of meta-analyses of this type of intervention (see Table 3) has shown that training behavioral skills provides considerable benefits for behavioral change. Communication-skills training effectively increases both safer sex discussions with partners ($d = 0.35$) and condom use ($d = 0.39$)¹⁷⁹. Organizational training across a variety of skills such as interpersonal communication also produces sizable improvements in work behavior ($d = 0.62$), particularly for programmed instruction ($d = 0.94$), which is given in small, specific steps requiring a correct response before the learner moves to the next step¹⁸⁰. The summary effect size for intervention efficacy is $OR = 2.36$, which is small. Behavioral skills are, however, among the more promising targets to achieve behavioral change.

Habits

Past behavior is an important precursor of future behavior. For example, past condom use correlates $r = .36$ with current condom use⁸³; past recycling correlates $r = .41$ with future recycling⁸⁴; and past recycling correlates $r = .48$ with seeing oneself as a person who recycles⁸⁴. Now, although habit has been equated with past behavior in many analyses, contemporary theories of habit define habits as repeated behaviors that exhibit automaticity, occur without

awareness, and are difficult to stop even when they no longer provide benefits to the individual^{181–184,197–199} (see Table 1). A meta-analysis of associations between health-provider habits, such as handwashing, measured with habit scales tapping automation, showed a correlation $r = .33$ with the execution of those behaviors¹⁸⁵, and a meta-analysis of the association between car habits and car use revealed a correlation of $r = .50$ ¹⁸⁶. In sum, habits have sizable associations with behaviors (see Table 4), making habituation a promising avenue for behavioral change. In fact, the summary *OR* is 12.37, which is a large effect (see Figure 1).

Habit-promoting interventions involve the use of implementation intentions^{187,188}, training to stop in the face of temptations^{189,190}, introducing environmental regularity to promote habit formation¹⁸³, and distracting oneself from behavioral cues¹⁹¹. For example, lab cognitive training to inhibit approach to food cues, promote distraction, reappraise food cravings, and use other cognitive control techniques has shown a $g = 0.27$ effect on food intake, with reappraisal ($g = 0.45$), attentional bias modification ($g = 0.44$), and distraction ($g = -.31$) having the strongest effects¹⁹¹. Similarly, interventions have been conducted to improve eating behavior through stop signal training and attentional bias modification. A meta-analysis of these techniques to reduce food intake showed a $d = -0.39$ for stop-signal training; and a $d = -0.51$ for attention biased modification¹⁹². Habit reversal training for tic reduction has also garnered attention. In this treatment, patients are trained to identify occurrences of the tic and the events that trigger it and implement a competing, incompatible response. For example, if stress or hunger increases tics, activation of antagonist muscles when a tic is expected can eliminate the tic¹⁹⁰ ($d = 0.94$)¹⁸⁹. Apparently, the treatment changes motor associations with external stimuli and thus reduces behaviors that are executed despite undesirable consequences for the individual. The summary efficacy is $OR = 2.67$, which is a medium effect (see Figure 1).

As is the case with many of the individual factors we considered, the effects obtained from correlational studies are markedly stronger than the corresponding effects from intervention studies (see Figure 1). Also, interventions to curb habits are impressive because they are fighting chronic tendencies that have been automated and are difficult to eliminate. Interventions to train habits are clearly promising and, among all individual targets, demonstrate the strongest impact on behavioral change. In fact, habits are the only individual intervention target that achieved a medium effect size (see Figure 1).

SOCIAL AND STRUCTURAL DETERMINANTS AND INTERVENTIONS

Social and structural determinants of behavior, which include trustworthiness, norms, social support, access, legal and administrative sanctions, incentives, and monitors and reminders, are first assessed through correlational designs that measure a determinant along with the behavior in question. A summary of the correlational findings we review appears in Table 4, although we identified no meta-analyses of correlations between behavior and either legal and administrative sanctions or monitors and reminders. Although these determinants reflect social and environmental conditions, the measures of determinants often rely on self-report. For example, descriptive norms tap how much others perform a behavior, but measures in correlational studies reflect a respondent's perception of what others do (see Table 1).

Behavioral intervention programs targeting these determinants (see Table 5) are typically tested using randomized controlled trials and quasi-experimental designs, although some have only been investigated in the laboratory. Many of these factors comprise government and other administrative actions, which are not present in interventions targeting individual factors. However, other programs, such as those targeting trustworthiness and descriptive norms, are modified through communications¹⁹³, community programs¹⁹⁴, and one-on-one interventions¹⁹⁵.

Legal and administrative sanctions

Laws and other regulations are attempts to ban negative behavior and link it to sanctions (e.g., restricting one's ability to work or travel when one chooses not to vaccinate)¹⁹⁶. Criticisms of these policies include their potential for psychological reactance, a negative emotional response caused by threats to or actual losses of freedom^{197,198}. Specifically, people generally believe that they possess a certain level of freedom and wish to have control over their actions. When they encounter events restricting their perceived freedom, they might become motivated to restore it by acting against the threatening events. Accordingly, although deterrence theory has remained a cornerstone of criminal justice policy, deterrence-based initiatives have weak effects ($r = 0.22$ to 0.33)¹⁹⁹. However, mandates sometimes can work, as shown by COVID-19 vaccination efforts in many places^{200–202}. Collectively, these studies show an efficacy $OR = 1.24$ (see Figure 1), which is negligible. Legal and administrative sanctions may provide constituents a basic knowledge of the rules of their social world but do not appear to guide their behavior.

Injunctive Norms

As mentioned, several health behavior theories (e.g., the theories of reasoned action and planned behavior^{25,203}, as well as the theory of normative focus^{46,204}) converge on the hypothesis that social norms influence behavior. Injunctive norms (see Table 1) are perceptions of the degree to which others support one's behavior^{25,46}. These perceptions in turn correlate with blood donation behavior at $r = .17$ ²⁰⁵, recycling at $r = .21$ ²⁰⁶, adolescent sexual behavior at $r = .22$ ¹⁴ and the various behaviors in Table 4. The summary effect for these associations is $OR = 2.47$, which is small (see Figure 1).

Over the past decades, social normative interventions, such as messages that communicate that others approve specific behaviors (see Table 1), have been used to change

environmental behaviors, violence and harassment, health, and other risky behaviors by making people feel that others approve of the course of action recommended in the intervention. The impact of these interventions has been synthesized in a meta-analysis of behaviors across numerous domains, revealing a $d = 0.34$ effect on behavior²⁰⁷. The impact of injunctive norm interventions has also been synthesized in the domain of environmental behavior, where the effect is $d = 0.10$ ²⁰⁸. Of note, these interventions can have effects because people are unaware of the true injunctive norms²⁰⁹. For example, if most students drink heavily because they assume their peers approve of drinking, reporting disapproving injunctive norms can curb drinking²¹⁰. All in all, however, the summary *OR* for intervention efficacy is 1.53, which constitutes a small effect (see Figure 1).

Monitors and Reminders

Tracking sheets and paper planners have often been replaced by electronic devices and smart phones but continue to have a special place among behavioral change interventions. Monitors and reminders have the potential to delegate these functions to the environment and consequently decrease self-control failures²¹¹. Manual reminders can assist with a variety of health screenings, including for breast and cervical cancer ($OR = 1.63$ and 1.10)²¹². They also facilitate colorectal cancer screening ($OR = 1.85$)²¹² but fail to influence preventive care more generally ($OR = 0.99$)²¹² and have negligible effects on vaccination ($OR = 1.11$)⁸⁶. Often, the use of both manual and computer reminders is most effective, as shown by $OR = 2.57$ and 2.23 for colorectal cancer screening and all preventive care. As shown in Figure 1, monitors and reminders have an efficacy *OR* of 1.91, which constitutes a small effect. Thus, they might be a useful intervention strategy, particularly in combination with other targets.

Trustworthiness

Trust is a combination of attitudes, affective reactions, and beliefs about others (e.g., healthcare providers or politicians) that reduces interpersonal vigilance and increases vulnerability⁵⁹⁻⁶¹. Thus, increasing the trustworthiness of institutions is a critical consideration when analyzing social and structural determinants of behavior, as well as interventions to change behavior (see Table 1). For instance, the trustworthiness of an individual delivering a message has been found to influence its persuasiveness²¹³⁻²¹⁹. When it comes to predicting behavior, trust has been frequently studied in the context of cooperation games, where trust in one's partner in a game does so strongly ($r = .58$)²²⁰. Trust has also been examined in organizational research, where intrateam trust predicts better team performance ($r = .30$)²²¹, and trust in leaders predicts both better task performance ($r = .26$) and better organizational citizenship behavior ($r = .30$)²²².

Beyond the realm of interpersonal trust, behavioral scientists have been interested in institutional forms of trust such as trust in scientists and government institutions. One meta-analysis found that climate-friendly behaviors correlated with trust in governmental institutions ($r = .17$), trust in environmental groups ($r = .38$), trust in industry ($r = .14$), and trust in scientists ($r = .33$)²²³. Interestingly, however, these relations tend to be stronger for public than for private behaviors²²³. In the context of COVID-19-prevention behavior, trust in government institutions correlated $r = .11$ with compliance with COVID-19 behavioral guidelines and $r = 0.10$ with vaccination²²⁴. Notably, however, specific political leaders can change the strength and direction of this relation, as suggested by the finding that trust in Trump correlated negatively with all COVID-19 prevention behaviors²²⁴. The overall *OR* representing the association between trustworthiness and behavior is 3.19, which is a medium effect (see Figure 1).

Interventions to increase trustworthiness concentrate on increasing the perceived fairness and good will of authorities or organizations, in addition to programs to increase distributed and

procedural justice. Past research has shown that interventions aimed at improving the perceived trustworthiness of healthcare authorities (see Table 5) lead to small increases in a measure of behavioral outcomes ($g = 0.13$)²²⁵. Interventions to increase distributed justice at work have produced small effects on work performance ($OR = 1.24$), whereas interventions to increase procedural justice are more promising ($OR = 1.61$)²²⁶. Our summary OR for interventions to increase institutional trustworthiness is 2.12, which represents a small effect (see Figure 1).

Descriptive Norms

Norms also involve descriptive norms⁴⁶, which are subjective estimates of the frequency of a behavior in a particular population^{54–57} and do not always correlate with injunctive norms ($r = .1$ to $r = .4$)^{83,205,227}. Like injunctive norms, descriptive social norms (see Table 1) contribute to the social processes that shape a wide range of behaviors. The behaviors of other people do not correlate with blood donation behavior at $r = .03$ ²⁰⁵ but do correlate with recycling at $r = .33$ ²⁰⁶, with adolescent sexual behavior at $r = .40$ ¹⁴, with consumer behavior at $r = .31$ ⁹, and with smoking initiation at $OR = 1.88$ to $OR = 2.53$ ²²⁷ (Table 4). The overall OR representing the association between descriptive norms and behavior is 3.07, which is a medium effect (see Figure 1).

Interventions to change descriptive norms include comparative feedback such as a chart tracking one's energy consumption in relation to one's neighbors. Other related interventions involve using role models to promote a target behavior³⁰, as well as public commitments to behave in a particular way²²⁸. Most normative interventions (see Tables 1 and 5) try to persuade recipients that others already behave in the recommended ways. For example, college students tend to overestimate the amount of alcohol consumed by their peers²⁰⁹ and normative interventions that revise this misperception reduce drinking²²⁹. In fact, communicating

descriptive social norms has been shown to change behavior in a variety of settings, especially when the desired behavior is highly prevalent²³⁰, and meta-analyses of approaches to modify descriptive norms have shown positive effects for alcohol use²³¹ as well as condom use¹¹. However, people often dislike comparative feedback and descriptive norms are sometimes suspected of backfiring²³², even though exercise apps that provide comparative feedback are highly effective ($d = 0.96$)²³³.

Of all normative approaches, having role models to look up to and learn from appears highly consequential as well (see Table 4). In fact, of different types of interventions in which the behavior of others is described, role models are quite influential ($d = 0.51$)²⁰⁸. This finding is consistent with evidence that interventions delivered by facilitators who resemble recipients demographically are more successful at increasing condom use than interventions delivered by demographically dissimilar facilitators²³⁴. The overall *OR* representing the effect of interventions to change descriptive norms and behavior is 2.2, which is a small effect (see Figure 1).

Social Support

Social support, which is the provision of informational, instrumental, or financial help to facilitate a particular behavior⁵⁸ (see Table 1) has a long history in the social and behavioral sciences^{58,235,236}. Accordingly, it has been examined in relation to not only stress and health, but also behaviors, particularly difficult ones that benefit from external advice and assistance. Social support differs from norms in that, as studied in relation to behavior, the support concerns a particular behavioral goal. Whereas social norms might concern others' approval of one maintaining a healthy diet or their own dietary behaviors, social support implies that others are willing to provide advice or other forms of help around dieting.

Based on meta-analyses of this research (see Table 4), adherence to medical treatments is 1.74 times higher among patients with cohesive families and 1.53 times lower among patients with high-conflict families²³⁷. As another example, exercise is greatly facilitated by support from family and important others ($d = .36$ and $.44$) as well as exercise-class leaders and classmates ($d = .31$ and $.32$)²³⁸. Also, maternal behaviors correlate with the support mothers receive, such that emotional, material, and informational support respectively correlate $r = .31$, $.27$, and $.31$ with the quality of child-care behaviors executed by mothers²³⁹. The overall *OR* representing the association between social support and behavior is 2.1, which is a small effect (see Figure 1).

Social support interventions include leveraging family or ad-hoc groups to assist individuals in meeting their goals. These interventions (see Table 5) often take the form of support groups that facilitate a behavior such as the dietary or physical activity modifications required to lose weight. In this regard, social support interventions have shown an *OR* = 1.66 in adherence to antiretroviral medication²⁴⁰ and a reduction in suicide (*OR* = 0.48)²⁴¹, whereas public commitments to a behavior have shown larger increases in conservation behavior ($g = 0.58$ ²⁰⁸ and $d = 0.27$ ²). The overall *OR* representing efficacy is 2.32, which is a small effect (see Figure 1).

Material Incentives

Many policies designed to promote human behavior adopt behaviorist principles²⁴² by pairing positive behavior with incentives (e.g., providing financial incentive when one chooses to vaccinate; see Table 1). Financial incentives offered by many countries to encourage COVID-19 vaccination are an example of an incentive-based policy intervention, although a meta-analysis in this domain showed negligible positive effects (*OR* = 1.26)⁸⁶. Financial incentives have also been used to decrease energy consumption, where the effects are small ($d = 0.36$)²⁴³, and to curb

substance use, where the effects have been more substantial ($d = 0.70$)²⁴⁴. In our review (see Figure 1), the *OR* for the efficacy of incentives is 2.45, which represents a small effect.

Access

According to Bandura's³⁰ social cognitive theory, when environmental attributes constrain behavior, they emerge as the critical determinants (see Table 1). For example, as shown in Table 4, the price of pesticides decreases environmentally friendly pesticide application ($d = -0.36$)²⁴⁵. Likewise, demographic variables related to a person's position within the social hierarchy, have a range of associations with behavior. Healthy behaviors during pregnancy correlate with income ($r = .26$)²⁴⁶ and having a recycling bin and owning a home both correlate with recycling ($r = .16$ and $.24$, respectively)⁸⁴.

On the intervention side, some access interventions are designed to impact the system at large. Interventions to decrease inequality appear an attractive solution given large disparities in behaviors that benefit individuals and society at large. Accordingly, researchers have conducted structural and community interventions, included microfinancing. In this area, randomized controlled trials testing the impact of microloans showed a $d = -0.01$ on women's control over household expenses²⁴⁷. In the area of health, broader structural and community interventions have shown small effects ($RRs = 1.20$ and 0.90 for condom use and number of partners, respectively)²⁴⁸. The summary *OR* for the association between access and behavior is 1.95, which corresponds to a small effect (see Figure 1).

Other policy instruments increase access by offering more specific opportunities for governments for behavioral change by changing the environment. In the area of vaccination, for example, interventions that ensure access double vaccination coverage⁸⁶. Other policies channel

behavior by designing situations that favor one behavior over another^{4,249}, such as making the desired behavior default in organ-donation forms (e.g., $d = 0.68$)^{250,251}. Yet others decrease access by taxing alcohol to reduce use ($OR = 5.92$)²⁵². The summary OR for access interventions is 2.99, which corresponds to a medium effect (see Figure 1).

INTERVENTION TARGET RESULTS

FOR ALL BEHAVIORS, HEALTH BEHAVIORS, AND ENVIRONMENTAL BEHAVIORS

Our comprehensive review examined sixteen factors of interest that are associated with behavior. Figure 2 provides a graphic display of our intervention results, which comprise an empirical model of behavioral change interventions across all the behaviors we examined. The model presents individual targets of change to the left and social and structural ones to the right. Vertically, targets of change are organized from least to most effective. However, we also group them into those associated with negligible, small, and medium effects, as these classifications may prove more reliable than minute differences between the summaries in Figure 1.

The model in Figure 1 shows that, among the individual targets of change, knowledge, general attitudes, and beliefs have negligible impact; emotions, general skills, behavioral attitudes, and behavioral skills have small effects; and habits have medium effects. Among the social and structural targets of change, legal and administrative sanctions have negligible effects; injunctive norms, monitors and reminders, trustworthiness, descriptive norms, social support; and material incentives have small effects, and access has medium effects.

As the model in Figure 2 is the result of our synthesis of all behaviors, we decided to replicate our analysis by comparing factors while keeping behaviors relatively constant. Thus, we conducted the same analyses and produced the same plots (for the bar graphs, see

Supplement) for the most frequently encountered studies, which concern health behavior and environmental behavior. These models, which appear in Figure 3, show that the conclusions from Figure 2 are relatively robust, particularly with respect to what targets of change are better. For health behaviors, on the side of individual targets of change, knowledge, beliefs, general attitudes, and emotions have negligible effects, whereas behavioral attitudes, behavioral skills, and general skills have small ones, and habits have a medium one. On the side of social and structural targets of change, trustworthiness has a negligible effect, social support and monitors and reminders have small effects, and material incentives, descriptive norms, and access have medium effects. For environmental behaviors, on the side of individual targets of change, knowledge has a negligible effect, whereas behavioral attitudes and beliefs have small effects, and behavioral skills have a medium one. On the side of social and structural targets of change, legal and administrative sanctions and injunctive norms have negligible effects, descriptive norms and material incentives have small effects, and social support has a medium effect.

SUMMARY AND FUTURE DIRECTIONS

This ambitious review offers scientists and practitioners a tool to understand that certain variables, although highly salient, may not change behavior and should never be the primary focus of a behavioral intervention. Our review also shows that correlational studies of behavioral determinants are often ill-suited as a basis for decisions about what determinants to address. The discrepancies in their effects relative to those derived from intervention studies are too large to ignore and suggest important distortions. We thus urge psychologists and other behavioral scientists to turn their attention to measuring real-world behavior to ensure that our science can inform practical decisions.

For all behaviors (see Figure 2), the individual targets of knowledge, general attitudes, and beliefs have negligible effects; emotions, general skills, behavioral attitudes, and behavioral

skills have small effects, and habits have medium effects. The same distribution is present for health behaviors, except for emotions, which have negligible effects for health. The distribution is also similar for environmental behavior, except that the data are less complete. However, the information we gathered suggests negligible effects for knowledge; small ones for behavioral attitudes and beliefs; and medium for behavioral skills.

The results for individual factors suggest several targets that can be leveraged. Based on these data, interventions may sometimes profitably communicate to induce emotions. However, they should always train individuals in general and behavioral skills as well as counterargue perceived negative outcomes of the recommended behavior or find ways to mitigate those outcomes. For example, the US campaign for COVID-19 targeted vaccine confidence, which is an attitude toward an object. However, our review suggests that it would have been more appropriate to figure out ways of reducing negative outcomes through counterarguing or problem solving; discuss and model how to negotiate masking or alternative social gatherings; as well as generate self-control experiences that increase general skills. Similar forms of negotiation and skills training as well as problem solving and counterarguing for negative outcomes should be effective to induce behaviors to curb climate change. However, in this case, actual beliefs also have a medium effect, suggesting that the dominant emphasis of increasing perceptions of climate change and its outcomes, albeit insufficient, is appropriate.

Meanwhile, across all behaviors, the social targets of legal and administrative sanctions have negligible effects; injunctive norms, monitors and reminders, trustworthiness, descriptive norms, social support, and material incentives have small effects; and access has medium ones. The efficacy data for health and environmental behaviors are sparser but still revealing. For health behaviors, trustworthiness has negligible effects; social support as well as monitors and

reminders have small effects; and access, descriptive norms, and material incentives have medium effects. For environmental behaviors, legal and administrative sanctions as well as injunctive norms have negligible effects; descriptive norms and material incentives have small effects; and social support has medium effects. In both cases, building interventions to target descriptive norms, material incentives, and social support would be worthwhile, whereas the emphasis on trustworthiness in the health domain and legal and administrative sanctions in the environmental domain may be insufficient to move populations to change.

One possibility, however, is that seemingly negligible determinants associated with information exert combined effects. For example, although the correlations between general attitudes and behaviors range from $r = .12$ to $.15$, the same attitudes can have strong correlations ($r = .61$ to $.71$) with broader behavioral tendencies¹⁵¹. For example, the association between positive attitudes toward religion and attending services is much lower than those between these attitudes and the sum of various religious behaviors such as attending services, praying at meals, and donating money to charity¹⁵¹. Therefore, ensuring that the educational system socializes individuals for positive beliefs and general attitudes is important when it comes to the additive impacts of each belief. We have, after all, a much larger repertoire of knowledge and beliefs than we have habits, and this large knowledge repertoire is critical for humanity as it addresses its most pressing crises. However, the next pandemic and current climate change crisis will require, not knowledge, but rather, active approaches that allow individuals to circumvent obstacles and gain support, and for societies to distribute resources in ways that promote positive behavior in all groups.

This review is the first effort of this magnitude to synthesize the efficacy of behavioral health interventions. To be sure, meta-reviews have been conducted but they have included only

health interventions and have included a more limited number of meta-syntheses ($k = 62^{253}$ and $k = 66^{254}$) with other meta-synthesis being circumscribed to even more specific domains²⁵⁵. It is somewhat surprising that given a thriving science on behavioral change, no similar efforts have been published in the past, and we hope that our review will inspire intervention and basic researchers alike.

For intervention researchers, what lays ahead is first linking these results to specific intervention contents and policies. The field is ready for randomized controlled trials that test different methods to change descriptive norms or alternate implementations of programs to increase access to a behavior. Second, as mentioned, we need to move away from repeating programs that are typically unsuccessful. For example, whereas some boilerplate information about a behavior should routinely be introduced, if the motivation is behavioral change, launching large efforts to test the efficacy of interventions to increase institutional trust or corrections for misinformation seems futile. Third, we need more trials testing different intervention targets so that future research reviews have more data that better control for populations and contexts. Such controls are not possible when different experiments test different targets of change.

For basic researchers, the difference between effects sizes obtained from correlational and intervention research on individual factors is striking. It suggests that people overweigh individual factors over social and structural ones, but this needs to be more precisely demonstrated in the future. The fundamental attribution error naturally comes to mind²⁵⁶⁻²⁵⁹ but internal attributions, when present (see ²⁶⁰), are typically circumscribed to failures and explanations about the behavior of others^{260,261}. Therefore, the biases that emerge here may stem from differences in measurement error, which may be more pronounced when people self-report

on social and structural factors. They may also emerge from a chronic attention to individual factors that end up overestimated as people explain their own behavior.

Our review included more data on health and environmental behavior change than any other domain. In this context, it was important to verify that this selection reflects the availability of meta-analyses in the literature. We used Google Scholar to inspect the frequency of meta-analyses in each domain found in Tables 2-5. We specifically searched for “health,” “environment,” “organizational,” “financial,” “consumer,” “criminal,” and “intergroup” along with “behavior” and “meta-analysis.” We found 4,460,000 entries for health behavior, 3,240,000 for environmental behavior, 2,900,000 for organizational behavior, 2,540,000 for financial behavior, 835,000 for consumer behavior, 502,000 for criminal behavior, and 185,000 for intergroup behavior. For each domain, we also searched for “behavioral change” and “meta-analysis.” We found 3,250,000 entries for health behavior change intervention, 1,810,000 for environmental behavior change intervention, 1,500,000 for financial behavior change intervention, 789,000 for organizational behavior change intervention, 381,000 for consumer behavior change intervention, 226,000 for criminal behavior change intervention, and 54,700 for intergroup behavior change intervention.

The entries we identified from Google Scholar, which undoubtedly involve many false positives, support the idea that our review provided adequate coverage of the state of the field. However, the uneven frequency of behavioral change meta-analyses in each domain also suggests that researchers should turn their attention to behaviors they have neglected in the past. Also, some behaviors might have been studied but have not been sufficiently synthesized. To make that determination, we also searched Google Scholar for entries on “behavioral change intervention” for each domain, finding that some domains have large literatures that have not

been as extensively meta-analyzed. We found 4,990,000 entries for health behavior change intervention, 3,920,000 for environmental behavior change intervention, 4,070,000 for financial behavior change intervention, 4,200,000 for organizational behavior change intervention, 1,430,000 for consumer behavior change intervention, 2,130,000 for criminal behavior change intervention, and 181,000 for intergroup behavior change intervention. Of these, however, adding “experiment” reduced the set to 3,220,000 in the health behavior change intervention area, 1,860,000 in the environmental behavior change intervention area, 1,940,000 in the financial behavior change intervention area, and 1,080,000 in the organizational behavior area. It thus appears that the financial behavior change intervention area is one in which meta-analysis is less common, which opens the door to future research synthesis of this abundant literature. All in all, however, our efforts resulted in highly comprehensive and precise evidence on behavioral determinants and targets of change.

We also encourage researchers to study naïve theories about behavioral change among policymakers and their constituents. If policy makers believe that knowledge is fundamental to behavioral change, we will continue to see well-intended but unsuccessful intervention efforts. Likewise, if policy makers consider all targets of change as equally attractive possibilities without considering their relative efficacy, their choices are also likely to be misguided. Understanding these naïve conceptualizations and how they translate into behavioral change initiatives is critical to ensuring that evidence-based findings like the ones we provide shape the practice of behavioral change.

Any literature review has limitations. First, our review did not specifically consider that different channels may be used to impart knowledge or modify beliefs or injunctive norms. For instance, individualized knowledge may be imparted to a person who visits with a dietician,

delivered to schools, or broadcasted on mass media. In these situations, even when the beliefs exist within the minds of individuals, interventions may operate at the individual, school, or community level. By the same token, policies to increase access to services may be implemented at the level of an organization, a county, a state, a nation, or a group of nations that enter international agreements. Clearly, which level or combination of levels produces most effective interventions is an important question that future research should address.

Readers may wonder if the choice to synthesize meta-analyses biased the conclusions from this review. It is possible that some areas have been meta-analyzed more than others, but meta-analysis remains the only method that allows for comparisons across research that uses different metrics^{262,263}. However, a first-order meta-analysis of this broad intervention literature might be an aspirational goal for the field, particularly with newer forms of automation. For the time being, however, our review of meta-analyses is novel, informative, and actionable. Behavioral change is likely to remain one of the most important humanity challenges, and we must be armed with more and better guidelines to undertake it.

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Table 1
Behavioral Determinants and Targets of Behavioral Change

Variables	Definition	Sample measures	Sample Interventions
Individual factors			
Knowledge	Collection of facts about an object or behavior, which can include information about the properties and consequences of a particular object or event, such as a virus or pollution. Knowledge links an object or behavior to an attribute or event with absolute certainty.	Measure of literacy, which involves a body of facts and mental models in a particular domain: “Contact with a dirty toilet is a common cause of Venereal Disease (VD) or Sexually Transmitted Disease (STD)” ²⁶⁴	Health education; didactic instruction about climate change in schools
Beliefs	Subjective assignments of probability that an object or behavior has a given attribute or outcome ^{40,153} .	Self-report measures of conspiracy beliefs: “To what extent do you think the virus is part of a biological warfare program?” ²⁶⁵	Messages that explicitly introduce expectations about a behavior; growth mindset interventions in academic settings
General Attitudes	Evaluations of objects, persons, and events. For example, prejudice is a negative judgment of a group as the attitude object, and an attitude toward cars is a positive or negative evaluation of cars as the attitude object. This type of attitude is often termed “attitude toward the target” ^{25,87,152,203} .	Likert scales measuring attitudes toward environmental protections: “Humans are severely abusing the environment” ²⁶⁶ ; implicit attitude test concerning persons of different races ²⁶⁷	Mass-media health-promotion campaigns about a behavior ⁷⁸ ; interventions that aimed at weakening associations such as instilling goals and threat ⁷⁹ .
General Skills	Cognitive or overt routines that allow individuals to carry out a variety of specific behaviors. They involve broad	Measure of abilities or inhibitory control ²⁶⁸	Behavioral change programs emphasizing the need to train general skills that might aid

Variables	Definition	Sample measures	Sample Interventions
Behavioral Attitudes	<p>capacities such as controlling attention during tasks and being able to inhibit temptations when behaviors require high levels of self-control.</p> <p>Evaluations of a behavior as good or bad. For example, whereas an attitude toward cars is a general attitude, an attitude toward driving a car for transportation is a behavioral attitude. This type of attitude is often referred to as “attitude toward a behavior”^{25,87,150–153}.</p>	<p>Semantic differential measures of attitudes toward recycling: “Recycling household waste for me is something...”²⁶⁹</p>	<p>individuals in controlling undesirable behaviors¹⁴⁹.</p> <p>Mode of questioning designed to uncover and reduce attitudinal ambivalence toward a particular behavior^{163,164}</p>
Emotions	<p>Visceral feelings associated with a particular object, such as happiness or sadness that one links to an object person or event. Experiencing fear of climate change or disgust about a particular group of individuals is an example of emotion.</p>	<p>Likert scale measures of emotions toward COVID-19: “I feel fearful about COVID-19”²⁷⁰</p>	<p>Fear appeals and other emotional appeals used to sensitize audiences to their risks and include discussion of the threat posed by a problem or the audience’s susceptibility to it.</p>
Behavioral skills	<p>Routines that allow people to execute a target behavior, often reflected in higher levels of perceived control or efficacy concerning the behavior^{30,153,171}</p>	<p>Measure of behavioral control, and confidence to perform or abstain a behavior: “If I wanted to, it would be easy for me to exercise for at least twenty minutes, three times a week for the next fortnight”²⁷¹</p>	<p>Practicing and receiving feedback on the behavior and performing homework^{33,175}.</p>

Variables	Definition	Sample measures	Sample Interventions
Habits	Behavioral routines that have acquired features of automaticity ²⁷² , meaning that they occur efficiently, without awareness, or continue even without intention and after they are no longer adaptive ^{184,273–275}	Measure of handwashing habit using habit scales tapping automation: “Washing my hands would require effort not to do” ²⁷⁶	Asking individuals to formulate implementation intentions ^{187,188} ; training to stop in the face of temptations ^{189,190} ; introducing environmental regularity to promote habit formation ¹⁸³ ; distracting oneself from behavioral cues ¹⁹¹
Social and structural factors			
Legal and administrative sanctions	Legal and administrative instruments to prescribe, ban, and sanction a behavior.	State and county records of laws coded through a policy review ²⁷⁷	Banning smoking in public establishments ²⁷⁸ ; mandating vaccination ²⁷⁹ ; mandating sick pay ²⁸⁰
Injunctive norms	Perceptions of the degree to which others support a person’s behavior ^{25,46}	Self-reported injunctive norms: “People who are important to me think I should use condoms” ²⁸	Messages that communicate that others approve of condom use ²⁸¹ ; posting signs stating that taking the stairs was a good way to get some exercise ²⁸²
Monitors and reminders	Physical or digital instrument to track behavioral performance and remind users of the need to execute a behavior.	Self-reported use of pill boxes, diaries, and planners ²⁸³	Clinical reminder system for promoting preventive care ²⁸⁴ ; digital watches and phone apps to promote physical activity
Trustworthiness	Justice or fairness within an organization or government entity, which leads constituents to feel trust and reduce vigilance ^{59–61} .	Self-reported procedural justice: “How fair were the procedures used to handle the problem?” ²⁸⁵	Providing voice to Latinx voters; community-oriented policing such as fostering non-enforcement interactions ¹⁹⁴

Variables	Definition	Sample measures	Sample Interventions
Descriptive norms	Frequency of a behavior in a particular population ⁵⁴⁻⁵⁷ .	Reports of perceptions of what others do: “Most residents would vaccinate their child against COVID-19,” and “The majority of residents will probably vaccinate their children against COVID-19” ²⁷⁷	Comparative feedback such as a chart tracking one’s energy consumption in relation to one’s neighbors; using role models to promote a target behavior ³⁰ ; posting signs stating that most people used the stairs ²⁸²
Social Support	Informational, instrumental, or financial help to facilitate a particular behavior ⁵⁸ .	Self-reported lists of individuals who can perform instrumental, informational, and emotional support functions ²⁸⁶	Leveraging family or ad-hoc groups to assist individuals to meet their physical activity goals; groups of Latina mothers led by “promotoras” to support and accompany each other during health promoting activities ²⁸⁷ .
Material Incentives	Providing an added material benefit in the form of financial or non-financial rewards in exchange for a behavior.	Introduction of state lottery as reviewed by researchers ²⁸⁸	Taxation of pollution ²⁸⁹ ; financial incentives for positive behavior ¹⁹⁶
Access and defaults	Material or logistic resources to facilitate the performance of a behavior.	Census demographics and self-report of health insurance: Education, income ²⁹⁰ ; self-reported health insurance ²⁹¹	Reducing co-payments for medication ²⁹² ; providing health insurance ²⁹³ ; providing basic income ²⁹⁴

Table 2
Studies of Individual Behavioral Determinants

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Knowledge					
Financial	Financial decisions and objective financial literacy (cross-sectional analyses)	Hwang & Park (2023) ⁸¹	$r = .29$	3.00	NA
Financial	Financial decisions and financial literacy (longitudinal analyses)	Hwang & Park (2023) ⁸¹	$r = .09$	1.39	NA
Health	Attending a dentist and oral health literacy	Firmino et al. (2018) ⁸²	$OR = 1.25$	1.25	NA
Health	Condom use and HIV knowledge	Sheeran et al. (1999) ⁸³	$r = .06$	1.24	NA
Environment	Recycling and general knowledge	Geiger et al. (2019) ⁸⁴	$r = .21$	2.18	Yes
Environment	Recycling and specific knowledge	Geiger et al. (2019) ⁸⁴	$r = .20$	2.10	Yes
Environment	Climate change adaptation and knowledge	van Valkengoed & Steg (2019) ⁸⁵	$r = .14$	1.67	Yes
Environment	Waste sorting and knowledge	Rousta et al. (2020) ²⁹⁵	$r = .14$	1.67	Yes
Health	Health behaviors during pregnancy and education	Cannella et al. (2016) ²⁴⁶	$r = .24$	2.45	Yes
Health	Maternal behavior and education	Booth et al. (2018) ²⁹⁶	$r = .26$	2.66	Yes
General Attitudes					
Cross	Recidivism and explicit attitudes toward sexual offending	Helmus et al. (2013) ⁸⁸	$d = 0.22$	1.49	NA
Cross	Cross-domain behavior and explicit attitudes	Kraus (1995) ⁸⁹	$r = .14$	1.67	NA
Cross	Cross-domain behavior and explicit attitudes	Glasman & Albarracín (2006) ¹⁵⁶	$r = .44$	5.92	NA
Cross	Cross-domain behavior and explicit attitudes	Wallace et al. (2005) ⁹⁰	$r = .39$	4.65	NA
Health	Substance use and implicit attitudes	Rooke et al. (2008) ⁹⁸	$r = .27$	2.77	NA

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Health	Physical activity and implicit attitudes	Chevance et al. (2019) ²⁹⁷	$r = .11$	1.49	NA
Environment	Recycling and general attitudes	Geiger et al. (2019) ⁸⁴	$r = .19$	2.02	Yes
Environment	Past recycling behavior and identifies as environmentally friendly	Geiger et al. (2019) ⁸⁴	$r = .30$	3.13	Yes
Health	Condom use and attitudes toward condoms	Sheeran et al. (1999) ⁸³	$r = .32$	3.41	NA
Beliefs					
Health	COVID-19 prevention behavior and conspiracy beliefs	Stasielowicz (2022) ¹⁰⁴	$\beta = 0.09$	1.39	Yes
Environment	Recycling and belief in anticipated affect	Geiger et al. (2019) ⁸⁴	$r = .26$	2.66	Yes
Health	Condom use and belief in attractiveness of condoms	Sheeran et al. (1999) ⁸³	$r = .14$	1.67	NA
Health	Condom use and belief in negative interpersonal consequences	Sheeran et al. (1999) ⁸³	$r = -.10$	1.44	NA
Health	Condom use and belief in purchase embarrassment	Sheeran et al. (1999) ⁸³	$r = -.05$	1.20	NA
	Discriminatory behavior and beliefs	Talaska et al. (2008) ¹⁴²	$r = .08$	1.34	NA
Environment	Climate change adaptation behavior and climate change belief	van Valkengoed & Steg (2019) ⁸⁵	$r = .23$	2.36	Yes
Environment	Climate change adaptation behavior and outcome efficacy	van Valkengoed & Steg (2019) ⁸⁵	$r = .29$	3.00	Yes
Environment	Climate change adaptation behavior and confidence in measures	van Valkengoed & Steg (2019) ⁸⁵	$r = .11$	1.49	Yes
Education	Academic behavior and growth mindset	Sisk et al. (2018)	$r = .10$	1.44	Yes
Environment	Pro-environmental behavior and materialism	Hurst et al. (2013) ²⁹⁸	$r = -.24$	2.45	Yes
Intergroup	Intimate partner violence and hostile sexism	Agadullina et al. (2022) ¹⁰⁹	r to $z = .26$	2.59	Yes
Intergroup	Intimate partner violence and benevolent sexism	Agadullina et al. (2022) ¹⁰⁹	r to $z = .05$	1.2	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Crime	Criminal behavior and religiosity	Baier & Wright (2001) ¹¹⁰	$r = -.12$	1.55	NA
Crime	Physical aggression and religiosity	Gonçalves et al. (2023) ¹¹¹	$r = -.12$	1.55	NA
Crime	Sexual aggression and religiosity	Gonçalves et al. (2023) ¹¹¹	$r = -.05$	1.2	NA
Crime	Domestic violence and religiosity	Gonçalves et al. (2023) ¹¹¹	$r = -.05$	1.2	NA
Crime	Cross-domain destructive behavior and religiosity	Cheung & Yeung (2011) ¹¹²	r to $z = -.17$	1.87	NA
Crime	Cross-domain constructive behavior and religiosity	Cheung & Yeung (2011) ¹¹²	r to $z = .20$	2.1	NA
Health	Smoking and acculturation among Asian Americans	Choi et al. (2008) ²⁹⁹	$OR = 0.98$	1.02	NA
Health	Alcohol use and acculturation among Hispanic Americans	Lui & Zamboanga (2018) ³⁰⁰	$r = .09$	1.39	NA
Crime	Intimate partner violence and Latinx acculturation	Alvarez et al. (2020) ³⁰¹	$r = .11$	1.49	Yes
Health	Condom use and acculturation among international migrants	Du & Li (2015) ³⁰²	$r = .01$	1.04	Yes
Health	Multiple partnership and acculturation among international migrants	Du & Li (2015) ³⁰²	$r = .15$	1.73	Yes
Health	Unsafe sex and acculturation among international migrants	Du & Li (2015) ³⁰²	$r = .16$	1.80	Yes
Health	Early sexual initiation and acculturation among international migrants	Du & Li (2015) ³⁰²	$r = .13$	1.61	Yes
Emotions					
Health	Condom use and worry, concern, and fear	Sheeran et al. (1999) ⁸³	$r = .09$	1.39	NA
Health	Condom use and perceived HIV susceptibility	Sheeran et al. (1999) ⁸³	$r = .06$	1.24	NA

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Health	Condom use and perceived severity of HIV	Sheeran et al. (1999) ⁸³	$r = .02$	1.08	NA
Health	COVID protection behaviors and fear	Zhao et al. (2023) ¹³²	$r = .24$	2.45	Yes
Health	COVID protection behaviors and anxiety	Zhao et al. (2023) ¹³²	$r = .12$	1.55	Yes
Health	COVID protection behaviors and perceived severity	Zhao et al. (2023) ¹³²	$r = .30$	3.13	Yes
Health	COVID protection behaviors and perceived susceptibility	Zhao et al. (2023) ¹³²	$r = .21$	2.81	Yes
Environment	Climate change adaptation behavior and negative affect	van Valkengoed & Steg (2019) ⁸⁵	$r = .29$	3.00	Yes
Environment	Climate change adaptation behavior and risk perception	Van Valkengoed & Steg (2019) ⁸⁵	$r = .20$	2.10	Yes
Crime	Interpersonal aggression and negative affectivity	Hershcovis et al. (2007) ³⁰³	$r = .29$	3.00	NA
Crime	Organizational aggression and negative affectivity	Hershcovis et al. (2007) ³⁰³	$r = .28$	2.88	NA
Health	Condom use and sexual arousal	Sheeran et al. (1999) ⁸³	$r = -.08$	0.75	NA
Environment	Car use and threat	Gardner & Abraham (2008) ¹⁸⁶	$r = -.20$	2.10	NA
Environment	Car use and environmental concern	Gardner & Abraham (2008) ¹⁸⁶	$r = -.13$	1.61	NA
Work	Core performance and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .04$	1.16	Yes
Work	Organization citizenship behaviors and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = -.21$	2.18	Yes
Social	Help seeking and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = -.03$	1.12	Yes
Education	Learning behaviors and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = -.08$	1.34	Yes
Social	Other improvement and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .05$	1.20	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Work	Counterproductive workplace behaviors and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .33$	3.55	Yes
Work	Abusive supervision and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .27$	2.77	Yes
Social	Ostracism and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .37$	4.24	Yes
Social	Social undermining and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .29$	3.00	Yes
Crime	Incivility and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .29$	3.00	Yes
crime	Other forms of mistreatment and envy	Li, Xu, & Kwan (2023) ¹³⁷	$r = .28$	2.88	Yes
Environment	Pro-environmental behavior and guilt	Bamberg & Moser (2007) ¹³⁸	$r = .30$	3.13	Yes
Consumer	Purchasing behavior and guilt	Kranzbuhler et al. (2020) ¹⁴⁰	$r = -.01$	1.04	Yes
Social	Sharing behavior and guilt	Kranzbuhler et al. (2020) ¹⁴⁰	$r = .54$	10.25	Yes
Social	Prosocial behavior and gratitude	Renshaw et al. (2016) ¹³⁹	$r = .26$	2.66	NA
Consumer	Purchasing behavior and gratitude	Kranzbuhler et al. (2020) ¹⁴⁰	$r = .50$	8.12	Yes
Social	Sharing behavior and gratitude	Kranzbuhler et al. (2020) ¹⁴⁰	$r = .74$	54.11	Yes
Consumer	Purchasing behavior and pride	Kranzbuhler et al. (2020) ¹⁴⁰	$r = .07$	1.29	Yes
Social	Sharing behavior and pride	Kranzbuhler et al. (2020) ¹⁴⁰	$r = .32$	3.41	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Social	Enacted behavior and interpersonal attraction	Montoya et al. (2018) ¹⁴¹	r to $z = .20$	2.10	Yes
Crime	Discrimination behavior and emotional prejudice	Talaska et al. (2008) ¹⁴²	$r = .35$	3.88	NA
Crime	Speeding and anger/aggression	Sarbescu & Rusu (2021) ¹³⁵	$r = .12$	1.55	Yes
Crime	Risky driving behaviors and anger	Akbari et al. (2019) ¹³⁶	$r = .39$	4.65	Yes
Consumer	Purchasing behavior and anger	Kranzbuhler et al. (2020) ¹⁴⁰	$r = -.19$	2.02	Yes
Social	Sharing behavior and anger	Kranzbuhler et al. (2020) ¹⁴⁰	$r = -.38$	4.44	Yes
Crime	Interpersonal aggression and trait anger	Hershcovis et al. (2007) ³⁰³	$r = .43$	5.63	NA
Work	Organizational aggression and trait anger	Hershcovis et al. (2007) ³⁰³	$r = .33$	3.55	NA
Crime	Aggressive driving and driving anger	Bogdan et al. (2016) ³⁰⁴	r to $z = .38$	4.05	Yes
Crime	Aggressive driving and trait anger	Bogdan et al. (2016) ³⁰⁴	r to $z = .46$	6.55	Yes
Health	Breastfeeding and positive emotions	Russell et al. (2022) ¹³	$r = .24$	2.45	NA
Health	Breastfeeding and negative emotions	Russell et al. (2022) ¹³	$r = .5$	8.12	NA
Behavioral Attitudes					
Cross	Cross-domain behavior and behavioral attitude	Wallace et al. (2005) ⁹⁰	$r = .42$	5.36	NA
Cross	Cross-domain behavior and behavioral attitude	Glasman & Albarracin (2006) ¹⁵⁶	$r = .58$	13.23	NA
Health	Sun protection behavior and behavioral attitude	Starfelt & White (2016) ¹⁵⁷	$r = .31$	3.26	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Health	Exercise and behavioral attitude	Hagger & Chatzisarantis (2009) ¹⁵⁸	$r = .37$	4.24	NA
Environment	Car use and behavioral attitude	Lanzini & Kahn (2015) ¹⁵⁹	$r = .41$	5.11	Yes
Health	Organic vegetables and behavioral attitude	Scalco et al. (2017) ¹⁶⁰	$r = .44$	5.92	NA
Health	Condom use and behavioral attitude	Albarracin et al. (2001) ¹⁵⁵	$r = .38$	4.44	NA
Environment	Recycling and specific attitudes	Geiger et al. (2019) ⁸⁴	$r = .34$	3.71	Yes
Environment	Recycling and values	Geiger et al. (2019) ⁸⁴	$r = .24$	2.45	Yes
Environment	Car use and behavioral attitudes	Gardner & Abraham (2008) ¹⁸⁶	$r = .27$	2.77	NA
Cross environment	Cross-behavior and behavioral attitudes	Notani (1998)	$z = .23$	2.36	No
Environment	Waste sorting and behavioral attitudes	Rousta et al. (2020) ²⁹⁵	$r = .39$	4.65	Yes
Environment	Pro-environmental behavior and behavioral attitudes	Bamberg & Moser (2007)	$r = .42$	5.36	Yes
General skills					
Work	Obtaining employment and social skills	Tayfur et al. (2021) ¹⁶⁷	$OR = 1.03$	1.03	NA
Environment	Recycling and general behavioral control	Geiger et al. (2019) ¹⁷⁴	$r = .18$	1.94	Yes
Cross	Cross-domain behaviors and trait self-control	de Ridder et al. (2012) ³⁰⁵	$r = .26$	2.66	NA
Health	Food intake and executive functioning	Shields et al. (2022) ¹⁶⁸	$r = -.14$	1.67	Yes
Health	Condom use and impulsivity	Sheeran et al. (1999) ⁸³	$r = .02$	1.08	NA
Specific Behavioral Skills					
Environment	Recycling and specific perceived behavioral control	Geiger et al. (2019) ⁸⁴	$r = .39$	4.65	Yes
Health	Alcohol use frequency and refusal skills	Plata et al. (2022) ¹⁷⁴	$r = -.35$	3.88	Yes
Health	Alcohol use quantity and refusal skills	Plata et al. (2022) ¹⁷⁴	$r = -.29$	3.00	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Health	Binge drinking and refusal skills	Plata et al. (2022) ¹⁷⁴	$r = -.32$	3.41	Yes
Health	Condom use and condom use self-efficacy	Sheeran et al. (1999) ⁸³	$r = .25$	2.55	NA
Health	Condom use and carrying a condom	Sheeran et al. (1999) ⁸³	$r = .31$	3.26	NA
Environment	Climate change adaptation behavior and self-efficacy	van Valkengoed & Steg (2019) ⁸⁵	$r = .26$	2.66	Yes
Environment	Car use and perceived behavioral control	Lanzini & Kahn (2015) ¹⁵⁹	$r = .27$	2.77	Yes
Environment	Organic vegetables and perceived behavioral control	Scalco et al. (2017) ¹⁶⁰	$r = .33$	3.55	NA
Cross	Cross-behavior and perceived behavioral control	Notani (1998)	$r = .24$	2.45	No
Environment	Waste sorting and perceived behavioral control	Rousta et al. (2020) ²⁹⁵	$r = .28$	2.88	Yes
health	Sun protection behavior and perceived behavioral control	Starfelt & White (2016) ¹⁵⁷	$r = .31$	3.26	Yes
Health	Condom use and condom efficacy	Sheeran et al. (1999) ⁸³	$r = .10$	1.44	NA
Environment	Pro-environmental behavior and perceived behavioral control	Bamberg & Moser (2007)	$r = .30$	3.13	Yes
Habits					
Environment	Past recycling behavior and future recycling	Geiger et al. (2019) ⁸⁴	$r = .41$	5.11	Yes
Environment	Past recycling behavior and identifies as a recycler	Geiger et al. (2019) ⁸⁴	$r = .48$	7.23	Yes
Health	Past and future condom use	Sheeran et al. (1999) ⁸³	$r = .36$	4.05	NA
Work	Health provider habits and future behavior	Potthoff et al. (2019) ¹⁸⁵	$r = .33$	3.55	NA
Environment	Car use and habit	Gardner & Abraham (2008) ¹⁸⁶	$r = .50$	8.12	NA
Health	Exercise and past behavior	Hagger & Chatzisarantis (2009) ¹⁵⁸	$r = .57$	12.39	NA
Environment	Car use and past car use	Lanzini & Kahn (2015) ¹⁵⁹	$r = .69$	31.76	Yes

Domain	Behavior and Determinant	Meta-analysis	Effect Size	OR	Extreme publication bias ruled out?
Environment	Car use and habit	Lanzini & Kahn (2015) ¹⁵⁹	$r = .42$	5.36	Yes

Note. OR = Odd Ratio. RR: Risk Ratio. d and g : Standardized mean differences. r : Pearson correlation. Δ : Difference in d .

Standardized beta weights were recorded as r . Following Cohen's effect size classification⁶⁵, d s smaller than 0.2 are negligible, those equal to or larger than 0.2 and smaller than 0.5 are small, those equal or larger than 0.5 but smaller than 0.8 are medium, and those equal or larger than 0.80 are small. Correspondingly, r s smaller than .1 are negligible, those equal to or larger than .1 but smaller than .24 are small, those equal to or larger than .24 but smaller than .37 are medium, and those greater or equal to .37 are large. With our conversion⁶³, ORs smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. Extreme publication bias ruled out was coded *Yes* if analyses did not suggest extreme bias, *No* when they did, and NA when they were not performed.

Table 3
Studies of Individual Intervention Effects

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Knowledge					
Environment	Climate change and education	Bergquist et al. (2023) ²	$d = 0.09$	1.18	Yes
Environment	Environmentally friendly application of pesticide and education	Li et al. (2023) ²⁴⁵	$d = 0.01$	1.02	NA
Work	Food handling and training and education	Young et al. (2019) ³⁰⁶	$d = 0.18$	1.39	Yes
Health	Smoking and early life and education interventions	Courtin et al. (2020) ³⁰⁷	$OR = 0.92$	1.09	Yes
Health	Healthy eating and curriculum-based approaches in children	Dudley et al. (2015) ³⁰⁸	$d = 0.12$	1.24	Yes
Environment	Consumer intake of energy and food labeling	Shangguan et al. (2019) ³⁰⁹	$OR = 0.93$	1.08	Yes
Health	Vaccination and vaccine information	Liu et al. (2023) ⁸⁶	$OR = 1.19$	1.19	Yes
Health	Vaccination and vaccinee misinformation correction	Liu et al. (2023) ⁸⁶	$OR = 0.96$	0.96	Yes
General Attitudes					
Health	Health behavior and explicit attitude treatment	Anker et al. (2016) ⁹⁹	$r = .05$	1.20	No
Cross	Cross-domain behavior and implicit attitude treatment (weakening associations)	Forscher, Lai, et al. (2019) ¹⁰⁰	$g = -.11$	1.22	Yes
Health	Relapse in substance use and cognitive bias training	Boffo et al. (2019) ³¹³	$d = -0.27$	1.63	Yes
Health	Reduction of substance use and cognitive bias training	Boffo et al. (2019) ³¹³	$d = 0.19$	1.41	Yes
Health	Food consumption and implicit attitude treatment (evaluative conditioning)	Aulbach et al. (2019) ³¹⁴	$g = -0.01$	1.02	Yes
Beliefs					
Education	Academic behavior and growth mindset	Sisk et al. (2018)	$d = 0.08$	1.16	Yes

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Education	Academic behavior and growth mindset	MacNamara et al. (2023) ⁸	$d = 0.04$	1.08	Yes
Health	Calorie consumption and food and drink labeling	Crocketta et al (2018) ³¹⁰	$d = 0.05$	1.10	Yes
Environment	Environmental behavior and changing beliefs	Greene et al. (2023) ²⁴³	$d = 0.46$	2.30	Yes
Health	HIV risk behavior in adolescents and ethnographic intervention basis	Herbst et al. (2006) ¹²⁴	$OR = 0.60/0.83 = 0.72$	1.39	Yes
Health	HIV risk in adolescents and described as culturally appropriate	Herbst et al. (2006) ¹²⁴	$OR = 0.65/0.95 = 0.68$	1.47	Yes
Health	Health behavior and cultural adaptation of short internet- and mobile-based health promotion intervention	Balci at al. (2022) ¹²³	$g = 0.10$	1.20	NA
Health	Health behavior and cultural adaptation of long internet- and mobile-based health promotion intervention	Balci at al. (2022) ¹²³	$g = 0.20$	1.44	NA
Health	Substance use among Latinx adolescents and cultural adaptation	Hernandez Robles et al. (2018) ³¹¹³¹¹	$g = 0.06$	1.12	NA
Health	HIV risk in adolescents and Hispanic cultural beliefs	Herbst et al. (2006) ¹²⁴	$OR = 0.62/0.80 = 0.78$	1.28	Yes
Crime	Corruption behavior and public sector reforms to change organizational culture	Mugellini et al. (2021) ³¹²	$r to z = -0.07$	1.29	Yes
Emotions					
Cross	Cross-domain behavior and discrete emotions	Lench et al. (2011) ¹⁴³	$g = 0.31$	1.76	Yes
Cross	Cross-domain behavior and risk perceptions	Tannenbaum et al. (2016) ¹²⁸	$d = 0.14$	1.29	Yes
Health	Food consumption and negative emotions	Evers et al. (2018) ¹⁴⁴	$g = 0.02$	1.04	Yes
Health	Food consumption and positive emotions	Evers et al. (2018) ¹⁴⁴	$g = 0.24$	1.54	Yes
Cross	Cross-domain behavior and anticipatory emotions	Sheeran et al. (2014) ¹⁴⁸	$d = 0.21$	1.46	NA
Cross	Cross-domain behavior and anticipated emotions	Sheeran et al. (2014) ¹⁴⁸	$d = 0.30$	1.72	NA

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Cross	Cross-domain behavior and perceived risk	Sheeran et al. (2014) ¹⁴⁸	$d = 0.25$	1.57	NA
Cross	Cross-domain behavior and perceived severity	Sheeran et al. (2014) ¹⁴⁸	$d = 0.34$	1.85	NA
Cross	Cross-domain behavior and fear	Peters, Ruiter, & Kok (2013) ¹⁴⁶	$d = 0.11$	1.22	Yes
Crime	Aggressive driving behavior and fear appeals	Carey et al. (2013) ³¹⁹	$r = .08$	1.34	Yes
health	Smoking cessation and visual feedback of arterial scans	Hollands et al. (2010) ³¹⁹	$OR = 2.81$	2.81	NA
Health	Smoking cessation and communication about DNA-based risk	Marteau et al. (2010) ³²⁰	$OR = 1.03$	1.03	Yes
Health	Physical activity and communication about DNA-based risk	Marteau et al. (2010) ³²⁰	$OR = 1.03$	1.03	Yes
Health	Medication/vitamin use and communication about DNA-based risk	Marteau et al. (2010) ³²⁰	$OR = 1.26$	1.26	Yes
Health	Dietary behavior and communication about DNA-based risk	Marteau et al. (2010) ³²⁰	$OR = 2.24$	2.24	Yes
Health	Exercise and gratitude intervention	Dickens (2017) ¹⁴⁹	$d = .10$	1.20	NA
Social	Prosocial behavior and gratitude intervention	Dickens (2017) ¹⁴⁹	$d = .12$	1.24	NA
Social	Prosocial behavior and gratitude intervention	Renshaw et al. (2016) ¹³⁹	$g = 0$	1.00	NA
Social	Behavioral gratitude and gratitude intervention	Renshaw et al. (2016) ¹³⁹	$g = 0.40$	2.07	NA
Social	Compliance with request and guilt intervention	Boster et al. (2016) ³²¹	$\rho = .26$	2.66	Yes
Behavioral Attitudes					
Work	Prescribing by pharmacists and system feedback on prescriptions	Carter et al. (2023) ³¹⁵	$RR = 0.78$	1.28	NA
Work	Advance planning and information about behavioral outcomes	Schichtel et al. (2021) ³¹⁶	$OR = 2.06$	2.06	Yes

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Health	Substance use and motivational interviewing	VanBuskirk & Wetherell (2014) ³¹⁷	$d = 0.22$	1.49	NA
Health	Physical activity and motivational interviewing	VanBuskirk & Wetherell (2014) ³¹⁷	$d = 0.07$	1.14	NA
Health	Adherence to treatment and motivational interviewing	VanBuskirk & Wetherell (2014) ³¹⁷	$d = 0.19$	1.41	NA
Health	Oral health behaviors and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.38$	1.99	Yes
Health	Physical activity and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.15$	1.31	Yes
Health	Screen viewing time and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.16$	1.34	Yes
Health	Screen viewing access and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.19$	1.41	Yes
Health	Diet and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.24$	1.55	Yes
Health	Smoking cessation and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.33$	1.82	Yes
Health	Smoking restrictions and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.17$	1.36	Yes
Health	Secondhand smoking and motivational interviewing	Borrelli et al. (2015) ³¹⁸	$d = 0.05$	1.10	Yes
Health	Smoking cessation (no smoking cessation treatment control) and motivational interviewing	Lindson et al. (2019) ⁷⁸	$OR = 0.84$	0.84	NA
Health	Smoking cessation and motivational interviewing (different smoking cessation treatment control)	Lindson et al. (2019) ⁷⁸	$OR = 1.24$	1.24	NA
Environment	Environmental behavior and inducing pleasure	Greene et al. (2023) ²⁴³	$d = 0.66$	3.31	Yes
Environment	Environmental mitigation behavior and feedback	Bergquist et al. (2023) ²	$d = 0.16$	1.34	Yes
Environment	Environmental mitigation behavior and appeals to behavior	Bergquist et al. (2023) ²	$d = 0.28$	1.66	Yes
General Skills					
Health	Behavior in children and executive function training	Takacs & Kassai (2019) ¹⁶⁹	$g = 0.30$	1.72	Yes
Health	Reduction of negative behaviors and mindfulness intervention	Dunning et al. (2022) ¹⁷⁰	$d = 0.21$	1.46	Yes

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Health	Smoking cessation and mindfulness intervention (no treatment control)	Jackson et al. (2022) ³²⁵	$RR = 0.81$	0.81	NA
Health	Smoking cessation and mindfulness intervention (intensity-matched control)	Jackson et al. (2022) ³²⁵	$RR = 0.99$	0.99	NA
Health	Smoking cessation and mindfulness intervention (less intensive control)	Jackson et al. (2022) ³²⁵	$RR = 1.19$	1.19	NA
Crime	Aggression and meditation intervention	Kreplin et al. (2018) ³²⁶	$r = .11$	1.49	Yes
Specific Behavioral Skills					
Health	Safer sex discussion with partners and behavioral skills	Gause et al. (2018) ¹⁷⁹	$d = 0.35$	1.89	NA
Health	Condom use and behavioral skills	Gause et al. (2018) ¹⁷⁹	$d = 0.39$	2.03	NA
Work	Organizational behavior and skills training	Arthur et al. (2003) ¹⁸⁰	$d = 0.62$	3.08	NA
Work	Organizational behavior and programmed instruction	Arthur et al. (2003) ¹⁸⁰	$d = 0.94$	5.50	NA
Health	Food consumption and implementation intentions	Turton et al. (2016) ¹⁹²	$d = 0.26$	1.60	No
Health	Alcohol use and implementation intentions	Malaguti et al. (2020) ⁷	$d = 0.31$	1.76	Yes
Health	Tobacco smoking and implementation intentions	Malaguti et al. (2020) ⁷	$d = 0.31$	1.76	Yes
Health	Advanced planning and analysis of behavioral prompts/cues	Schichtel et al. (2021) ³¹⁶	$OR = 4.18$	4.18	Yes
Health	Advanced planning and goal setting for outcome	Schichtel et al. (2021) ³¹⁶	$OR = 2.67$	2.67	Yes
Health	Advanced planning and behavioral practice	Schichtel et al. (2021) ³¹⁶	$OR = 2.64$	2.64	Yes
Health	Advanced planning and instruction on performance	Schichtel et al. (2021) ³¹⁶	$OR = 2.49$	2.49	Yes
Health	Advanced planning and goal setting for behavior	Schichtel et al. (2021) ³¹⁶	$OR = 2.12$	2.12	Yes
Environment	Environmental behavior and goal setting	Epton et al. (2017) ³²²	$d = 0.57$	2.81	Yes
Health	Health behavior and goal setting	Epton et al. (2017) ³²²	$d = 0.44$	2.22	Yes

Domain	Behavior and Strategy	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Health	Sports behavior and goal setting	Epton et al. (2017) ³²²	$d = 0.41$	2.10	Yes
Work	Production behavior and goal setting	Epton et al. (2017) ³²²	$d = 0.36$	1.92	Yes
Health	Keeping appointments and goal setting	Epton et al. (2017) ³²²	$d = 0.26$	1.60	Yes
Health	Physical activity and self-monitoring	Kanejima et al. (2019) ³²³	$d = 0.97$	5.81	NA
Work	Using open questions and healthcare professionals' communication skills training	Moore et al. (2018) ³²⁴	$d = 0.25$	1.57	NA
Work	Eliciting patients' concerns and healthcare professionals' communication skills training	Moore et al. (2018) ³²⁴	$d = 0.24$	1.55	NA
Work	Giving appropriate information and healthcare professionals' communication skills training	Moore et al. (2018) ³²⁴	$d = -0.08$	0.87	NA
Work	Showing empathy and healthcare professionals' communication skills training	Moore et al. (2018) ³²⁴	$d = 0.18$	1.39	NA
Work	Providing facts and healthcare professionals' communication skills training	Moore et al. (2018) ³²⁴	$d = -0.26$	0.62	NA
Habits					
Health	Food intake and cognitive control training	Wolz et al. (2020) ¹⁹¹	$g = 0.27$	1.63	Yes
Health	Food intake and reappraisal of craving	Wolz et al. (2020) ¹⁹¹	$g = 0.45$	2.26	Yes
Health	Food intake and attentional bias modification	Wolz et al. (2020) ¹⁹¹	$g = 0.44$	2.22	Yes
Health	Food intake and distraction	Wolz et al. (2020) ¹⁹¹	$g = -0.31$	1.76	Yes
Health	Tics and habit reduction training	McGuire et al. (2014) ¹⁸⁹	$d = 0.94$	5.50	Yes
Health	Food consumption and stop-signal training	Turton et al. (2016) ¹⁹²	$d = -0.39$	2.03	No
Health	Food consumption and attention bias manipulation	Turton et al. (2016) ¹⁹²	$d = -0.51$	2.52	No

Note. OR = Odd Ratio. RR: Risk Ratio. d and g : Standardized mean differences. r : Pearson correlation. Δ : Difference in d .

Standardized beta weights were recorded as r . Following Cohen's effect size classification⁶⁵, d s smaller than 0.2 are negligible, those

equal to or larger than 0.2 and smaller than 0.5 are small, those equal or larger than 0.5 but smaller than 0.8 are medium, and those equal or larger than 0.80 are small. Correspondingly, *rs* smaller than .1 are negligible, those equal to or larger than .1 but smaller than .24 are small, those equal to or larger than .24 but smaller than .37 are medium, and those greater or equal to .37 are large. With our conversion⁶³, *ORs* smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. Extreme publication bias ruled out was coded *Yes* if analyses did not suggest extreme bias, *No* when they did, and *NA* when they were not performed.

Table 4
Studies of Social and Structural Determinants

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out?</i>
Injunctive Norms					
Health	Blood donation and subjective norms	Bednall et al. (2013) ²⁰⁵	$r = .2$	1.87	Yes
Environment	Recycling and injunctive norm about general pro-environmental behavior	Geiger et al. (2019) ¹⁷⁴	$r = .21$	2.18	Yes
Health	Adolescent sexual behavior and injunctive norms	van de Bongardt et al. (2015) ¹⁴	$r = .22$	2.27	Yes
Environment	Recycling and injunctive norm for recycling	Geiger et al. (2019) ⁸⁴	$r = .33$	3.55	Yes
Health	Smoking and injunctive, close friend norms	East et al. (2021) ²²⁷	$OR = 2.36$	2.36	Yes
Health	Smoking and injunctive, parent norms	East et al. (2021) ²²⁷	$OR = 1.74$	1.74	Yes
Health	Condom use and subjective norms	Sheeran et al. (1999) ⁸³	$r = .26$	2.66	NA
Environment	Conservation and subjective norms	Niemiec et al. (2020) ¹⁰	$r \text{ to } z = .09$	1.39	NA
Health	Breastfeeding and injunctive norms	Russell et al. (2022) ¹³	$r = .26$	2.66	NA
Health	Health behaviors and injunctive norms	McEachan et al. (2016) ³²⁷	$r = .22$	2.27	Yes
Health	Condom use and injunctive norms	Albarracín et al. (2001) ¹⁵⁵	$r = .25$	2.55	NA
Consumer	Consumer behavior and injunctive norms	Melnyk et al. (2021) ⁹	$r = .22$	2.27	Yes
Health	Physical activity adherence in cancer patients and subjective norms	Husebø et al. (2013) ³²⁸	$r = .10$	1.44	NA
Health	Physical activity and subjective norms	Hagger et al. (2002) ³²⁹	$r = .17$	1.87	NA
Health	Health behavior and subjective norms	Hagger & Chatzisarantis (2009) ¹⁵⁸	$r = .19$	2.02	NA
Cross	Cross-domain behavior and injunctive norms	Manning et al. (2009) ³³⁰	$r = .28$	2.88	Yes
Environment	Climate change adaptation behavior and injunctive norms	van Valkengoed & Steg (2019) ⁸⁵	$r = .25$	2.55	Yes

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out?</i>
Environment	Car use and injunctive norm	Lanzini & Kahn (2015) ¹⁵⁹	$r = .23$	2.36	Yes
Health	Organic vegetables consumption and injunctive norm	Scalco et al. (2017) ¹⁶⁰	$r = .38$	4.44	NA
Health	Sun protection behavior and subjective norm	Starfelt & White (2016) ¹⁵⁷	$r = .24$	2.45	Yes
Environment	Car use and injunctive norm	Gardner & Abraham (2008) ¹⁸⁶	$r = -.07$	0.78	NA
Cross	Cross-behavior and subjective norm	Notani (1998)	$r = .15$	1.73	No
Environment	Waste sorting and subjective norm	Rousta et al. (2020) ²⁹⁵	$r = .30$	3.13	Yes
Environment	Pro-environmental behavior and social norms	Bamberg & Moser (2007)	$r = .31$	3.26	Yes
Trustworthiness					
Social	Cooperation in behavioral games and trust in game partner	Balliet & Van Lange (2013) ³³¹	$r = .58$	13.23	Yes
Work	Team performance and intrateam trust	De Jong et al. (2016) ²²¹	$r = .30$	3.13	Yes
Work	Task performance within organizations and trust in leader	Legood et al. (2021) ²²²	$r = .26$	2.66	NA
Work	Organizational citizenship behavior and trust in leader	Legood et al. (2021) ²²²	$r = .30$	3.13	NA
Environment	Climate-friendly behavior and trust in scientists	Cologna & Siegrist (2020) ²²³	$r = .33$	3.55	Yes
Environment	Climate-friendly behavior and trust in environmental science	Cologna & Siegrist (2020) ²²³	$r = .38$	4.44	Yes
Environment	Climate-friendly behavior and trust in industry	Cologna & Siegrist (2020) ²²³	$r = .14$	1.67	Yes
Health	Compliance with COVID-19 protection behaviors and political trust	Devine et al. (2023) ²²⁴	$r = .11$	1.49	Yes
Environment	Climate change adaptation behavior and trust in government	van Valkengoed & Steg (2019)	$r = .12$	1.55	Yes

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out?</i>
Environment	Climate-friendly behavior and trust in government institutions	Cologna & Siegrist (2020) ²²³	$r = .17$	1.87	Yes
Health	COVID-19 vaccination and political trust	Devine et al. (2023) ²²⁴	$r = .10$	1.44	Yes
Work	Work performance and distributed justice	Cohen-Charash & Spector (2001) ²²⁶	$r = .13$	1.61	NA
Work	Work performance and procedural justice	Cohen-Charash & Spector (2001) ²²⁶	$r = .45$	6.22	NA
Work	Work performance and interactional justice	Cohen-Charash & Spector (2001) ²²⁶	$r = .16$	1.80	NA
Work	Counterproductive work behavior and procedural justice	Cochran (2014) ³³²	$r = -.11$	1.49	NA
Work	Counterproductive work behavior and interpersonal justice	Cochran (2014) ³³²	$r = -.27$	2.77	NA
Work	Counterproductive work behavior and informational justice	Cochran (2014) ³³²	$r = -.21$	2.18	NA
Work	Organizational citizen behavior and procedural justice	Viswesvaran & Ones (2002) ³³³	$r = .24$	2.45	NA
Work	Productivity and procedural justice	Viswesvaran & Ones (2002) ³³³	$r = .16$	1.80	NA
Work	Organizational citizen behavior and distributed justice	Viswesvaran & Ones (2002) ³³³	$r = .15$	1.73	NA
Work	Productivity and distributed justice	Viswesvaran & Ones (2002) ³³³	$r = .08$	1.34	NA
Crime	Compliance and procedural justice (cross-sectional)	Walters & Bolger (2019) ³³⁴	$r = .10$	1.44	Yes
Crime	Compliance and procedural justice (longitudinal)	Walters & Bolger (2019) ³³⁴	$r = .06$	1.24	Yes
Descriptive Norms					
Health	Blood donation and descriptive norms	Bednall et al. (2013) ²⁰⁵	$r = .03$	1.12	Yes

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out?</i>
Environment	Recycling and general pro-environmental behavior and descriptive norms	Geiger et al. (2019) ²⁰⁶	$r = .38$	4.44	Yes
Environment	Recycling and recycling descriptive norms	Geiger et al. (2019) ⁸⁴	$r = .33$	3.55	Yes
Health	Adolescent sexual behavior and descriptive norms	van de Bongardt et al. (2015) ¹⁴	$r = .40$	4.87	Yes
Health	Smoking initiation and close friend descriptive norms	East et al. (2021) ²²⁷	$OR = 2.53$	2.53	Yes
Health	Smoking initiation and parental descriptive norms	East et al. (2021) ²²⁷	$OR = 1.88$	1.88	Yes
Health	Condom use and descriptive norms	Sheeran et al. (1999) ⁸³	$r = .37$	4.24	NA
Environment	Conservation and descriptive norms	Niemiec et al (2020) ¹⁰	$r \text{ to } z = .17$	1.87	NA
Health	Health behaviors and descriptive norms	McEachan et al. (2016) ³²⁷	$r = .27$	2.77	Yes
Consumer	Consumer behavior and descriptive norms	Melnyk et al. (2022) ⁹	$r = .31$	3.26	Yes
Cross	Cross-domain behavior and descriptive norms	Manning et al. (2009) ³³⁰	$r = .34$	3.71	Yes
Environment	Climate change adaptation behavior and descriptive norms	van Valkengoed & Steg (2019) ⁸⁵	$r = .29$	3.00	Yes
Environment	Car use and descriptive norm	Lanzini & Kahn (2015) ¹⁵⁹	$r = .26$	2.66	Yes
Environment	Car use and habit	Gardner & Abraham (2008) ¹⁸⁶	$r = .36$	4.05	NA
Social Support					
Health	Exercise and support from important others	Carron et al. (1996) ²³⁸	$d = .44$	2.22	NA
Health	Exercise and support from family	Carron et al. (1996) ²³⁸	$d = .36$	1.92	NA
Health	Exercise and support from class members	Carron et al. (1996) ²³⁸	$d = .32$	1.79	NA
Health	Exercise and support from class leaders	Carron et al. (1996) ²³⁸	$d = .31$	1.76	NA
Health	Adherence to medical treatment and cohesive families	Dimatteo (2004) ²³⁷	$OR = 1.74$	1.74	NA
Health	Adherence to medical treatment and high-conflict families	Dimatteo (2004) ²³⁷	$OR = 1.53$	1.53	NA

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out?</i>
Health	Maternal behaviors and emotional support	Andresen & Tellen (1992) ²³⁹	$r = .31$	3.26	NA
Health	Maternal behaviors and material support	Andresen & Tellen (1992) ²³⁹	$r = .27$	2.77	NA
Health	Maternal behaviors and informational support	Andresen & Tellen (1992) ²³⁹	$r = .31$	3.26	NA
Health	Maternal behavior and father absent from home	Booth et al. (2018) ²⁹⁶	$r = -.12$	1.55	NA
Health	Health behaviors during pregnancy and social support	Cannella et al. (2016) ²⁴⁶	$r = .20$	2.10	Yes
Material Incentives					
Health	Smoking cessation towards the end of pregnancy and financial incentives provided as vouchers for biochemically validated	Morgan et al. (2015) ³³⁵	$RR = 2.58$	2.58	NA
Environment	Environmentally friendly application of pesticide and subsidies	Li et al. (2023) ²⁴⁵	$d = 0.12$	1.24	Yes
Access					
Health	Health behaviors during pregnancy and income	Cannella et al. (2016) ²⁴⁶	$r = .26$	2.66	Yes
Health	Health behaviors during pregnancy and employment	Cannella et al. (2016) ²⁴⁶	$r = .14$	1.67	Yes
Health	Maternal behavior and income	Booth et al. (2018) ²⁹⁶	$r = .29$	3.00	Yes
Health	Maternal behavior and composite SES	Booth et al. (2018) ²⁹⁶	$r = .29$	3.00	NA
Environment	Environmentally friendly application of pesticide and income	Li et al. (2023) ²⁴⁵	$d = 0.06$	1.12	Yes
Health	Condom use and socio-economic status	Sheeran et al. (1999) ⁸³	$r = .05$	1.20	NA
Environment	Waste sorting and income	Rousta et al. (2020) ²⁹⁵	$r = .02$	1.08	Yes
Environment	Environmentally friendly application of pesticide and production cost	Li et al. (2023) ²⁴⁵	$d = 0.23$	1.52	Yes

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out?
Environment	Environmentally friendly application of pesticide and farm size	Li et al. (2023) ²⁴⁵	$d = -0.02$	1.04	Yes
Environment	Environmentally friendly application of pesticide and pesticide price	Li et al. (2023) ²⁴⁵	$d = -0.36$	1.92	Yes
Health	Condom use and condom availability	Sheeran et al. (1999) ⁸³	$r = .41$	5.11	NA
Environment	Recycling and house ownership	Geiger et al. (2019) ⁸⁴	$r = .16$	1.80	Yes
Environment	Recycling and possession of bin	Geiger et al. (2019) ⁸⁴	$r = .24$	2.45	Yes
Environment	Recycling and distance towards drop off location	Geiger et al. (2019) ⁸⁴	$r = -.11$	1.49	Yes
Environment	Recycling and recycling facilities in place	Geiger et al. (2019) ⁸⁴	$r = .26$	2.66	Yes
Other					
Environment	Recycling and house type	Geiger et al. (2019) ⁸⁴	$r = .12$	1.55	Yes
Environment	Recycling and size of neighborhood	Geiger et al. (2019) ⁸⁴	$r = -.17$	1.87	Yes

Note. OR = Odds Ratio. RR: Risk Ratio. d and g : Standardized mean differences. r : Pearson correlation. Following Cohen's effect size classification⁶⁵, d s smaller than 0.2 are negligible, those equal to or larger than 0.2 and smaller than 0.5 are small, those equal or larger than 0.5 but smaller than 0.8 are medium, and those equal or larger than 0.80 are large. Correspondingly, r s smaller than .1 are negligible, those equal to or larger than .1 but smaller than .24 are small, those equal to or larger than .24 but smaller than .37 are medium, and those greater or equal to .37 are large. With our conversion⁶³, ORs smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. Extreme publication bias ruled out was coded *Yes* if analyses did not suggest extreme bias, *No* when they did, and NA when they were not performed.

Table 5
Studies of Social and Structural Intervention Effects

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out
Legal and administrative sanctions					
Work	Deviant employee behavior and formal sanction severity	Trang & Brendel (2019) ¹⁹⁹	$r = .29$	3.00	NA
Work	Deviant employee behavior and informal sanction severity	Trang & Brendel (2019) ¹⁹⁹	$r = .23$	2.36	NA
Work	Deviant employee behavior and formal sanction certainty	Trang & Brendel (2019) ¹⁹⁹	$r = .33$	3.55	NA
Work	Deviant employee behavior and informal sanction certainty	Trang & Brendel (2019) ¹⁹⁹	$r = .31$	3.27	NA
Work	Deviant employee behavior and sanction celerity	Trang & Brendel (2019) ¹⁹⁹	$r = .22$	2.27	NA
Crime	Gun violence and programs that attempt to reduce firearm	Makarios & Pratt (2012) ³⁴⁸	$r = -.14$	1.67	Yes
Environment	Pro environmental behavior and penalties	Greene et al. (2023) ²⁴³	$d = -0.12$	0.80	Yes
Injunctive Norms					
Cross	Cross domain behavior and injunctive norm intervention	Rhodes et al. (2020) ²⁰⁷	$d = 0.34$	1.85	Yes
Environment	Resource conservation and injunctive norm intervention	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.10$	1.20	Yes
Monitors and Reminders					
Health	Vaccination and reminders	Liu et al. (2023) ⁸⁶	$OR = 1.11$	1.11	Yes
Health	Physical activity and digital self-monitoring interventions	Wang et al. (2023) ³⁴⁹	$d = 0.56$	2.76	Yes
Health	Sedentary behavior and digital self-monitoring interventions	Wang et al. (2023) ³⁴⁹	$d = -0.34$	1.85	Yes
Health	Vaccination and computer reminder	Shea et al. (1996) ³⁵⁰	$OR = 3.09$	3.09	Yes

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out</i>
Health	Breast cancer screening and computer reminder	Shea et al. (1996) ³⁵⁰	OR = 1.88	1.88	Yes
Health	Cervical cancer screening and computer reminder	Shea et al. (1996) ³⁵⁰	OR = 1.15	1.15	Yes
Health	Colorectal cancer screening and computer reminder	Shea et al. (1996) ³⁵⁰	OR = 2.25	2.25	Yes
Health	All preventive care and computer reminder	Shea et al. (1996) ³⁵⁰	OR = 1.02	1.02	Yes
Health	Other preventive care and computer reminder	Shea et al. (1996) ³⁵⁰	OR = 1.77	1.77	Yes
Health	Vaccination and manual reminder	Shea et al. (1996) ³⁵⁰	OR = 2.46	2.46	Yes
Health	Breast cancer screening and manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.63	1.63	Yes
Health	Cervical cancer screening and manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.10	1.10	Yes
Health	Colorectal cancer screening and manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.85	1.85	Yes
Health	All preventive care and manual reminder	Shea et al. (1996) ³⁵⁰	OR = 0.99	0.99	Yes
Health	Other preventive care and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.57	1.57	Yes
Health	Vaccination and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 3.06	3.06	Yes
Health	Breast cancer screening and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.88	1.88	Yes
Health	Cervical cancer screening and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 1.12	1.12	Yes
Health	Cervical cancer screening and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 2.71	2.71	Yes
Health	Colorectal cancer screening and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 2.57	2.57	Yes
Health	All preventive care and computer plus manual reminder	Shea et al. (1996) ³⁵⁰	OR = 2.23	2.23	Yes
Trustworthiness					
Health	Health-relevant behavior and trust in healthcare settings	Mosley (2021) ²²⁵	$g = 0.13$	1.27	Yes
Cross	Cross-behavior and interventions to increase trust in authorities	Jung et al. (2023) ³³⁷	$d = 0.60$	2.97	Yes
Work	Work performance and distributed justice	Cohen-Charash & Spector (2001) ²²⁶	$r = .05$	1.2	NA

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out</i>
Work	Work performance and procedural justice	Cohen-Charash & Spector (2001) ²²⁶	$r = .11$	1.49	NA
Crime	Restitution compliance and restorative justice	Latimer et al. (2005) ³³⁸	$r = .33$	3.55	NA
Crime	Reduction in recidivism and restorative justice	Latimer et al. (2005) ³³⁸	$r = .07$	1.29	NA
Descriptive Norms					
Cross	Cross-domain and descriptive norm intervention	Rhodes et al. (2020) ²⁰⁷	$d = 0.10$	1.20	Yes
Health	Alcohol consumption and descriptive norm intervention	Dotson et al. (2015) ²³¹	$d = 0.29$	1.89	Yes
Health	Health behavior and descriptive norm intervention	Sheeran et al. (2016) ¹¹	$d = 0.36$	1.92	NA
Environment	Environmental behavior and descriptive norm intervention	Greene et al. (2023)	$d = 0.18$	1.39	Yes
Environment	Conservation behavior and modeling	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.51$	2.52	Yes
Environment	Conservation behavior and group feedback	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.29$	1.69	Yes
Environment	Conservation behavior and social comparison feedback	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.13$	1.27	Yes
Health	Physical activities and social features in mobile apps	Tong & Laranjo (2018) ²³³	$d = 0.96$	5.71	Yes
Environment	Environmental mitigation behavior and social comparison	Bergquist et al. (2023) ²	$d = 0.37$	1.96	Yes
Social Support					
Health	Adherence to antiretroviral medication and social support provision	Shushtari et al. (2023) ²⁴⁰	$OR = 1.66$	1.66	Yes
Health	Adherence to weight loss and social support provision	Lemstra et al. (2016) ³³⁶	$RR = 1.29$	1.29	Yes
Health	Suicide prevention and social support provision	Hou et al. (2022) ²⁴¹	$RR = 0.48$	2.05	Yes

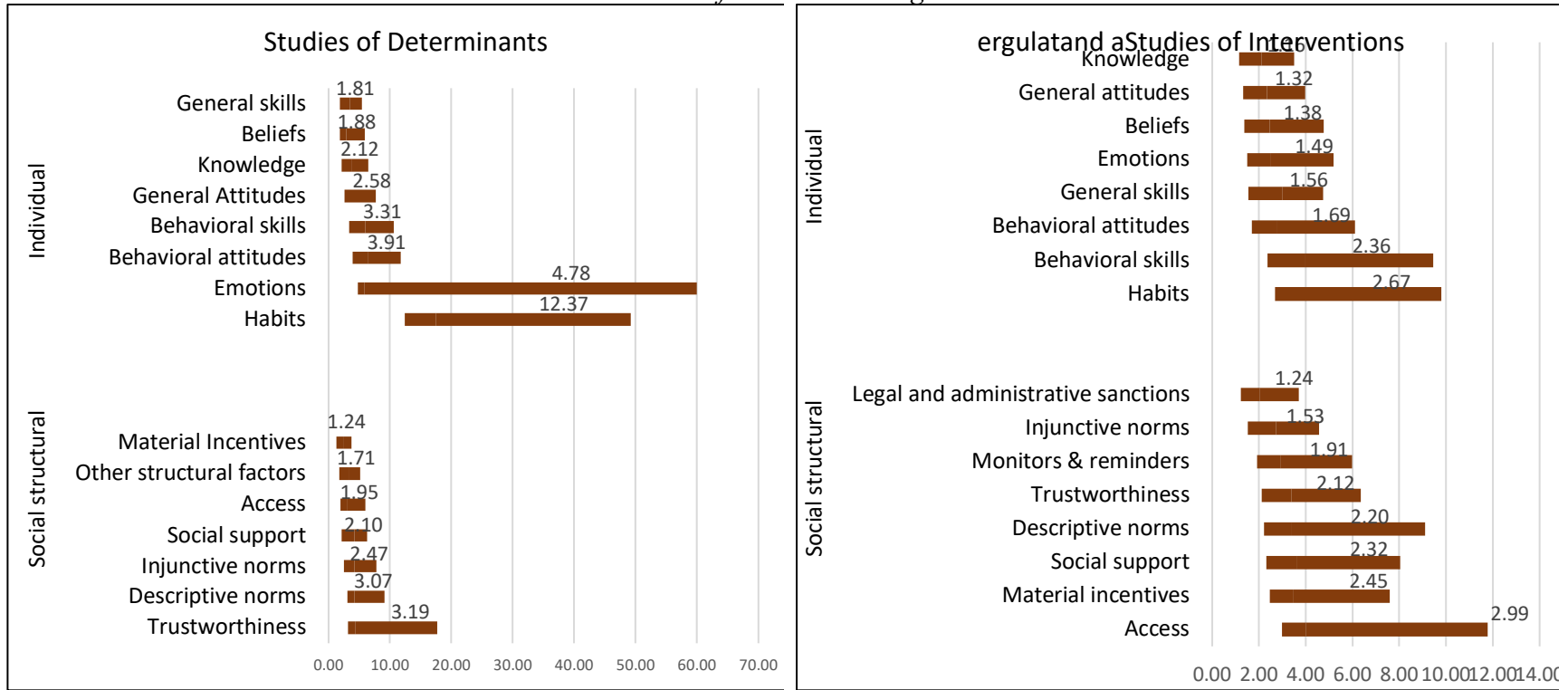
Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	<i>Extreme publication bias ruled out</i>
Environment	Resource conservation and appointing block leader	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.82$	4.43	Yes
Environment	Resource conservation and public commitment	Abrahamse & Steg (2013) ²⁰⁸	$g = 0.58$	2.86	Yes
Environment	Environmental mitigation and public commitment	Bergquist et al. (2023) ²	$d = 0.26$	1.60	Yes
Material Incentives					
Health	Vaccination and incentives for vaccination	Liu et al. (2023) ⁸⁶	$OR = 1.26$	1.26	Yes
Environment	Pro environmental behavior and financial incentives	Maki et al. (2016) ³⁴⁴	$d = 0.36$	1.92	Yes
Health	Stimulant use and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.70$	3.56	Yes
Health	Cigarette use and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.78$	4.12	Yes
Health	Illicit opioid use and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.58$	2.86	Yes
Health	Medication adherence and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.75$	3.90	Yes
Health	Polysubstance use and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.46$	2.30	Yes
Health	Therapy attendance and material incentives	Bolivar et al. (2021) ²⁴⁴	$d = 0.43$	2.18	Yes
Health	Smoking abstinence and competitions for incentives	Fanshawe et al. (2019) ³⁴⁵	$RR = 1.16$	1.16	NA
Health	Health behavior and financial incentives	Haff et al. (2015) ³⁴⁶	$OR = 3.96$	3.96	NA
Health	Physical activity or weight loss and financial incentives	Gong et al. (2018) ^{243,347}	$d = 0.4$	2.07	Yes
Environment	Environmental mitigation behavior and financial incentives	Bergquist et al. (2023) ²	$d = 0.32$	1.79	Yes
Health	Adherence to weight loss and financial incentives	Lemstra et al. (2016) ³³⁶	$RR = 1.02$	1.02	Yes
Access					
Health	Smoking and income maintenance	Courtin et al. (2020) ³⁰⁷	$OR = 0.99$	1.01	NA
Health	Smoking and housing/neighborhood changes	Courtin et al. (2020) ³⁰⁷	$OR = 1.06$	0.94	NA

Domain	Determinant and domain	Meta-analysis	Reported Effect Size	OR	Extreme publication bias ruled out
Health	Vaccination and access to vaccination	Liu et al. (2023) ⁸⁶	OR = 1.26	1.26	Yes
Health	Fruits and vegetables consumption and provision	Micha et al. (2017) ³³⁹	r to z = .28	2.80	Yes
Health	Adherence to prescription and copayments for prescriptions	Sinnot et al. (2013) ³⁴⁰ 189	OR = 1.11	1.11	NA
Health	Alcohol sales/use and alcohol price and tax levels	Wagenaar et al. (2009) ²⁵²	r = -.44	5.92	NA
Health	Selection of food and lower food availability	Hollands et al. (2019) ³⁴¹	d = -1.13	7.77	Yes
Health	Food consumption and lower food availability	Hollands et al. (2019) ³⁴¹	d = -0.55	2.71	Yes
Health	Food selection and lower food proximity	Hollands et al. (2019) ³⁴¹	d = -0.65	3.25	Yes
Health	Food consumption and lower food proximity	Hollands et al. (2019) ³⁴¹	d = -0.6	10.57	Yes
Social	Women's control over household expenses and microfinancing	Vaessen et al. (2014) ²⁴⁷	d = -0.01	1.02	Yes
Health	Fruit and vegetable choice and food placement	Broers et al. (2017) ³⁴²	d = 0.39	2.03	Yes
Social	Donation behavior and defaults (no time pressure)	White et al. (2021) ²⁵¹	OR = 1.20	1.20	NA
Social	Donation behavior and defaults (time pressure)	White et al. (2021) ²⁵¹	OR = 2.36	2.36	NA
Cross	Cross-domain behavior and default choice formats	Jachimowicz et al. (2019) ²⁵⁰	d = 0.68	3.43	Yes
Environment	Environmental behavior and choice architecture	Greene et al. (2023) ²⁴³	d = 1.40	12.67	No
Cross	Cross-domain behavior and decision structure	Mertens et al. (2021) ³⁴³	d = 0.54	2.66	Yes

Note. OR = Odd Ratio. RR: Risk Ratio. d and g : Standardized mean differences. r : Pearson correlation. Following Cohen's effect size classification⁶⁵, d s smaller than 0.2 are negligible, those equal to or larger than 0.2 and smaller than 0.5 are small, those equal or larger than 0.5 but smaller than 0.8 are medium, and those equal or larger than 0.80 are large. Correspondingly, r s smaller than .1 are

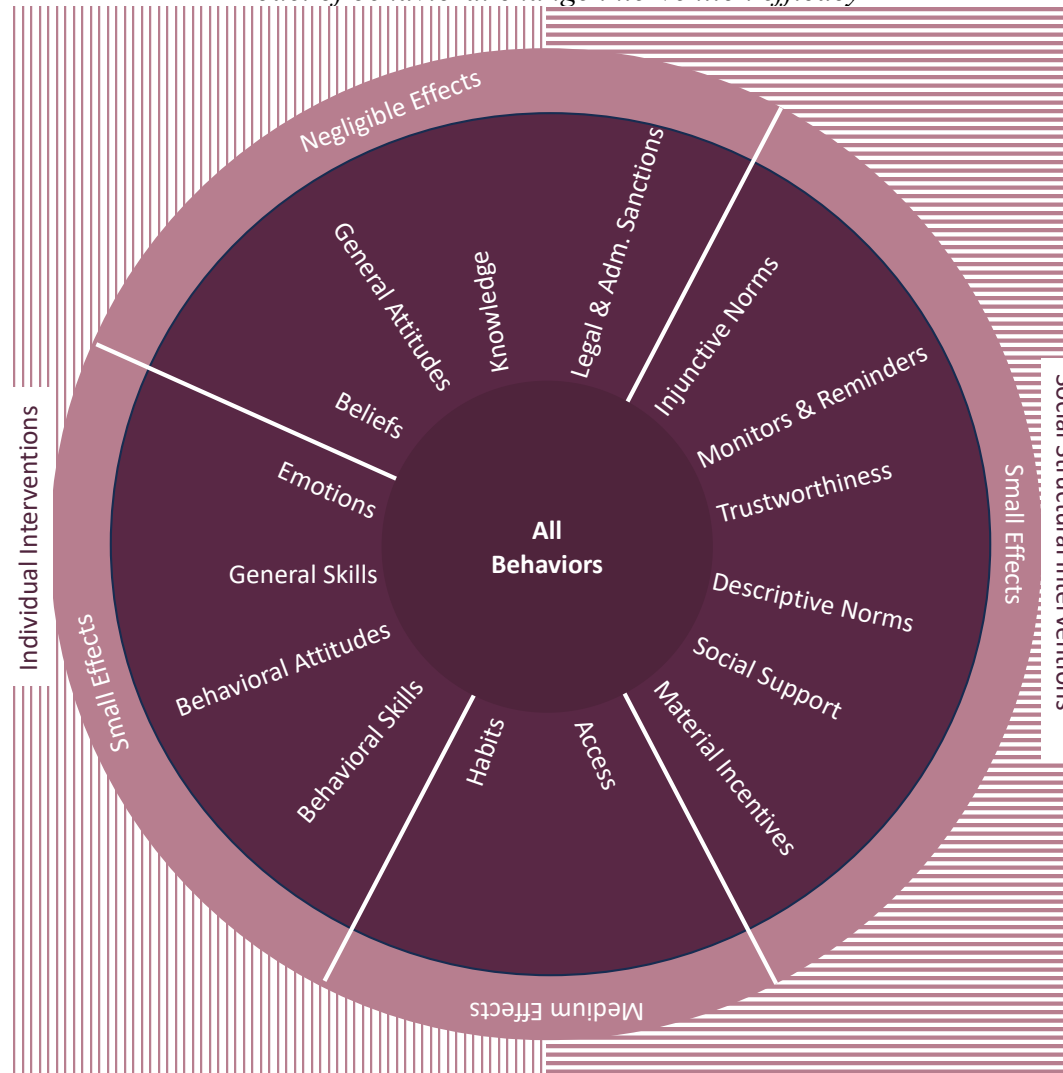
negligible, those equal to or larger than .1 but smaller than .24 are small, those equal to or larger than .24 but smaller than .37 are medium, and those greater or equal to .37 are large. With our conversion⁶³, *ORs* smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. Extreme publication bias ruled out was coded *Yes* if analyses did not suggest extreme bias, *No* when they did, and *NA* when they were not performed.

Figure 1
Studies of Behavior Change



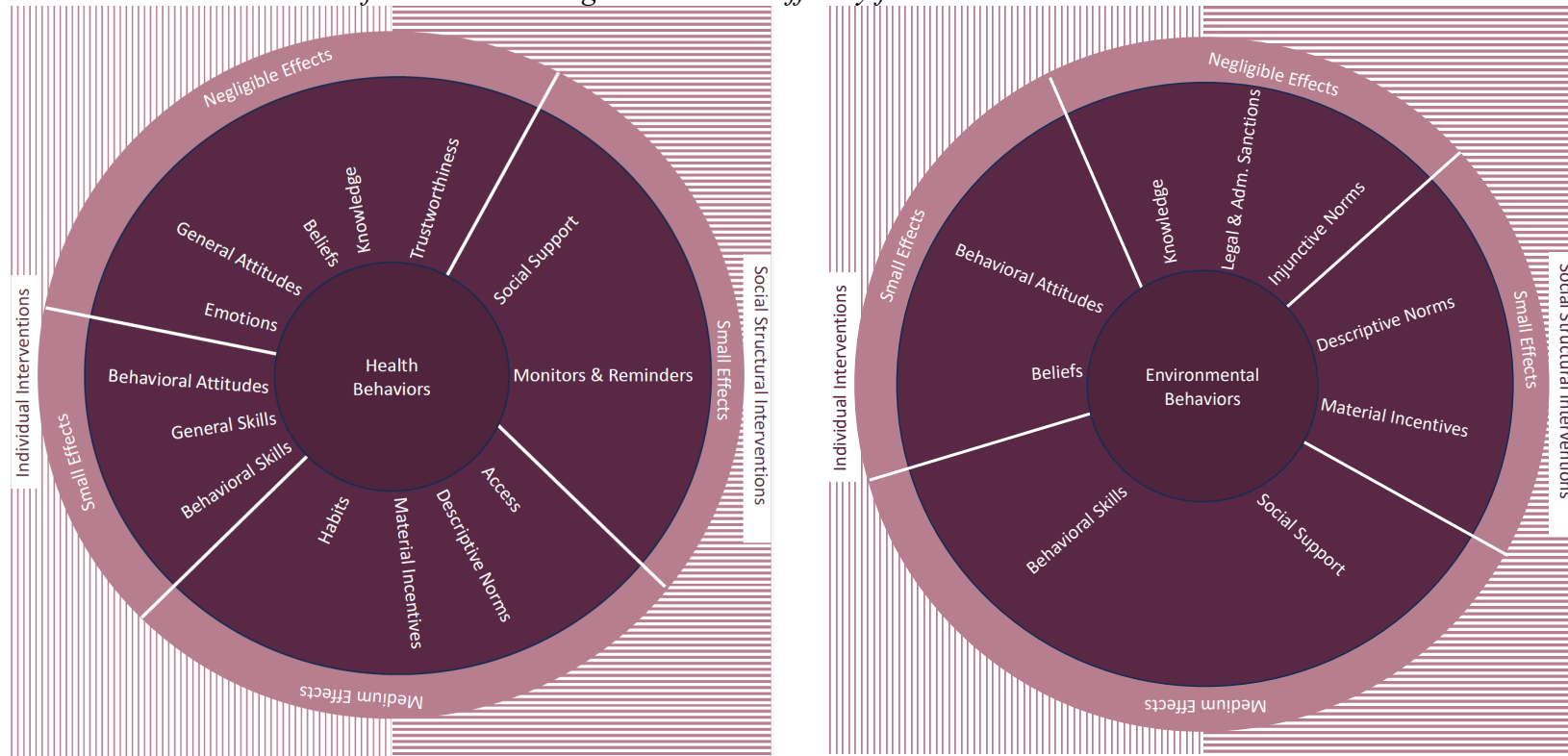
Note. Figure shows mean and ranges of effect sizes for studies that excluded extreme publication bias. Following Cohen's effect size classification⁶⁵, ORs smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large.

Figure 2
Model of behavioral change intervention efficacy



Note. The figure shows the model of behavioral change interventions that resulted from this review. Individual and social-structural factors appear to the left (vertical stripe background) and right (horizontal stripe background), respectively. Within each side of the circle, the order of the variables goes from smaller effects on top to larger ones on the bottom. Following Cohen's effect size classification⁶⁵, *ORs* smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. The order of the variables is based on the average effect sizes for each behavioral target (Figure 1 and Tables 3 and 5). Only studies that excluded extreme publication bias were included.

Figure 3
Model of behavioral change intervention efficacy for health and environmental behaviors



Note. The figure shows the results for health and environmental behaviors. Individual and social-structural factors appear to the left (vertical stripe background) and right (horizontal stripe background), respectively. Within each side of the circle, the order of the variables goes from smaller effects on top to larger ones on the bottom. Following Cohen's effect size classification⁶⁵, *ORs* smaller than 1.44 are negligible, those equal to or larger than 1.44 but smaller than 2.48 are small, those equal to or larger than 2.48 but

smaller than 4.27 are medium, and those greater or equal to 4.27 are considered large. The order of the variables is based on the average effect sizes for each behavior (see Tables 3 and 5). Only studies that excluded extreme publication bias were included.