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Attitudes, Intentions and Behavior Change

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Attitudes, Intentions and Behavior Change

Abstract

Are attitudes or intentions related to behavior change? Does changing attitudes or intentions change behavior? These are important questions for increasing our understanding of the determinants of behavior and how to change behavior. This review employs four stages of the experimental medicine approach to answer these questions. First, attitudes and intentions have been identified as key determinants of behavior in many theories (identification stage). Second, correlational studies show that attitudes and intentions have small to medium-sized relationships with behavior change, while experimental studies show that medium-sized changes in attitudes and intentions produce small-sized changes in behavior (validation stage). Third, evidence shows that interventions can change attitudes or intentions (engagement stage). Fourth, changes in attitudes and intentions at least partially mediate intervention effects on behavior change (intervention stage). A systematic program of experimental work is needed to extend understanding of what works for whom, when, and how, and for what behaviors.

Key words: attitudes, intentions, behavior change, attitude change, intention change, intervention.

Introduction

Understanding, predicting and changing individuals' behavior has been an important focus for psychological research over many decades (Ajzen & Fishbein, 1980; Hagger, 2025; Hagger et al., 2020; Sheeran et al., 2017; Verplanken & Orbell, 2022). In part, this is attributable to the importance of individual behavior change to tackling key issues faced by modern societies. For example, population health could be improved if individuals increased protection (e.g., healthy eating; physical activity etc.) and decreased risk (e.g., smoking; drinking alcohol, etc.) health behaviors (Conner & Norman, 2015). The impact of pandemics and epidemics could be lessened if people took up vaccinations and engaged in behaviors to reduce the risk of transmission. Similarly, individual behavior change (e.g., reduced meat consumption and fossil fuel use; greater recycling) could contribute to tackling climate change and global heating (Steg, 2023).

Attitudes and intentions have long been considered important psychological determinants of behavior (Fishbein & Ajzen, 1975) and their potential malleability has made them a focus of attention in relation to engendering behavior change (Ajzen & Fishbein, 1980). Interest in attitudes, intentions and other modifiable determinants of behavior change has been given renewed impetus in recent years due to their assumed role in helping explain *how* behavior change interventions exert their influence (Michie et al., 2013). For example, in the behavior change area, a focus on identifying and classifying effective techniques for changing behavior (i.e., Behavior Change Techniques; BCTs; Michie et al., 2013) is being supplemented by work to understand how such interventions work. This has focused attention on so called mechanisms of action or mediators (i.e., intervention targets) such as attitudes and intentions that help explain the impact of interventions. The Experimental Medicine

(EM) Approach (Nielsen et al., 2018; Sheeran et al., 2017) and Operating Conditions Framework (OCF; Rothman & Sheeran, 2021) provides an important account of how to systematically study interrelationships between interventions, mechanisms of action (such as attitudes and intentions) and behavior change plus potential moderators (Figure 1). This provides a novel overarching framework for the current review.

Experimental Medicine Approach and Operating Conditions Framework

The EM Approach is a general framework for linking interventions to outcomes via intervention targets (Davidson et al., 2020). In relation to behavior change, it links interventions to change behavior through mechanisms of action (i.e., mediators) that are held to cause behavior (Sheeran et al., 2017), with the OCF exploring moderators of these links (Rothman & Sheeran, 2021). Application of this approach to behavior change involves four stages (Figure 1). The first stage (i.e., identification) involves identifying targets or mechanism of actions (e.g., attitudes or intentions) that might cause behavior change and are modifiable. The second stage involves assessing the impact of mechanisms of action on behavior change (i.e., the validation pathway). Both correlational and experimental evidence is relevant. Moderators of relationships between mechanisms of action and behavior change are also explored at this stage (i.e., validity moderators). Subsequent stages draw almost exclusively on experimental research. The third stage assesses the impact of different manipulations/interventions on changes in the mechanisms of action (i.e., engagement pathway) and moderators of these effects (i.e., engagement moderators). The fourth and final stage (i.e., standard efficacy trial) tests whether an intervention produces change in behavior through change in the mechanism of action (i.e., mediation model) and can also assess moderators (i.e., intervention

moderators). The current review of the relationships between attitudes, intentions and behavior change is organized by these four stages of the EM Approach/OCF. The final section of the review integrates evidence from the earlier sections on attitudes and intentions in relation to behavior change and outlines key future research directions.

Focus on Behavior Change

A second novel aspect of the current review is the focus on associations between attitudes, intentions and behavior *change* rather than behavior *per se*. When reviewing correlational research, we prioritize prospective studies that measure attitudes and/or intentions at baseline and behavior at baseline plus at a later time point; such designs allow for an examination of how well attitudes and intentions predict behavior change (i.e., via controlling for past behavior). Where such evidence is lacking, particularly when considering moderators, we also draw on findings from correlational studies that do not control for past behavior. The focus on prospective studies (i.e., that measure attitudes and/or intentions at baseline and behavior at a later time point) help address one important concern with cross-sectional studies, the issue of temporal direction of effect (i.e., from attitudes or intentions to behavior). However, correlational research cannot be used to assess the *causal* impact of attitudes and intentions on behavior change (Rothman & Sheeran, 2020). Doing so requires experimental studies that provide the strongest evidence for causal impact. When reviewing experimental research, we focus on studies that have sought to experimentally induce changes in attitudes and/or intentions. Where such studies also assess the impact of interventions on subsequent behavior, the extent to which attitudes and/or intentions mediate the effects can also be tested.

In reviewing the literature on attitudes, intentions and behavior change the current review classified the size of effects in correlational and experimental studies in terms of small, medium and large effect sizes for correlational (*r* and *partial r*) and experimental (*d* or *g*) studies for comparison purposes. In doing so the review relies on interpretations of effect sizes provided by Cohen (1992), i.e., small effect size: *r* = .10, *partial r* = .02; *d* or *g* = 0.20; medium effect size: *r* = .30, *partial r* = .15; *d* or *g* = 0.50; large effect size: *r* = .50, *partial r* = .35; *d* or *g* = 0.80.

Identification Stage: What to target?

An important initial stage of the EM Approach is the identification of potential targets or mechanisms of action. These are variables that potentially drive behavior change and can be targeted in interventions. The identification stage is predominantly about hypothesis generation, while subsequent stages are more focused on hypothesis testing in relation to identified targets. McGuire (1997) provides a range of creative heuristics to generate hypotheses (e.g., analysing one's own behavior in similar situations, imagining the effects of reducing a variable to zero, multivariate fishing expeditions). Attitudes and intentions have long been identified as potential mechanisms of action for behavior change. This has resulted in attitudes and intentions having a prominent role in various theories of behavior change (Conner & Norman, 2015; Michie et al., 2014) and being potential targets for a broad range of intervention studies.

Focus on Attitudes and Intentions

The current review therefore focuses on two reflective determinants (Strack & Deutsch, 2004) of behavior change, namely attitudes and intentions. The justification for the focus on attitudes and intentions as opposed to other key

(reflective and impulsive) determinants (e.g., norms, self-efficacy, risk perceptions, habits, associations) that are outlined in theories of behavior change is twofold. First, both variables play central roles in a broad range of theories developed in relation to behavior change, i.e., they are key variables. For example, in a review of health behavior change, Sheeran et al. (2017) identified 13 theories and detailed the key cognitions about the focal behavior they specified. Intentions (appeared in 10 theories) and attitudes (appeared in 11 theories) were the most frequently included motivational variables. Second, attitudes and intentions are the reflective psychological variables with the largest and strongest evidence base in relation to their impact on behavior change. For example, in relation to attitudes, a recent review (Albarracín et al., 2024) highlighted that interventions targeting attitudes towards behaviors (alongside habits) were most effective in producing behavior change. In relation to intentions, reviews regularly highlight intentions as having the strongest correlation with behavior/behavior change (McEachan et al., 2011).

Definitions of Attitudes and Intentions

Attitudes are defined here as being overall evaluations of an attitude object (Eagly & Chaiken, 1991). In relation to predicting behavior change, the focus is usually on attitudes towards a behavior, i.e., overall evaluation of engaging in a behavior (Fishbein & Ajzen, 1975). Attitudes towards a behavior are most commonly measured using semantic differential measures (e.g., 'My avoiding red meat is… bad-good'; Ajzen, 2002; Conner & Sparks, 2015). More recently it has become common to distinguish instrumental or cognitive (e.g., healthy–unhealthy, valuable–worthless) from experiential or affective (e.g., pleasant–unpleasant, interesting–boring) attitudes. These two components of attitudes towards a behavior have medium-sized inter-correlations, but can be discriminated based on underlying belief

systems, different functions, experimental manipulations, and empirical differences (Conner & Sparks, 2015). Fishbein and Ajzen (2010) suggested that the sub-components reflect the more general construct (i.e., experiential and instrumental attitudes both reflect overall attitudes). However, research increasingly uses them as distinct influences on behavior change (e.g., McEachan et al., 2016). Attitudes towards behavior are central to a range of theories about the determinants of behavior including the reasoned action theories (i.e., Theory of Reasoned Action, Theory of Planned Behavior, Reasoned Action Approach; Fishbein & Ajzen, 2010). A range of other theories include similar concepts, although labelled differently (e.g., perceived benefits – Health Belief Model; response efficacy – Protection Motivation Theory; outcome expectancies – Social Cognitive Theory; see Conner & Norman, 2015).

Behavioral intentions are defined as self-instructions or decisions to act (Sheeran & Webb, 2016; Triandis, 1980) capturing the underlying motivation (Rogers, 1983) or commitment (Sheeran & Webb, 2016) to act. It is common to distinguish goal (e.g., 'I intend to get fit') and behavioral (e.g., 'I intend to engage in physical activity at least five times per week') intentions, with the former focusing on achieving desired goals and the latter focusing on engaging in a behavior (perhaps in the service of reaching a goal). It is the latter that are the focus here. Behavioral intentions are central to a range of theories about the determinants of behavior. For example, they are the proximal and sole determinant of action in the reasoned action theories (Fishbein & Ajzen, 2010) and protection motivation theory (Rogers, 1983), and one of several proximal determinants of behavior in social cognitive theory (Bandura, 1997) and the health action process approach (Schwarzer & Luszczynska, 2015). See Side Bar for some common definitions of attitudes and intentions.

Validation Stage: Linking Attitudes and Intentions to Behavior Change

The validation pathway involves assessing the impact of mechanisms of action (e.g., attitudes or intentions) on behavior change and potential moderators of these relationships (i.e., validation pathway/moderators, Figure 1). Validation evidence from correlational studies that relate attitudes and intentions to behavior/behavior change is considered first, followed by validation evidence from experimental studies linking changes in attitudes and intentions to behavior change. Moderators are considered separately for correlational and experimental evidence.

Validation Evidence from Correlational Studies

Attitudes

Research in psychology on relationships between attitudes and behavior dates back over 90 years (e.g., LaPierre, 1934). Classic reviews (e.g., Eagly & Chaiken, 1991; Kraus, 1995) indicate medium-sized relationships between attitudes and behavior (r_+ ~ .30). Table 1 summarizes six meta-analyses of prospective studies reporting each of the relationships between attitudes, intentions and behavior/behavior change (i.e., controlling for past behavior or not). The frequency-weighted correlation between attitudes and behavior across 426 studies was r_+ = .30, indicating a medium-sized effect. When controlling for past behavior, the size of the frequency-weighted partial correlation between attitudes and behavior change across 239 studies was *partial* r_+ = .14, again indicating a medium-sized effect.

Studies summarized in Table 1 mainly used overall evaluation measures of attitudes (e.g., My engaging is regular physical activity is… bad—good). Reviews that focus on attitude measures based on experiential evaluations report similar sized relationships between attitudes and behavior: r_+ = .30 (McEachan et al., 2016).

In contrast, attitude measures based on instrumental evaluations (e.g., harmful-healthy) report small to medium-sized relationships with behavior: r_+ = .19 (McEachan et al., 2016). The meta-analysis of Hagger et al. (2017) showed that when entered simultaneously, both experiential (*partial* r_+ = .28) and instrumental (*partial* r_+ = .10) attitudes were predictive of behavior, although only the former remained a significant predictor of behavior change (experiential attitude: *partial* r_+ = .13; instrumental attitude: *partial* r_+ = .05), with both effects attenuated. Stronger effects for experiential over instrumental attitudes on behavior change are not limited to short-term follow-ups. For example, Conner et al. (2022a) showed that when entered simultaneously, experiential attitudes were significant predictors of behavior change, while instrumental attitudes were not. It is worth noting the fact that measures of past and future behavior usually share common method variance (see Ajzen, 2002; Conner et al., 1999) perhaps leading to underestimates of the effects of attitudes on behavior change (see Weinstein, 2007).

Intentions

Research in psychology on relationships between behavioral intentions and behavior now dates back around 50 years (Fishbein & Ajzen, 1975). Reviews (e.g., Conner & Norman, 2022; Sheeran, 2002; Sheeran & Webb, 2016) indicate a medium to large-sized average correlation between intentions and behavior (r_+ ~ .30–.50). Table 1 summarizes six meta-analyses of prospective tests of the relationships between intentions and behavior/behavior change (i.e., controlling for past behavior or not). The frequency-weighted correlation between intentions and future behavior across 465 studies was r_+ = .42, a medium to large-sized effect. In the sub-set of studies that controlled for past behavior, the impact of intentions on behavior change across 239 studies was also a medium to large-sized effect (partial

r_+ = .22). Behavioral intentions have also been shown to be predictive of behavior change over considerable periods of time. For example, Conner et al. (2002a) showed intentions to have a medium to large-sized effect on behavior change over six years for healthy eating (*partial* r_+ = .29).

Reasoned action theories (Fishbein & Ajzen, 2010) propose that intentions should fully mediate the effect of attitudes on behavior and behavior change. This suggests that the effect of attitudes on behavior/behavior change should become non-significant when controlling for intentions. The large-sized effect of attitudes on intentions in meta-analyses (r_+ = .51 across 521 tests in Table 1) is consistent with the idea that intentions are, at least, partial mediators of the attitude-behavior relationship. Mediation tests of the average correlations reported in Table 1 indicate the medium-sized effect of attitude on behavior (r_+ = .30) is partially mediated when controlling for intentions (*partial* r_+ = .12, $p < .001$), while the medium-sized effect of attitude on behavior change (*partial* r_+ = .14, $p < .001$) is fully mediated when controlling for intentions (*partial* r_+ = .04, $p = .30$). Similarly, the meta-analysis of Hagger et al. (2018) showed that when experiential and instrumental attitudes are entered simultaneously, only the former is predictive of behavior change, and its effect on behavior change is fully mediated by intentions (effect reduced from *partial* r_+ = .13, $p < .001$ to *partial* r_+ = .05, $p = .13$ controlling for intentions).

Validation Moderators in Correlational Studies

Attitudes

A wide variety of moderators of the relationship between attitudes and behavior/behavior change have been identified. These include methodological factors (e.g., objectively assessed versus self-reported behavior, Wallace et al.,

2005), aspects of the behavior (e.g., degree of perceived control over the behavior) and population (e.g., younger versus older samples) under study. The focus here is on moderators that help inform behavior change efforts, the majority of which are aspects of attitude strength (Krosnick & Petty, 1995).

Attitude strength has been defined as “the extent to which attitudes manifest the qualities of durability and impactfulness” (Krosnick & Petty, 1995, p. 3). Durability includes stability over time and resistance to change efforts, while impactfulness includes biasing the processing of information and guiding behavior. These have been labelled the defining features of attitude strength (Luttrell & Sawicki, 2020) and are distinguished from predictors of attitude strength. On this view, the strength of the attitude-behavior relationship is a marker of a strong attitude, while predictors of attitude strength are moderators of the attitude-behavior relationship. The four defining features of attitude strength show a degree of interrelationship. For example, a strong attitude is likely to be predictive of behavior, in part, because it is resistant to change, stable over time and leads to bias in the processing of information about the attitude object (Krosnick & Petty, 1995). Temporal stability of attitudes has been identified as one important mechanism through which strong attitudes better predict behavior (i.e., prediction explanation; Fabrigar et al., 2005). As Schwartz (1978) noted, attitudes will not likely predict subsequent behavior unless they persist over the intervening time interval between when the two are measured. Several studies support this prediction explanation (Davidson & Jaccard, 1979; Schwartz, 1978; see also Glasman & Albarracín, 2006). For example, Conner et al. (2022a), across three studies, showed more stable instrumental and experiential attitudes were each more predictive of behavior change (i.e., controlling for past behavior). However, when considered

simultaneously, it was only more stable experiential attitudes that were predictive of behavior change. Moreover, temporally stable experiential attitudes predict behavior over periods as long as ten years (Conner & Norman, 2021). This would suggest that increasing attitude stability may be one useful way to increase its impact on behavior change.

Howe and Krosnick (2017) listed 11 predictors of attitude strength (extremity, intensity, vested interest, accessibility, certainty, importance, knowledge, moral basis, elaboration, ambivalence, cognitive-affective consistency) that may moderate attitude-behavior relationships. *Extremity* is the measure of attitude strength that is most widely used and incorporated into most measures of attitudes. For example, typical measures of attitude employ bipolar response formats with a neutral mid-point (e.g., 'For me, recycling plastics each week over the next month is…bad – good'; scored 1-7). Such measures simultaneously tap the valence (i.e., negative for scores 1-3; neutral for a score of 4; positive for scores 5-7) and extremity (i.e., scored as the distance from the neutral point; scores of 5 and 7 both indicate positive attitudes but the latter score indicates a more extreme positive score than the former) of the attitudes. Considerable evidence indicates that more extreme attitudes are more predictive of behavior and more stable over time (see Abelson, 1995, for review).

Of the other predictors of attitude strength identified by Howe and Krosnick (2017), eight have been shown to moderate attitude-behavior relationships: *accessibility* (i.e., likelihood that attitudes will come to mind automatically in relevant situations; Fazio et al., 1982; see Cooke & Sheeran, 2004, Glasman & Albarracin, 2006, for reviews); *knowledge* (i.e., amount of information the person has about the attitude object; Davidson et al., 1985); *elaboration* (i.e., degree of thought or careful

consideration given to the attitude object's merits and shortcomings; Barden & Petty, 2008); *moral basis* (i.e., degree to which an attitude is a strong and absolute belief that something is right versus wrong, moral versus immoral, or it reflects core moral values and convictions; Judge et al., 2012; Skitka & Bauman, 2008); *ambivalence* (i.e., degree to which an individual has both positive and negative reactions to an attitude object; Armitage & Conner, 2000; Conner et al., 2021; see Cooke & Sheeran, 2004; Van Gent et al., 2024, for reviews); *cognitive-affective inconsistency* (i.e., absolute difference between the cognitive and affective evaluations of an attitude object, irrespective of whether these evaluations are oppositely valenced or not; Conner et al., 2021); *certainty* (i.e., degree of confidence an individual has that his or her evaluation of the attitude object is correct/clear to him or her; see Cooke & Sheeran, 2004, for review); and *importance* (i.e., degree to which an individual attaches significance to the attitude; Bolson, 2013; Kokkinaki & Lunt, 1997; Ziegler & Schlett, 2016); whereas two have received little attention as moderators of attitude-behavior relationships (*intensity*: degree to which a person's evaluation of the attitude object activates powerful emotions; Howe & Krosnick, 2017; *vested interest*: degree to which the attitude object is perceived to be of significant personal consequence; Crano, 1995; Howe & Krosnick, 2017).

In contrast, tests of the ability of attitude strength predictors to moderate the attitude-behavior change relationship are mostly lacking or have produced inconsistent effects. For example, Conner et al. (2002b) showed attitudinal ambivalence to moderate attitude-behavior change relationships, while Conner et al. (2021) reported cognitive-affective inconsistency to significantly moderate attitude-behavior change relationships in one out of two studies.

There are few tests of multiple predictors of attitude strength as simultaneous

moderators of attitude-behavior/behavior change relations. One exception is Conner et al. (2022b) who explored the simultaneous effects of eight potential moderators as well as the extent to which the stability of attitudes accounts for any moderation effects. Eight predictors of attitude strength (certainty, importance; knowledge; moral basis; elaboration; felt ambivalence; cognitive-affective potential ambivalence; cognitive-affective inconsistency) were tested as individual and simultaneous moderators of attitude-behavior relationships (across a set of COVID-19 protection behaviors). Six of the predictors of attitude strength (i.e., not elaboration or cognitive-affective potential ambivalence) were significant moderators of attitude-behavior relations in individual tests. Attitude importance and cognitive-affective inconsistency were the only significant moderators of attitude-behavior relations in simultaneous tests, with only the former remaining significant when controlling for the moderating effects of attitude stability. Reanalysis of this dataset indicated that both attitude importance and cognitive-affective inconsistency were also significant moderators (*p*s < .01) of the relationships between attitudes and behavior change (i.e., when controlling for past behavior), but became non-significant when also controlling for the moderating effects of attitude stability (*p*s > .05). These findings point to the potential value of targeting attitude strength, and attitude importance and cognitive-affective inconsistency (in particular), in order to increase the impact of attitudes (via more stable attitudes) on behavior change.

Intentions

Intentions have medium to large-sized average relationships with behavior and behavior change (Table 1), but these relationships are also highly variable. Examining moderators of these relationships offers one way to account for this variability. A wide range of moderators of the intention-behavior relationship have

been examined (see Conner & Norman, 2022; Rhodes et al., 2022; Sheeran & Webb, 2016; Webb & Sheeran, 2006, for reviews), but tests of moderators of the intention-behavior change relationship are more limited. For example, Rhodes et al. (2022) reviewed 144 moderators of the intention-physical activity relationship. The most consistent moderator was temporal stability of intentions (significant in 10 of 13 tests; see also Cooke & Sheeran, 2004 review). Temporal stability of intentions has been identified as one important mechanism through which intentions determine behavior and is a limiting condition in reasoned action theories (Fishbein & Ajzen, 2010), i.e., intentions should only predict behavior to the extent that they remain unchanged between when they are measured and the time point at which they influence behavior. Various studies support the moderating effects of temporal stability on intention-behavior relationships. For example, Conner and Godin (2007) reported that the intention-behavior relationship was much stronger in those with more stable [1SD above mean] than less stable [1SD below mean] intentions (r_+ = .60 vs r_+ = .27). Only a few studies have examined the moderating effect of temporal stability on relationship between intention and behavior change. For example, Conner et al. (2002a) showed that when intentions to eat a healthy diet were stable over six months, they were significantly more predictive of changes in healthy eating behavior six years later. Similar findings have been reported by Norman et al. (2022) in relation to Covid-19 protection behaviors. Taken together, these findings suggest that increasing the stability of an intention may be one useful way to increase its impact on behavior change. Indeed, Sheeran and Abraham (2003) showed that the effects of a number of moderators of intention-behavior relations (i.e., intention certainty, past behavior, self-schema, anticipated regret and attitudinal control) were fully explained by their effects on intention stability. This might suggest

changing these variables as means to increase intention stability.

Other important moderators of the relationship between intentions and behavior/behavior change are here grouped under goal dimensions, basis and structure of intention, and strength predictors (see Conner & Norman, 2022 for detailed discussion). The goal dimensions explored as moderators of the relationship between intentions and behavior prominently include goal difficulty, priority and conflict. Goal difficulty is a function of the goal and the skills, resources, and effort an individual can bring to achieving the goal. The power of intentions to predict behavior decreases as goal difficulty increases (e.g., Sheeran & Abraham, 2003). Reasoned action theories (Fishbein & Ajzen, 2010) posit this as an interaction between intentions and perceived behavioral control, although reviews provide only mixed support (Armitage & Conner, 2001; Hagger et al., 2022; Rhodes et al., 2022). Sheeran and Webb (2016) argue that these mixed findings may be attributable to respondents under-estimating actual difficulty for more complex behaviors. The observation that the reported intention-health behavior relationship is weaker in individuals from more compared to less deprived circumstances (e.g., Conner et al., 2013; Schüz et al., 2017, 2020, 2021) may also be attributable to the same goal being of greater difficulty in deprived groups due to variations in the opportunities, resources, ability, skills, time and effort required to realize the goal (Schüz, 2017; Sheeran & Webb, 2016). Conner et al. (2013, Study 3) and Schüz et al. (2021) showed these effects for deprivation extended to moderation of the intention-behavior change relationship (i.e., controlling for past behavior). Goal conflict (i.e., the focal goal conflicting with other goals) has also been shown to attenuate the intention-behavior relationship in several studies (significant in 6 of 9 tests in Rhodes et al., 2022), but tests on intention-behavior change relationships are

currently lacking. Goal priority is an important concept in understanding the pursuit of multiple goals and refers to the temporary increase in importance attached to, and resources directed towards, one goal compared to other goals – that serve to benefit the performance of the the prioritized behavior (Unsworth et al., 2014). Few studies have examined the moderating effect of goal dimensions in relation to the intention-behavior change relationship, although Conner et al. (2016b) showed goal priority to moderate both the intention-behavior and intention-behavior change relationships in one study. Reducing goal conflict and increasing goal priority may be useful targets for interventions designed to change behavior, with experimental studies supporting this view for goal priority (e.g., Conner et al., 2016a, 2022c).

The basis and structure of intentions has also been explored as an intention-behavior moderator and to a lesser extent an intention-behavior change moderator. For example, intentions based on attitudes versus norms (Sheeran & Orbell, 1999) and experiential versus instrumental attitudes (Keer et al., 2014) are more predictive of behavior. In addition, high levels of moral norms (Godin et al., 2005), anticipated regret (Sheeran & Abraham, 2003), and self-identity (Carfora et al., 2017; Sheeran & Orbell, 2000) have each been associated with stronger intention-behavior relationships. Rhodes et al. (2022) reported that level of experiential attitudes (significant in 4 of 6 tests), anticipated regret (4 of 5 tests), and physical activity personal/self-identity (5 of 7 tests) each significantly moderated the intention-physical activity relationship. Conner et al. (2016b) showed that out of instrumental attitude, experiential attitude, injunctive norm, descriptive norm, and anticipated regret, it was intentions based on anticipated regret that most strongly predicted health behavior change. Notably this effect remained when also controlling for the moderating effect of intention stability. Other studies have shown that drawing

attention to anticipated regret via measuring it (i.e., Question-Behavior Effect; Wilding et al., 2016; Wood et al., 2016) is sufficient to moderate the intention-behavior change relationships for sports center use (Sandberg & Conner, 2011) and cervical screening attendance (Sandberg & Conner, 2009). Recent studies have reported that various aspects of the structure of intentions moderate the intention-behavior change relationship, including the degree of reasoned action (i.e., how well behavior-relevant cognitions predict intentions; Sheeran & Conner, 2019), motivational coherence (i.e., extent to which predictors of intentions such as attitudes, norms, and perceived behavioral control cohere or point in the same direction; Sheeran & Conner, 2017) and the realism of the intentions (i.e., based on considerations of the expectations that the behavior could be performed; Avishai et al., 2019). Future research should prioritize studies that manipulate these aspects of the basis and structure of intentions and observe effects on behavior change.

Drawing on the attitude strength literature, Conner and Norman (2022) highlighted nine predictors of intention strength that might be expected to moderate intention-behavior and intention-behavior change relationships: extremity, accessibility, moralization, ambivalence, cognitive-affective inconsistency, knowledge, elaboration, certainty, and importance. However, supportive evidence is only available in relation to intention-behavior moderation for accessibility (Bassili, 1993, 1996; Doll & Ajzen, 1992; see Cooke & Sheeran, 2004, for a review of five studies), moralization (Godin et al., 2005), ambivalence (Armitage & Conner, 2004), and certainty (Bagozzi & Yi, 1989; Bassili, 1993; Sheeran & Abraham, 2003; see Cooke & Sheeran, 2004, for review). Conner et al. (2023) showed that an overall measure of intention strength (based on certainty, importance, moralization, knowledge, elaboration) moderated the intention-behavior change relationship

across eight Covid-19 protection behaviors (e.g., wearing a face mask in public) over a two-month period. This relationship was also moderated by intention stability, goal priority and goal conflict, and controlling for their moderating effects reduced the moderating effects of intention strength to non-significance. This would suggest that while strong intentions are more predictive of behavior change, this is attributable to stronger intentions being more stable over time, more prioritized over competing intentions and less conflicting with other intentions. Additional studies should further test intention strength as an intention-behavior change moderator and test the effects of manipulating strength.

Validation Evidence in Experimental Studies

Attitudes

Sheeran et al. (2016) conducted a meta-analytic review of experimental studies that assessed the impact of changing attitudes on subsequent intentions and behavior. Studies had to fulfil three criteria to be included: participants were randomly allocated to condition (e.g., intervention versus control); the intervention produced significant attitude change (comparing intervention and control conditions); and a follow-up assessment of intentions and/or behavior was reported. The 87 interventions included in the review had a small to medium-sized effect on attitudes ($d_+ = 0.47$). In turn, these interventions had a significant small to medium-sized effect on behavior ($d_+ = 0.38$), indicating that changing attitudes led to behavior change. The interventions were also found to have a significant small to medium-sized effect on intentions ($d_+ = 0.48$). It was noteworthy that the effect of changing attitudes on intentions was larger than the effect on behavior, consistent with attitude-behavior models, such as reasoned action theories (Fishbein & Ajzen, 2010) which posit that the effect of attitudes on behavior should be mediated by intentions.

Sheeran et al. (2016) conducted mediation analyses which indicated that the effect of changing attitudes on behavior change was significantly, but only partially, mediated by changes in intentions (i.e., a significant direct effect of attitudes change on behavior change remained), suggesting the presence of other non-reasoned routes through which attitude change produces behavior change as outlined in dual process models of behavior (Strack & Deutsch, 2004).

As noted earlier, a distinction can be made between instrumental and experiential attitudes. Given that experiential attitudes show stronger correlations with behavior change than instrumental attitudes they are likely to represent useful targets for engendering behavior change. Experimental evidence in support of this proposition is provided by several primary studies (e.g., Carfora et al., 2016; Conner et al., 2011). Rhodes et al. (2019) conducted a meta-analysis of 32 studies in the physical activity domain that assessed the impact of interventions on affective judgements (including experiential attitudes, but also other affective judgements). Interventions were reported to have a significant small to medium-sized effect on affective judgements ($g_+ = 0.43$) and, in the 14 studies that also assessed subsequent behavior, a similar sized significant effect on physical activity ($g_+ = 0.38$). Importantly, the size of changes in affective judgements was predictive of the size of the changes in physical activity, consistent with the idea that changing affective judgements produces corresponding changes in behavior.

Intentions

Several reviews have reported meta-analyses of experimental studies that assess the impact of changing intentions on subsequent behavior change. These reviews have included studies that: randomly allocated participants to condition (e.g., intervention versus control); produced significant differences in intentions; and

included follow-up assessment of behavior. The reviews sought to assess the extent to which changing intentions leads to corresponding changes in behavior.

The most comprehensive meta-analytic review to date was conducted by Webb and Sheeran (2006) and included 47 experimental studies that evidenced statistically significant differences in the strength of intentions between intervention and comparison conditions. On average, the interventions had a medium-sized effect on intentions ($d_+ = 0.66$) and a significant, but small to medium-sized, effect on behavior ($d_+ = 0.36$). In contrast, 15 additional studies that did not produce significant changes in intentions ($d_+ = 0.07$) were found to have a significantly smaller effect on behavior ($d_+ = 0.20$). Moreover, a strong correlation ($r = .57$) was found between the effect sizes for intention change and behavior change, indicating that interventions that produced greater changes in intentions also produced greater changes in behavior. Mediation analyses further revealed that changes in intentions partially mediated the effects of interventions on behavior change (i.e., a significant direct intervention effect on behavior remained), suggesting the operation of other mechanisms by which intervention influenced behavior change, such as increasing self-efficacy.

Rhodes and Dickau (2012) conducted a similar meta-analysis focusing solely on 11 experimental studies that targeted physical activity intentions and behavior. The interventions had a significant small to medium-sized effect on intention change ($d_+ = 0.45$), but only a small-sized effect on physical activity change ($d_+ = 0.15$). These results provide weaker evidence for purported causal links between intentions and behavior given the smaller effect on behavior change. Encouragingly, Rhodes and Dickau (2012) reported a strong correlation ($r = .50$) between the effect sizes for

intention change and behavior change, again indicating that interventions that produced greater changes in intentions also produced greater changes in behavior.

McDermott et al. (2016) reviewed 25 experimental studies that produced significant changes in intentions related to physical activity or healthy eating and assessed behavior at follow-up. In line with Webb and Sheeran (2006), they reported that the interventions had a medium-sized effect on intentions ($d_+ = 0.64$) and a significant but small to medium-sized effect on behavior ($d_+ = 0.41$). These findings underscore the proposition that changing intentions leads to behavior change.

Taken together, these reviews provide evidence for the purported causal impact of intentions on behavior change. In particular, interventions that change intentions also tend to produce behavior change and the impacts of these interventions on behavior change appear to be, at least, partially (statistically) mediated by changes in intentions. However, the smaller magnitude of changes observed in behavior versus intentions signals the need to consider volitional (i.e., post-intentional) processes, such as self-monitoring and action planning, that may aid the translation of intentions into action (Carver & Scheier, 1982; Schwarzer & Luszczynska, 2015).

Validation Moderators from Experimental Studies

Attitudes

The Sheeran et al. (2016) meta-analysis discussed above reported tests of a limited number of (validation) moderators of the effect of changing attitudes on behavior change. A range of predominantly methodological moderators was examined, including features of the study design and quality, construct measurement

and sample characteristics. For example, studies with better quality randomization and blinding procedures were associated with larger sized effects of attitude change on behavior change. However, of more theoretical interest was the finding that the type of behavior targeted in the interventions moderated intervention effects on behavior. First, interventions that sought to increase performance of a behavior (e.g., exercise more frequently) had larger effects than those that sought to reduce performance of a behavior (e.g., avoid unhealthy snacks). It is likely that (the goal of) reducing, is more difficult than that of increasing, performance of a behavior. Second, interventions that successfully changed attitudes had smaller effects on prevention behaviors performed frequently (e.g., diet) compared to infrequently (e.g., cancer screening) or disease management behaviors (e.g., blood pressure self-monitoring). This is consistent with the idea that behaviors performed frequently in stable contexts are more likely to come under the control of habitual rather than reflective processes such as attitudes (Gardner et al., 2020; Ouellette & Wood, 1998).

It is noteworthy that only a limited number of predominantly methodological validation moderators have been tested in experimental studies. Moreover, few studies have examined conceptual moderators of the effects of changing attitudes on behavior change, although Conner et al. (2011) reported that the effects of messages targeting affective attitudes on exercise behavior were significantly stronger for those who scored high on need for affect (Maio & Esses, 2001) as well as for those who scored low on need for cognition (Cacioppo et al., 1984). Future research could usefully draw on and test validation moderators have been tested in correlational studies, including attitude importance, cognitive-affective inconsistency and temporal stability (Conner et al., 2022b).

Intentions

In their review, Webb and Sheeran (2006) outlined three broad factors that may moderate the effect of intention change on behavior change. First, the effect of changing intentions on behavior change may vary according to study characteristics, such as the nature of the sample although, for example, Webb and Sheeran (2006) found that the size of intervention effects on behavior were no different for student versus nonstudent samples. Second, measurement characteristics may also moderate the effect of interventions that change intentions on behavior change. For example, Webb and Sheeran (2006) found that the length of the follow-up period moderated the effect of changing intentions on behavior change, with larger effect sizes found for interventions with short (≤ 11.5 weeks) versus long (> 11.5 weeks) follow-up periods. How behavior was measured also mattered, with larger effects of changes in intention typically observed on objective measures of behavior than on self-report measures. Third, and of more theoretical interest, Webb and Sheeran (2006) identified three conceptual factors that moderated of the effect of changing intentions on behavior change: (i) Interventions that changed intentions were found to be more effective when participants had higher levels of control (rated or perceived) over the target behavior, consistent with the goal difficulty moderation findings discussed earlier; (ii) Interventions were also more effective when the target behavior was a health-promoting versus a health-risk behavior, consistent with the prototype-willingness model (Gibbons et al., 2003) which posits that many health-risk behaviors are reactions to social influences and situations (i.e., a social reaction pathway) whereas health-promoting behaviors are more likely to be the result of reflective processes (i.e., a reasoned pathway); (iii) Interventions were less effective when the target behavior was performed under conditions likely to promote habitual

control. Ouellette and Wood (1998) propose that when a behavior is performed frequently in a stable context it is likely to under the control of habitual processes, thereby weakening the influence of more reflective (i.e., intentional) processes. Future research could also test validation moderators that have been tested in correlational studies, including the temporal stability (Sheeran & Abraham, 2003), strength (Conner et al., 2023) and structure (Avishai et al., 2019; Sheeran & Conner, 2017, 2019) of intentions plus goal difficulty (Hagger et al., 2022).

Engagement Stage: Changing Attitudes and Intentions

The engagement stage involves assessing the impact of different manipulations/interventions on changes in the mechanisms of action (e.g., attitudes or intentions). Research reviewed in the previous section on testing the validation pathway highlights that attitudes and intentions are associated with behavior change and that changing attitudes or intentions produces corresponding changes in behavior. However, an important unanswered initial question is: can we change attitudes and/or intentions? In order to answer this question, experimental research on whether interventions can change attitudes and intentions and how much change is observed is reviewed (i.e., engagement evidence). A subsequent question is: what factors influence the magnitude of effect on attitude and/or intention change? Research on moderators of intervention effects on attitudes and intentions (i.e., engagement moderators) is reviewed to address this question.

Engagement Evidence

Attitudes

Several meta-analyses report the average effect size of interventions designed to change attitudes. For example, Sheeran et al. (2016) reported a small

to medium-sized change in attitudes (d_+ = 0.47) across 87 interventions that successfully changed attitudes. In contrast, Steinmetz et al. (2016) reported a small-sized change in attitudes (d_+ = 0.24) across 70 interventions designed to change attitudes within the context of reasoned action theories (Fishbein & Ajzen, 2010). Finally, Rhodes et al. (2019) reported a meta-analysis of 32 studies that assessed the impact of interventions on affective judgements (including experiential attitudes) in the physical activity domain. The interventions had a significant small to medium-sized effect on affective judgements (g_+ = 0.43). Each of these reviews observed considerable heterogeneity in the effect size for change in attitudes suggesting the value of exploring engagement moderators.

Intentions

Several meta-analyses report the average effect size of interventions designed to change intentions. For example, Steinmetz et al. (2016) reported a small-sized effect (d_+ = 0.34) across 70 interventions designed to change intentions in the context of reasoned action theories (Fishbein & Ajzen, 2010). In contrast, Webb and Sheeran (2006) reported a medium-sized effect (d_+ = 0.66) across 47 interventions that had a significant effect on intention change. Sheeran et al. (2016) reported that 87 interventions that successfully changed attitudes (d_+ = 0.47), 21 that changed norms (d_+ = 0.62), and 109 that changed self-efficacy (d_+ = 0.65), were each associated with medium-sized changes in intentions (d_+ = 0.48, 0.49, 0.51, respectively). Finally, Knittle et al. (2018) examined interventions that were associated with significant changes in intentions in physical activity studies. Across 77 studies, the interventions were found to have a small-sized effect on intentions (d_+ = 0.17). Considerable heterogeneity in the effect sizes for intention change was

again apparent in each of these reviews suggesting the value of exploring engagement moderators.

Engagement Moderators

Attitudes and Intentions

Rothman and Sheeran (2021) highlight the behavior, the target population and the context in which the intervention is administered as potential engagement moderators, although most research attention has focused on the content or features of the intervention. For example, graphic images of the outcomes of smoking have been used to increase the effectiveness of messages to change attitudes towards smoking (Noar et al., 2016), while repeated exposure to messages has been used to increase impacts on intention change (Keller & Lehman, 2008).

There are several excellent general reviews of the attitude change literature (e.g., Albarracín & Shavitt, 2018; Glasman & Albarracín, 2006; Hamilton & Johnson, 2020). Interventions to change attitudes prominently employ persuasive messages and in-person discussions of the benefits of behavior change (Albarracín et al., 2024). This research has drawn heavily on the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986; Petty et al., 2017) to examine how best to change attitudes. In line with the ELM, considerable research supports the idea that messages with strong, as opposed to weak, arguments produce more attitude change (Johnson & Eagly, 1989), particularly when they are carefully considered (i.e., elaborated on). Strong messages may be more effective because they present consequences that are more positive for the message recipients and these effects are stronger when the motivation to process the message is high.

One area that has received attention in relation to attitude and behavior change is the extent to which persuasive messages are matched to the characteristics of the message recipients. In a systematic review and meta-analysis of 702 studies, Joyal-Desmarais et al. (2022) reported that, compared to control conditions, motivationally matched persuasive messages produced small to medium-sized increases in attitudes ($r+ = .21$), intentions ($r+ = .19$) and observed behavior ($r+ = .18$). It was notable that similar effects were apparent across health, environmental, prosocial, political and consumer behaviors..

In contrast to the work on attitudes, there is more limited research on which content or features of an intervention produce the greatest change in intentions, although a number of moderators considered in the attitude literature may be relevant. For example, psychological reactance (Rains, 2013) often reduces the effect of persuasive messages, although self-affirmation can be used to increase message acceptance with consequent effects on intentions and behavior (Epton et al., 2017).

Behavior Change Techniques (BCTs)

A prominent focus of work in the behavior change domain in the last few years has been an examination of intervention content in terms of the BCTs (Michie et al., 2013) included. Research on BCTs in relation to how best to change attitudes and intentions is reviewed below. Three main approaches are considered: namely, expert consensus, literature synthesis and meta-analysis. Supplementary Tables 1 and 2 provide details of the BCTs linked to attitude or intention change in the various studies reviewed in this section.

First, expert consensus studies have been conducted to identify specific BCTs, using Michie et al.'s (2013) taxonomy, that could be used to change specific determinants of behavior (including attitudes and intentions). For example, Connell et al. (2019) asked 105 experts to rate, discuss and rerate links between 61 BCTs and 26 potential mechanisms of action (including attitudes and intentions) through which BCTs may produce behavior change. The experts had at least 80% agreement on only two BCTs that could be used to change attitudes: pros and cons, and framing/reframing. In contrast, the experts agreed (≥ 80%) on six BCTs that should produce changes in intentions: goal setting (behavior), goal setting (outcome), behavioral contract, commitment, comparative imagining of future outcomes, and incentives (outcome).

A second, related, approach has been to chart the extent to which intervention studies describe a purported link between a BCT and mechanism of action. For example, Carey et al. (2019) conducted a literature synthesis which coded links between 77 BCTs and 26 potential mechanisms of actions as described in 277 published interventions. They then assessed the extent to which certain links were described more frequently than expected. Eight BCTs were frequently linked to attitude change as a mechanism of action: pros and cons; framing/reframing; information about health consequences; salience of consequences; information about social and environmental consequences; information about emotional consequences; material incentive (behavior); incompatible beliefs. In contrast, only two BCTs were frequently linked to changes in intentions as a mechanism of action: information about health consequences; information about others' approval.

Interestingly, there were discrepancies between the purported links between BCTs and mechanisms of action identified by expert consensus and those identified

through the synthesis of published intervention studies. For example, of the eight links between BCTs and attitudes as a mechanism of action described in published intervention studies (Carey et al., 2019), only two (i.e., pros and cons; framing/reframing) were identified in the expert consensus exercise (Connell et al., 2019). Similarly, of the six BCTs linked with changes in intentions through expert consensus (Connell et al., 2019), none were described in published intervention studies more than expected (Carey et al., 2019). In an attempt to reconcile these differences, Johnston et al. (2021) conducted a triangulation exercise using consensus development methods with 16 behavior change experts. Following this exercise, five BCTs were linked to changing attitudes (i.e., pros and cons; framing/reframing; information about health consequences; information about social and environmental consequences; credible source), and three were linked to changing intentions (i.e., goal setting (behavior); incentive (outcome); information about health consequences). A key criticism of this approach is that it is primarily based on expert views on which BCTs should lead to changes in attitudes and/or intentions. As cautioned by Johnston et al. (2021), they are hypothesised links that await empirical confirmation. Thus, experimental work is needed to test whether a specific BCT produces a change in attitudes or intentions which, in turn, produces a corresponding change in behavior, preferably in multiple studies across different behaviors and populations and including mediation tests.

A third approach has been to conduct meta-analytic reviews to identify the BCTs included in interventions that are associated with greater changes in attitudes and/or intentions. For example, Rhodes et al. (2019) tested 17 potential BCTs as moderators of the effect of interventions on affective judgements (including experiential attitudes) in the physical activity domain. The presence (versus

absence) of six BCTs were associated with significantly *smaller* effects on affective judgements: problem solving, active planning, self-monitoring, social comparison, prompts/cues, and pros and cons. It is unclear why these BCTs should be associated with weaker effects on affective judgements, but one possibility is that they focus on more reflective/instrumental outcomes and self-regulation strategies than on experiential consequences or reactions. Knittle et al. (2018) examined the BCTs in physical activity interventions that were associated with significant changes in intentions. Interventions that included goal setting (behavior), self-monitoring (behavior), information about social and environmental consequences, behavioral practice, and mental rehearsal of successful performance were associated with significantly larger effects on intention. Interestingly, of the BCTs linked with changes in intentions in the triangulation exercise (Johnston et al., 2021), only one (setting behavioral goals) was found to be associated with increases in intentions in the Knittle et al. (2019) meta-analysis. Similarly, McDermott et al. (2016) coded the BCTs included in physical activity and healthy eating interventions using the earlier CALO-RE taxonomy (Michie et al., 2011). Only the inclusion of providing information about the consequences of behavior in general was associated with increased intentions, whereas the inclusion of relapse prevention/coping planning was associated with decreased intentions. Providing information on the consequences of behavior might be expected to strengthen attitudes towards the behavior (a key determinant of intention), whereas relapse prevention/coping planning is more focused on post-intentional processes so might be expected to have a weaker effect on changing intentions.

The evidence in relation to use of different BCTs and attitude and intention change is summarized in Supplementary Table 1. This comparison reveals little

overlap between BCTs identified through expert consensus and literature synthesis exercises and BCTs identified in meta-analyses of interventions. Considering BCTs that might be used to change intentions, the only overlaps were for techniques focusing on the provision of information about the behavior and goal setting. For changing attitudes, there was no overlap between the techniques identified through these two routes. Other meta-analyses have also examined different intervention techniques but not using Michie et al.'s (2011, 2013) taxonomies (see Supplementary Table 2). However, there is little overlap with those BCTs that have been linked to changing mechanisms of action using BCT taxonomies, except for the use of persuasive massages/information to change attitudes and the use of goal setting and incentives to change intentions.

Webb and Sheeran (2006) coded interventions that successfully changed intentions according to the BCTs they used. Only the use of incentives was found to have a large effect on intentions ($d_+ > 0.80$), although several other BCTs were associated with medium-sized effects on intentions ($d_+ > 0.50$): social encouragement, pressure and support, providing risk awareness material, providing information on the behavior and outcomes, including questions on the material, specifying a goal or target, forming a plan or implementation intention, and making environmental changes. Many of these BCTs target constructs (e.g., attitudes, norms, perceived risk, goals, etc.) posited as determinants of intentions in reasoned action theories (Fishbein & Ajzen, 2010), protection motivation theory (Rogers, 1983) and control theory (Carver & Scheier, 1982).

In their meta-analysis, Steinmetz et al. (2016) also sought to identify intervention techniques that were associated with changes in attitudes and intentions. Only increasing skills through advising or agreeing on how to perform the

behavior was found to have a significant effect (d_+ = 0.39) on changing attitudes. In contrast, three broad types of interventions were found to have significant effects on changing intentions: motivation (d_+ = 0.51), persuasion (d_+ = 0.35), and planning (d_+ = 0.10). Interestingly, in a meta-analysis of 317 studies, O'Keefe (2021) reported similar sized effects for persuasive messages on attitudes, intentions and behavior change.

In summary, while progress has been made in relation to the engagement pathway and identifying moderators of the effects of interventions on changing attitudes and intentions, it is notable that gaps in our understanding remain. For example, although the number of interventions designed to produce behavior change is rapidly increasing, many typically include multiple BCTs, prioritizing the changing of behavior over understanding the pathways to behavior change. As a result, it is often difficult to isolate the effect of a specific BCT on a specific mechanism of action. A sustainable and generalizable science of behavior change may be best served through experimental studies that test single BCTs (e.g., pros and cons) on limited numbers of mechanisms of action (e.g., attitudes) plus behavior and by meta-analyses that estimate robust effects sizes for specific technique-mediator links and that also test mediation and identify engagement moderators across a broad range of behaviors.

Attitudes and Intentions as Mediators of Intervention-Behavior Change Relationships

The final stage of EM Approach involves testing whether the intervention produces behavior change through changing the proposed mechanism of action (i.e., a mediation model). This is the fourth and final stage of applying the EM Approach. Evidence consistent with the mediation model comes from meta-analyses of the

behavioral effects of interventions that have successfully changed attitudes or intentions, which have shown that the effect of such interventions on behavior change are partially mediated by changes in intentions (e.g., Rhodes et al., 2021; Sheeran et al., 2016; Webb & Sheeran, 2006). In addition, a limited number of primary studies have also tested whether attitudes and intentions (as mechanisms of action) mediate the effect of an intervention on behavior change. For example, in relation to attitudes, Hillhouse et al. (2008) developed an information booklet based on models of health behavior decision making that sought to reduce indoor tanning behavior. Female students who engaged in indoor tanning were recruited and randomly allocated to receive the booklet or to a no intervention control condition. Participants in the intervention condition had less positive attitudes towards indoor tanning at one-month follow-up and engaged in indoor tanning less frequently at six-month follow-up than those in the control condition. Moreover, mediation analyses revealed that the effect of the intervention on indoor tanning behavior at six-month follow-up was mediated by changes in attitudes (see Chatzirantis & Hagger, 2005, for similar effects of an intervention on physical activity via attitude change). Hillhouse et al. (2008) also reported that the intervention had a significant effect on intentions, but did not conduct additional analyses to test whether the effect of the intervention on behavior via attitudes was further mediated by changes in intentions (i.e., serial mediation). Serial mediation has been tested in relation to interventions designed to change behavior via changing experiential attitudes and intention. For example, Carfora et al. (2016) tested the effect of messages targeting experiential or instrumental attitudes in relation to eating fruit and vegetables, versus a no message control condition, on intentions and subsequent intake. Mediation analyses showed that the effects of the experiential attitudes message on behavior change was via

serial mediation through experiential attitudes and intention. Other studies have also found that the effects of experiential messages on behavior change were mediated through experiential attitude change (e.g., Conner et al., 2011).

Intention change has been tested as a mediator in other studies (Sanderson & Jemmott, 1996). For example, Norman et al. (2018) developed persuasive messages based on the theory of planned behavior (Ajzen, 1991) to target binge drinking in university students in the UK. Approximately one month prior to starting university, participants were randomly allocated to receive the persuasive messages or not and then followed up over their first six months at university. Participants who received the messages were found to have weaker intentions to engage in binge drinking compared to those who did not receive the messages. Importantly, participants who received the messages also reported consuming fewer units of alcohol and binge drinking less frequently in their first six months at university. Mediation analyses further indicated that the effect of the intervention on alcohol consumption and binge drinking at six-month follow-up was mediated by changes in intention (and to a lesser extent, self-efficacy).

A larger body of primary studies that examine attitude and intention change as mediators of intervention-behavior change relationships is required. A particular issue is the proportion of the effect that is mediated. Where this proportion is low it might point to exploration other mediators and perhaps moderators of mediated pathways.

Attitudes, Intentions and Behavior Change

This final section briefly integrates and summarizes evidence from the above sections on identification, validation and engagement pathways for the effects of

attitudes and intentions on behavior change plus their moderators (see Figure 1). Areas for future research on the relationship between attitudes, intentions and behavior change are also highlighted.

The considerable evidence from both correlational and experimental studies within the validation pathway generally supports the idea that attitudes and intentions influence behavior change. In both cases the magnitude of effect is equivalent to a small to medium-sized effect. Although at first blush this may appear disappointing, it should be judged in the context of weaker effects for other variables (e.g., Maier et al., 2022, suggest a lack of effect on behavior change for nudges) and the lack of evidence in relation to stronger effects for other mechanisms of action. There is considerably less convergence in relation to work on moderators of the associations between attitudes/intentions and behavior change. Only a limited number of moderators have been shown to have effects in both correlational and experimental research. Validation moderations that have undergone repeated tests in correlational studies are yet to be tested or remain little tested in experimental studies (e.g., attitude and intention stability). Importantly, there are few, if any, studies testing manipulations of validation moderators. However, perhaps the most glaring gap in the research literature in this area is the systematic exploration of the engagement pathway and moderators of the ability of interventions to change attitudes or intentions. Some research has begun to explore different BCTs as ways to change attitudes and/or intentions. Knowledge in this area would considerably benefit from further research that examines single BCTs and their impact on attitude and/or intention change plus relevant engagement moderators. Such work should also test the extent to which the effects of individual BCTs on behavior change are

fully or partially mediated by changes in attitudes and/or intentions as the hypothesized mechanisms of action.

Such mediation tests focus on how changes in attitudes and/or intentions explain behavior change. Such attitude and/or intention change (i.e., value change) has been the main focus in the current review. However, recent research has contrasted this focus on value change with a focus on activation or accessibility of a mechanism of action like attitudes or intentions (Sheeran et al., 2023). While BCTs might be used to promote value change, alternative interventions may be used to promote activation or accessibility. Sheeran et al. (2023) point to work on other interventions as ways to promote activation including goal priming (Weingarten et al., 2016), the question behavior effect (Wilding et al., 2016; Wood et al., 2016), and implementation intention formation (Gollwitzer & Sheeran, 2025). For example, priming a relevant goal may increase the effect of an intervention on intentions as well as on subsequent behavior (Stroebe, 2022). Whether similar or different moderators impact the engagement or validation pathways for value change versus activation for attitudes and intentions is an important question for further research.

A further weakness of the literature reviewed is the over-reliance on studies examining health behaviors to the exclusion of other important behaviors that we wish to change such as environmental, prosocial, political and consumer behaviors. Testing whether effects observed for health behaviors generalize to other behaviors should be a focus for research going forward (see Joyal-Desmarais et al., 2022, for a useful example). A more general concern is the role of engagement with a behavior change intervention. As noted by Yardley et al. (2016), individuals' engagement with an intervention is a prerequisite for its potential effectiveness. Although level of engagement is not typically assessed in behavior change interventions, evidence

suggests that engagement moderates the effectiveness of behavior change interventions for behaviors such as smoking cessation (Strecher et al., 2008). However, intervention engagement may also moderate the effect of an intervention on purported mechanisms of action. For example, Lippke et al. (2016) reported that the mediated effect of a planning intervention on dietary behavior via changes in planning was moderated by level of intervention engagement (i.e., moderated mediation).

The focus of the current review was on two mechanisms of action (attitudes and intentions) that have received considerable attention in relation to individual behavior change efforts. Such an approach has the advantage of providing focused attention to two key mechanisms of action and so adding to our understanding of how they impact on behavior change. However, there are at least two important drawbacks to such a focus. First, attitudes and intentions are just two of a number of mechanisms of action relevant to understanding behavior change. Theories of behavior change determinants (e.g., Reasoned Action Theories; Health Belief Model; Protection Motivation Theory; Social Cognitive Theory; see Conner & Norman, 2015; Michie et al., 2014) include other variables such as self-efficacy, norms, and risk perceptions that are proposed to have direct and indirect effects on behavior. Where effects of interventions on behavior change are not fully mediated by attitudes and/or intentions this might suggest the need to examine a broader range of mechanisms of action in order to understand how the intervention produces behavior change. This may involve, for example, looking beyond reflective influences on behavior change to consider more implicit influences on behavior (Strack & Deutsch, 2004) as well as volitional (i.e., post-intentional) processes that may bridge the intention-behavior gap (Sheeran, 2002; Sheeran & Webb, 2016). Second, a focus on behavior change at

the individual level may need to be complemented by examination of group or system level interventions. A recent review (Charter & Loewenstein, 2023) contrasted the effectiveness of S-level (system level) and I-level (individual level) interventions and called for a focus on the former. Rather than dismissing the value of I-level interventions this might suggest the need to better understand which I-level interventions are effective and why. It might also point to the need to test the extent to which I-level interventions can be enhanced by S-level interventions or vice-versa (Sheeran, 2024). The former was a focus of the current review, while the latter is an important, but as yet, little explored focus for future research.

Conclusions

In summary, the EM Approach/OCF provides a strong theoretical framework for advancing the science of behavior change (Prestwich et al., 2024) and identifying effective interventions. In particular, it helps to identify what works (e.g., behavior change techniques), how it works (e.g., mechanisms of action) and under what conditions it works (e.g., moderators). As highlighted in the current review, attitudes and intentions represent important targets for interventions to engender behavior change given that they have a strong theoretical basis, have consistent small to medium-sized relationships with behavior and behavior change, can help to explain why interventions work (or don't work), and can be manipulated in order to produce meaningful changes in behavior. Future research needs to adopt a more systematic focus, based on experimental work, that links specific intervention techniques to mechanisms of action and, in turn, behavior change. This work should also consider the impact of various conceptual, methodological and socio-structural moderators on the links between interventions, mechanisms of action and behavior change. This should lead to a better understanding of what interventions work for whom in which

contexts, delivered by what means and for what behaviors in producing attitude and/or intention change that results in effective behavior change (Armitage et al., 2021).

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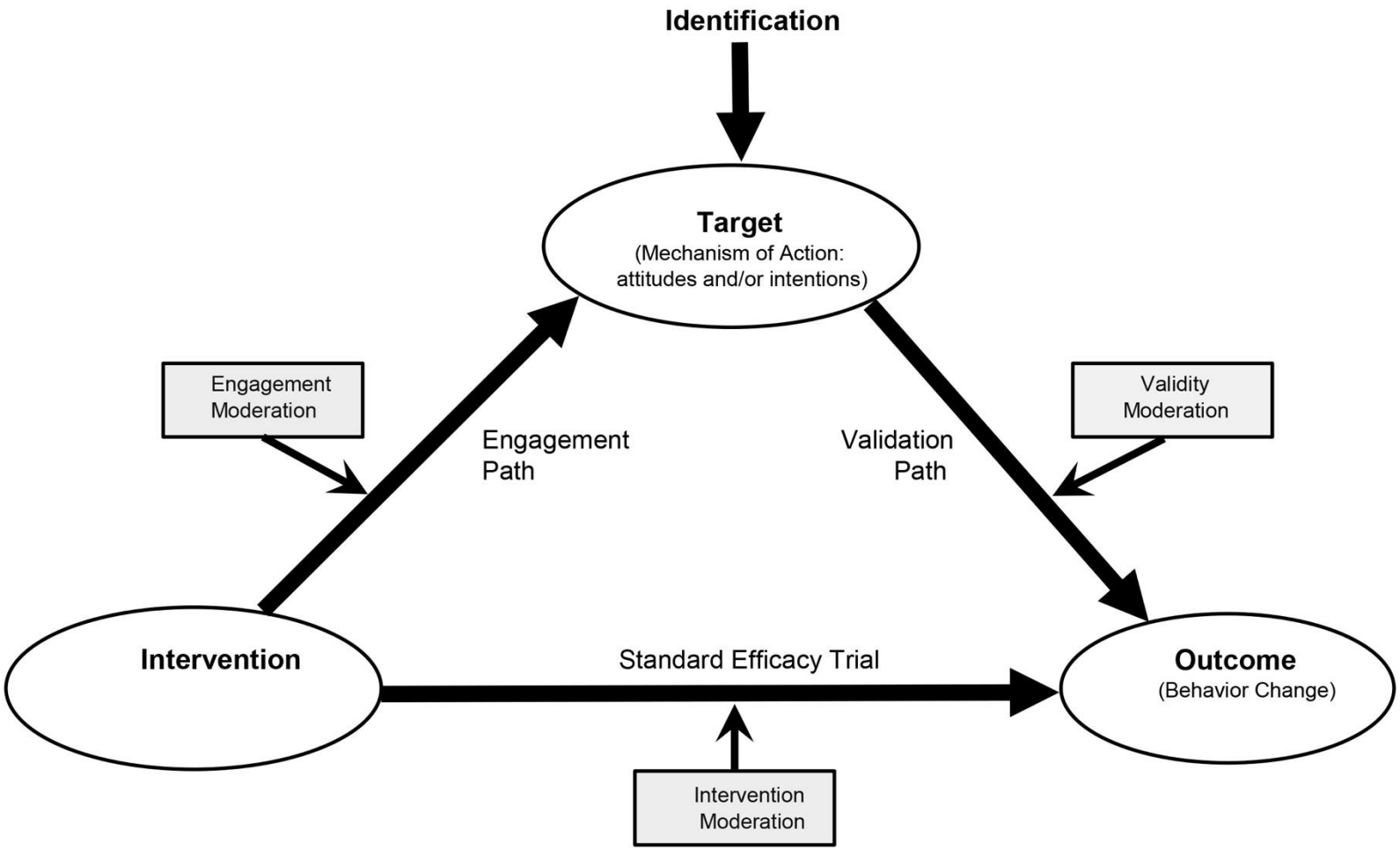
Table 1. *Meta-analyses of prospective studies reporting relationships between attitudes, intentions, and behavior or behavior change.*

		Relationship of Attitude with						Relationship of Intention with			
		Intentions		Behavior		Behavior Change		Behavior		Behavior Change	
Review	Focus	*k*	r_+	*k*	r_+	*k*	pr_+	*k*	r_+	*k*	pr_+
Albarracín et al. (2001)	Condom use	65	.58	42	.38	25	.29	41	.45	25	.38
Hagger et al. (2002)	Exercise behavior	70	.48	44	.30	22	.12	60	.42	22	.18
Hagger & Hamilton (2024)	Various behaviors	87	.51	87	.29	87	.09	87	.41	87	.15
Hamilton et al. (2020)	Child-health behaviors	31	.50	18	.31	8	.14	15	.49	8	.27
Hai et al. (2024)	Driving behaviors	56	.51	26	.42	11	.17	25	.58	11	.30
McEachan et al. (2011)	Health behaviors	212	.49	209	.27	86	.14	237	.40	86	.23
Mean		[521]	.51	[426]	.30	[239]	.14	[465]	.42	[239]	.22

Note. *k* minimum number of studies; r_+ frequency weighted average correlation; pr_+ frequency weighted average partial correlation.

Figure 1. *The Experimental Medicine (EM) Approach extended with the Operating Conditions Framework (OCF). Adapted from Rothman and Sheeran (2021).*



Supplementary Table 1. *Behavior change techniques (and definitions) linked to attitude and intention change in reviews.*

Behavior Change Technique (Number) [a]	**Definition**	**Review**		
Mechanism of Action: Attitudes				
Pros and cons (9.2)	"Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behavior"	EC	LS	TE
Framing/reframing (13.2)	"Suggest the deliberate adoption of a perspective or new perspective on behavior (e.g. its purpose) in order to change cognitions or emotions about performing the behavior"	EC	LS	TE
Information about health consequences (5.1)	"Provide information (e.g. written, verbal, visual) about health consequences of performing the behavior"		LS	TE
Salience of consequences (5.2)	"Use methods specifically designed to emphasise the consequences of performing the behavior with the aim of making them more memorable"		LS	
Information about social and environmental consequences (5.3)	"Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behavior"		LS	TE
Information about emotional consequences (5.6)	"Provide information (e.g. written, verbal, visual) about emotional consequences of performing the behavior"		LS	

Material incentive (behavior) (10.1)	“Inform that money, vouchers or other valued objects will be delivered if and only if there has been effort and/or progress in performing the behavior”		LS	
Incompatible beliefs (13.3)	“Draw attention to discrepancies between current or past behavior and self-image, in order to create discomfort”		LS	
Credible source (9.1)	“Present verbal or visual communication from a credible source in favour of or against the behavior”		TE	

Mechanism of Action: Intentions

Goal setting (behavior) (1.1)	“Set or agree a goal defined in terms of the behavior to be achieved”	EC	TE	MA1
Goal setting (outcome) (1.3)	“Set or agree a goal defined in terms of a positive outcome or wanted behavior”	EC		
Behavioral contract (1.8)	“Create a written specification of the behavior to be performed, agreed by the person, and witnessed by another”	EC		
Commitment (1.9)	“Ask the person to affirm or reaffirm statements indicating commitment to change the behavior’	EC		
Comparative imagining of future outcomes (9.3)	“Prompt or advise imagining and comparing future outcomes of changed versus unchanged behavior”	EC		
Incentive (outcome) (10.8)	“Inform that a reward will be deceived if and only if there has been effort and/or progress in achieving the behavioural outcome”	EC	TE	

Information about health consequences (5.1)	“Provide information (e.g. written, verbal, visual) about health consequences of performing the behavior”	LS	TE		
Information about others’ approval (6.3)	“Provide information about what other people think about the behavior. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do”	LS			
Self-monitoring of behavior (2.3)	“Establish a method for the person to monitor and record their behavior(s) as part of a behavior change strategy”			MA1	
Information about social and environmental consequences (5.3)	“Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behavior”			MA1	
Behavioral practice/rehearsal (8.1)	“Prompt practice or rehearsal of the performance of the behavior one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill”			MA1	
Mental rehearsal of successful performance (15.2)	“Advise to practice imagining performing the behavior successfully in relevant contexts”			MA1	
Provide information on consequences of behavior in general (1) [b]	“Information about the relationship between the behaviour and its possible or likely consequences in the general case, usually based on epidemiological data, and not personalised for the individual”				MA2

Note. [a] BCTs numbered and defined using the BCT Taxonomy V1 (Michie et al., 2013). [b] BCT numbered and defined using the CALO-RE Taxonomy V1 (CALO-RE taxonomy, Michie et al., 2011). EC = Expert consensus (Connell et al., 2019). LS = Literature

synthesis (Carey et al., 2019). TE = Triangulation exercise (Johnston et al., 2021). MA1 = Meta-analysis of physical activity interventions (Knittle et al., 2018). MA2 = Meta-analysis of physical activity and healthy eating interventions (McDermott et al., 2016).

Supplementary Table 2. *Other behavior change techniques linked to attitude and intention change in reviews.*

Review	**Behavior Change Technique**
Mechanism of Action: Attitudes	
Steinmetz et al. (2016)	Increasing skills through advising or agreeing on how to perform the behavior
Joyal-Desmarais et al. (2022)	Matched persuasive messages
Mechanism of Action: Intentions	
Webb & Sheeran (2006)	Use of incentives
	Social encouragement, pressure and support
	Providing risk awareness material
	Providing information on the behavior and outcomes
	Including questions on the material
	Specifying a goal or target
	Forming a plan or implementation intention
	Making environmental changes
Steinmetz et al. (2016)	Motivation
	Persuasion
	Planning
Joyal-Desmarais et al. (2022)	Matched persuasive messages

Side Bar

Examples of Definitions of Attitudes and Intentions

APA Dictionary

Attitudes: "A relatively enduring and general evaluation of an object, person, group, issue or concept on a dimension ranging from negative to positive. Attitudes provide summary evaluations of target objects and are often assume to be derived from specific beliefs, emotions, and past behaviors associated with those objects."

(https://dictionary.apa.org/attitude)

Intentions: "A prior conscious decision to perform a behavior."

(https://dictionary.apa.org/intention)

Behaviour Change Intervention Ontology

Attitudes: "A <mental disposition> that is an affective attitude or an evaluative belief about something."

(http://humanbehaviourchange.org/ontology/BCIO_050328)

Attitudes towards a behavior: "An <attitude> in which the entity that is the attitude object is a behaviour."

(http://humanbehaviourchange.org/ontology/BCIO_050329)

Behavioral intentions: "A <mental disposition> to commit to enact or not enact a behaviour."

(http://humanbehaviourchange.org/ontology/BCIO_00616)

Theory of Planned Behavior

Attitudes toward the behavior: "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question."

(Ajzen, 1991, p. 188)

Intentions: "capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior."

(Ajzen, 1991, p. 181)