

## ATTITUDES, HABITS AND BEHAVIOR CHANGE

Bas Verplanken

University of Bath, UK.

b.verplanken@bath.ac.uk. Orcid: [orcid.org/0000-0001-7217-0293](https://orcid.org/0000-0001-7217-0293)

Sheina Orbell

University of Essex, UK.

sorbell@essex.ac.uk. Orcid: [orcid.org/0000-0002-8665-3541](https://orcid.org/0000-0002-8665-3541)

*Annual Review of Psychology, vol. 73, 2022*

### **Acknowledgments**

The authors wish to thank Ian Anderson, Asaf Mazar, David Trafimow, and Wendy Wood for reading and insightful comments. To Alice Eagly, who more than 30 years ago inspired much of the work reported in this paper. Bas Verplanken and Sheina Orbell contributed equally to this article.

## ABSTRACT

Efforts to guide peoples' behavior towards environmental sustainability, good health, or new products have emphasized informational and attitude change strategies. There is evidence that changing attitudes leads to changes in behavior, yet this approach takes insufficient account of the nature and operation of habits, which form boundary conditions for attitude-directed interventions. Integration of research on attitudes and habits might enable investigators to identify when and how behavior change strategies will be most effective. How might attitudinally driven behavior change be consolidated into lasting habits? How do habits protect the individual against the vicissitudes of attitudes and temptations and promote goal achievement? How might attitudinal approaches to change habits be improved by capitalizing on habit discontinuities and strategic planning? When and how might changing or creating habit architecture shape habits directly? A systematic approach to these questions might help move behavior change efforts from attitude change strategies to habit change strategies.

Keywords:

Habit Architecture; Habit Formation; Habit Discontinuity; Attitude-Behavior Relation; Automatic Processes; Self-Regulation

## **CONTENTS**

### **INTRODUCTION**

The Constructs of Attitude and Habit

Does Changing Attitudes Change Behavior

Four Key Relationships Between Attitudes, Habits and Behavior Change

### **ATTITUDES CAN LEAD TO HABITS**

Antecedents of Habit Formation

The Role of Rewards

Planning to Create Habits

Conclusion

### **DO HABITS SHIELD AGAINST THE OPERATION OF ATTITUDES?**

Insensitivity to Outcome Devaluation

Habit Slips

Protective Functions of Habits

The Longevity of Habitual Behavior

Conclusion

### **MOTIVATED HABIT CHANGE**

Monitoring Unwanted Habits

Retraining Cue-Action Links

Planning to Change

Habit Discontinuities

Conclusion

### **LEVERAGING HABIT ARCHITECTURE TO CREATE OR CHANGE HABITS**

Cue Contexts

Feasibility of Action in Context

Conclusion

### **CONCLUSIONS**

## INTRODUCTION

A long-established practice used to guide social policy is to rely upon informational and attitudinal strategies to accomplish behavior change. According to this perspective, it is assumed that behavior is goal-directed and people's evaluative responses to recommended actions or to the outcomes of behavior are key to behavior change. A separate, arguably longer research tradition concerns the construct of habit, which developed in the context of learning. While both perspectives were investigating why people behave as they do, they describe different processes and mechanisms. Only during the last two decades has the view started to emerge that attitude and habit processes are both important to consider when tackling societal problems such as obesity, congestion, climate change or the need to regulate behavior during crises such as the COVID-19 pandemic.

While attitudes and attitude change have a long history in the *Annual Review of Psychology* and started to appear in the form of stand-alone articles since the sixties (Moscovici 1963), an article on habit did not feature until recently (Wood & Runger 2016) and the two literatures have not previously been integrated into a single article despite earlier calls to incorporate habit into attitude models (Eagly & Chaiken 1993). There are good reasons to address these topics together. Habits are often seen as 'ills of society' that need to be overcome, perhaps via changes in attitude, in order to arrive at healthier, safer, or more sustainable societies. However, this narrow view of habits overlooks the important role habits play in regulating desirable everyday behavior, or the goal of creating habits to consolidate long term behavior change. The re-emergence of habit within the domain of social psychological enquiry can be attributed to investigations regarding the strength of the relationship of attitude to behavior and to the importance of habit in modulating this relationship.

The emerging literature on attitudes and habits co-occurs with three major paradigm shifts. The first shift began to flourish in the nineteen eighties and nineties and concerns a focus on nonconscious processes (Schneider & Schiffrin 1977), which contributed to a renewed interest in the habit concept. A second shift concerns the realization that behaviors may be triggered by context cues rather than arising from deliberation or willpower within the individual. This is for instance signified by the popularity of the 'nudge' concept (Thaler & Sunstein 2008). These authors proposed the engineering of the context where choices are being made, the 'choice architecture' in their words, to influence people's behavior. Similarly, habitual behavior can be seen as being guided by a 'habit architecture', that is cues in the performance context, rather than individuals' attitudes and intentions (Lin et al. 2016). Finally, there is an increasing urge to test the validity of theory in field settings. While laboratory experiments remain important for investigating processes in controlled research environments and theory building, field experiments provide invaluable information on the robustness of findings and effect sizes that might be anticipated amongst general population samples and in daily life contexts. This has been propelled by new technologies, such as online experiments, within-person designs used in experience sampling, or the analysis of 'big data', for instance data retrieved from social media, which gives unprecedented insight into people's ongoing behavior (Lee & Kwan 2018).

### **The Constructs of Attitude and Habit**

Eagly and Chaiken (1993) defined attitude as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor” (p.1). This definition stresses the core feature of an attitude as a propensity to produce an evaluative response. This article focuses on attitudes towards behaviors such as buying new products, eating particular foods or taking actions to sustain the environment. Consequently attitude might be understood here as an individual’s evaluation of behavior and its outcomes.

'Habit' was for a long time equated with 'past behavioral frequency', which is how most lay people understand the term. This thwarted progress in habit theory since the heyday of behaviorism (Eagly & Chaiken 1993). Contemporary writers arrived at definitions of habits that are remarkably similar to William James' (1887) conception of habit (Wood & Neal 2007). Habits are memory-based propensities to respond automatically to cues that led to performance of behavior in the past. These propensities derive from cue-response associations in memory that were acquired through repeatedly acting in response to those cues in a stable contexts (Verplanken 2018). A distinction can be made between a habit (the mental construct), which is automatically activated when a cue is encountered, and a habitized response that may follow. This response may be an overt action or habitized thinking (Verplanken et al. 2007). While a habit mechanism is not directly observable, it may be inferred from precursors to and consequences of habit formation, for instance habit performance contexts (Wood et al. 2005), reaction time measures of context-response associations (Neal et al. 2012) or speed of response switching (Luque et al. 2020), self-reports of qualities of habitized behavior (Verplanken & Orbell 2003) or habit slips (de Wit et al. 2012) (see also Rebar et al. 2018). Habitized behavior has qualities such as persistence and insensitivity to new information and alternative choice options (Verplanken et al. 1998). These qualities render unwanted habits difficult to change, but are advantageous for desirable habits to acquire.

### **Does Changing Attitudes Change Behavior?**

How strong is the power of persuasion? A vast literature exists on the attitude-behavior relation, much of this research guided by subjective expected utility models and dominated by studies merely observing the relationship of attitudes to behavior. However, there are significant difficulties associated with inferring a causal association of attitude to behavior from observational studies. Consequently, the effect size observed from

correlational data may overestimate the extent of behavior change that might be expected from manipulating attitudes and intentions (Hornsey et al. 2016, Rhodes & Dickau 2012).

Recent syntheses of findings from experimental studies in which participants were randomized to a control group or received an intervention designed to change their attitudes have provided reliable evidence that attitudes can be changed. Albarracin and Shavitt (2018) report that "attitude change based on interventions or messages delivered at a particular time hovers around  $d_+ = 0.22$ , *which is a small effect*" (p. 303, italics added). Targeting attitudes can also change behavior. Sheeran et al. (2016) reported in an analysis in the health behavior domain, that interventions that successfully changed attitude had a small to medium effect on behavior change ( $d_+ = .38$ ). While it is evident that attitude change can lead to behavior change, nonetheless these and other syntheses also show that changes in attitude have highly variable (heterogeneous) consequences for behavior change and particularly for sustained behavior change (Wakefield et al. 2010).

Three broad approaches to explaining variability in the attitude-to-behavior relation can be discerned. First, people may not be sincere in reporting their attitudes, not aware of their attitudes, or change them 'on the fly' so that as guides to behavior they are relatively unimportant. Second, some attitudes acquire more resilience and therefore guide action more reliably than others. These differences in resilience can be referred to as attitude strength. Third, there are circumstances in which attitudes' influence on action is attenuated because existing behavior is controlled by alternative mechanisms characterized by habit and consequently insensitive to fluctuations in attitude.

The first concern, regarding the veridicality of attitude reports, prompted specification of measurement conditions, including the important principles of compatibility between measures of attitude and behavioral criteria in terms of action, target, time, and context (Ajzen 2011). The development of implicit measures re-invigorated methodological enquiry

with the promise to examine people's 'real' attitudes, even those to which they might not have conscious access or the desire to self-report truthfully in socially sensitive domains. These implicitly measured attitudes, it was supposed, might more faithfully predict behavior and represent suitable targets for intervention. However, syntheses of a substantial body of work examining the ability of implicitly measured attitudes to incrementally increase behavioral prediction (Greenwald et al. 2009, Kurdi et al. 2018, Oswald et al. 2013) suggest minimally consequential and highly heterogeneous effects (Albarracín & Shavitt 2018, Blanton et al. 2016, Oswald et al. 2013). Nor is there evidence that implicitly measured attitudes offer superior prediction of behavioral criteria characterized by lack of controllability and awareness, or even social sensitivity, calling a key assumption of implicit measurement into doubt.

A second approach to understanding variability in the attitude-to-behavior relation concerns attitude strength. Explicit attitudes may vary not only in evaluative positivity or negativity, but in properties collectively referred to as 'attitude strength'. Strongly held attitudes are stable over time (durable), resistant to persuasion (difficult to change) and have impact on behavior (Howe & Krosnik 2017). Persuasive interventions that target not only the valence of attitudes, but also ensure that they become integrated, crystallized, accessible and stable, are those most likely to lead to sustained intentions and behavior. If behavior is subsequently repeated in stable contexts, strong attitudes might also promote habit formation. Glasman and Albarracín (2006) synthesized evidence from experimental studies in which novel attitudes were formed, such as might occur when a new consumer product or vaccination is introduced. Direct, unambiguous experience of an attitude object and frequent expression of an attitude each strengthened the attitude-to-behavior relation via increases in attitude accessibility (how easily an attitude can be recalled or reported) and attitude stability. The link between accessible attitudes and behavior is not fully understood. More accessible

attitudes may drive people to seek motivational consistency in their actions. Alternatively, perhaps because of passive or active attitude-consistent information search, strong attitudes may bolster knowledge of related behavioral information such as self-efficacy to act.

Interestingly, this idea that strong elaborated attitudes might include behavior-relevant information beyond attitude itself has recently been found to have traction. For example, Dalege et al. (2019) show that highly connected attitude networks are more stable and more likely to relate to behavior.

A third important boundary condition to the attitude-to-behavior relation derives from Triandis' (1977) theory of interpersonal behavior, and has been discussed ever since the renewed interest in habits in the late nineties (Aarts et al. 1998, Gardner et al. 2020, Ouellette & Wood 1998, Verplanken & Aarts 1999, Verplanken & Wood 2006, Wood & Neal 2007, Wood & R nger 2016). Triandis proposed that if people repeatedly enact behaviors in the same contexts, those actions will gradually come to be guided by habit mechanisms. Consequently, changes in attitude and intention will be relatively ineffective in changing subsequent behavior. However, tests of this hypothesis that rely upon correlational data and a negative intention x past behavior interaction coefficient are problematic for many reasons, including restriction of range effects, use of self-reports if, for instance, participants infer an intention from their habit (Mazar & Wood 2021, Neal et al. 2012), or inadequate sampling of participants with strong habits and counter-habitual intentions, particularly in studies of desired behaviors such as exercise (Rebar et al. 2019). An alternative approach is to classify types of behavior according to whether they can be performed frequently in stable contexts and might therefore be capable of becoming habits (Ouellette & Wood 1998, Sheeran et al. 2016, Webb & Sheeran 2006). For example, Sheeran et al. (2016) reported that for behaviors that are infrequently performed, the effect of attitude change on behavior obtained in experimental studies was  $d_+ = .48$ . For frequent behaviors however, the relation was

attenuated to  $d_+ = .36$ . Perhaps stronger evidence was the observation that the effect of attitude change on behavior change was limited to interventions that sought to ‘increase’ behavior. Attitude change was ineffective in ‘decreasing’ existing behavior, consistent with the possibility that behavior was controlled by counter-attitudinal habits that were not susceptible to changes in attitude. In sum, habitized past behavior does seem to exert powerful limits on the influence of attitudes on behavior.

The observation derived from Triandis (1977) that attitudes are less predictive of behavior when people have acquired strong habits deserves further comment because it may be seen as inconsistent with the idea that attitudes derived from direct experience are stronger and more likely to predict subsequent behavior. However, this becomes more reconcilable from a process perspective; initially, direct experience with a novel behavior strengthens one's attitude toward that behavior, so that attitude is the primary driver. Over time, if the behavior is repeatedly performed in a stable context, the influence of an attitude diminishes and habit becomes the more consistent determinant of action (Sheeran et al. 2017). The diminishing relevance of motivation as habit strengthens can be reliably seen in studies that examined accessibility of attitudes versus habits in memory. For instance, Neal et al. (2012, Study 1) revealed the inverted U-shape relationship of attitude to behavior using a word recognition task with experimentally manipulated subliminal primes. They found that participants who had not yet formed strong habits recognized action words faster when primed with words related to motives, whereas participants with established habits recognized habit-related action words faster when primed with words referring to the performance context (habit cues), but not when primed with habit-related motives. This study demonstrated a shift from the mental availability of a motive that initiates a behavior, to the heightened mental association of the context with which the habitually performed behavior is associated.

## **Four Key Relationships Between Attitudes, Habits and Behavior Change**

Heterogeneity in the attitude-to-behavior relation and the modest effects of attitude change on behavior change have spurred renewed interest in habits in the past two decades, and in the potential for effective behavior change that might be afforded by consideration of habit cueing processes as well as motivational attitude change processes. The remaining sections of this article are devoted to taking stock of the accumulated evidence in this endeavor. We organize the review around four broad themes. Figure 1 provides a schematic overview.

First, attitude change can be an important starting point for behavior change. If successful, such change may be consolidated and become enduring by turning the newly formed behavior into a habit. This may occur spontaneously, for instance when someone decides to start regular exercising, or may benefit from interventions aimed at habit formation. This section addresses factors that foster this process.

Second, we consider features, operation, and persistence of habits once these have been established. Many initiatives such as exercising are discontinued when times get busy or stressful, or motivation wanes. Evidence that habits are relatively resilient against persuasion suggests they can persist despite the vicissitudes of daily life and, importantly, that habits can serve to regulate and protect behavior in times of stress or distraction. This section considers evidence for the resilience of habits and discusses the benefits of habitizing behavior.

Evidence that changes in attitude are often not sufficient to change established habits raises the question as to how and when it might be possible to break existing unwanted habits and increase the power of behavior change interventions. In the third section we consider how motivation might form the starting point for habit change and explore deliberative strategies to change habitized behavior, such as replacing the habit of taking the lift with stair climbing.

The final theme focuses on the context where habits are performed - the habit architecture. Cues in those contexts, rather than attitudes or 'willpower', elicit and maintain habitual action. Habit change may be accomplished by directly changing the habit architecture, such as features of the built environment that may foster exercising, thus changing behavior with relatively little regard to attitudes.

[FIGURE 1 ABOUT HERE]

### **ATTITUDES CAN LEAD TO HABITS**

Attitudes can be the starting point of habit formation. When we do something new and it works or we like it, this behavior might be repeated and ultimately become habitual. This may occur spontaneously, and sometimes lead to what are considered as 'bad' habits associated with unhealthy or unsustainable lifestyles. The same principles govern the formation of desirable 'good' habits and can be exploited in the context of behavior change interventions. The goal of behavior change interventions is usually long-term change. However, apart from the fact that most research stops short of evaluating whether behavior change remains detectable beyond the short term, consolidation of new behavior is seldom formulated explicitly as an *intervention goal* and few if any tools have been developed to specifically promote the maintenance of new behavior. Consequently, interventions could maximize long-term behavior change by making habitual new, desirable behaviors, so that they acquire features such as persistence or insensitivity to counterinformation (Orbell & Verplanken 2020). Habit formation might be a way to consolidate behavior change and, more generally, align behavior change with the attitudes that originally motivated it (Aarts & Dijksterhuis 2000).

### **Antecedents of Habit Formation**

What determines habit formation? If the behavior is something a person really wishes to establish, a positive, strong, and stable attitude is a good starting point. Likely candidate variables for habit formation are the frequency with which a behavior has been executed, consistency over time, the simplicity (vs. complexity) of behavior, positive affect or satisfaction with the outcome, the selection of suitable cues and their salience, and the stability of the performance context (Lally & Gardner 2013). To the degree these factors are present, behavior may evolve into a habit over time. This process was observed over a year in a longitudinal study on the introduction and development of use of tablet devices in a secondary school (Courtois et al. 2014). Pupils and teachers were given tablets to use in place of much of the usual hard copy paperwork. The researchers found that during a school year, attitudes and intentions initially predicted the uptake of tablet use. Mid-intervention some difficulties were encountered as people mastered the tablets and perceived control was a dominant predictor of use. In the end phase, the frequency of tablet usage during the previous 9 months was the main predictor, suggesting the development of a habit. While cue consistency was not directly assessed, the highly structured and integrated nature of the intervention marked opportunities to cue tablet use and made frequent and consistent usage likely. The study demonstrated how, with a sufficient duration of observation, an initially attitude-driven behavior may be seen to become habit-driven over time.

Some studies investigated factors influencing habit formation more explicitly. Kaushal and Rhodes (2015) followed new gym members for twelve weeks and observed the habitization of exercise behavior. Habits formed in approximately six weeks among participants who exercised at least four days a week. This was most strongly predicted by consistent attendance at the same time each day, followed by low behavioral complexity (perceived effort), a supporting physical environment, and positive affect. McCloskey and Johnson (2019) assessed relationships between perceived automaticity of 25 behaviors and

perceptions of frequency, reward, context stability and complexity. Frequency, reward and context stability were positively, and complexity negatively associated with perceived automaticity.

Lally et al. (2010) asked participants to perform a new behavior once daily and to submit daily entries of self-reported habit. There was wide variation in the time it took for habits to be established, ranging from approximately three weeks to over eight months. Two parameters of individuals' habit formation curves were observed. The first is the steepness of the curve, that is, the length of time it takes to reach maximum habit strength. In other words, how fast does a behavior habitize? The second parameter is the degree to which a behavior can become habitized and cue contingent. To what extent can the behavior be elicited with minimal conscious awareness and deliberation? This study demonstrated that habit formation can be modeled at the intra-individual level. The relationship of habit formation (frequency, complexity, context stability, cue salience) to these two parameters of habit curves is still open to investigations and requires systematic scrutiny across behaviors and contexts in longitudinal and experimental designs.

### **The Role of Rewards**

The classical mechanism for habit formation explored extensively in the behaviorist tradition is the use of rewards to promote action repetition in a given cue context. A distinction can be made between extrinsic and intrinsic motivation (Deci & Ryan 1985). Externally motivated behavior is instrumental in obtaining rewards such as money or other people's approval. Extrinsic rewards may be particularly effective in prompting action initially and promote habit formation by engaging dopamine systems (Amaya & Smith 2018). Provision of financial incentives have been used to promote behavior and form new habits. Such incentives can positively influence health behaviors (e.g. smoking cessation, physical activity), although these effects declined after the incentive was removed (Giles et al. 2014,

Mantzari et al. 2015). Maki et al. (2016) showed that financial rewards promoted specific pro-environmental behaviors, some of which (energy conservation, travel) persisted after removal of the incentive, perhaps because they de facto saved participants' money. However, few studies in this domain have assessed long-term effects or indeed the formation of habits.

Intrinsically motivated behavior is considered as an end in itself because it is inherently rewarding (Kruglanski et al. 2018). Gardner and Lally (2013) found that people whose frequent physical activity was autonomous, experienced exercising in their leisure time as more fluent, which characterizes habitual behavior. Intrinsic motivation may be present for some, but not all behaviors. Behaviors that are aligned with the self-concept may have the rewarding properties that ensure repetition and habit formation. The relation between habit and self-identity may stem from habits being based on important values, which can be considered as long-term motivations. This may pertain to personal identities but equally to shared social identities (Udall et al. 2021). Verplanken and Sui (2019, Study 2) provided experimental evidence that the association of habits with self-identity is stronger if habits are linked to values. Participants were presented with eighty behaviors covering ten value domains. For each behavior, they rated habit strength and the extent to which it represented their 'true self'. In the experimental condition, participants' values were primed by indicating how much each behavior was linked to the value domains, while in the control condition participants indicated at what time of day the behavior would typically occur. For each participant a within-participant correlation was calculated between their eighty habit and true self ratings. These correlations were larger in the experimental condition, when values were primed, compared with the control condition. Values may thus form a 'bridge' between habits and (parts of) one's self-concept by framing the intrinsic rewards gained from a behavior. In a two-month habit formation study containing four measurement points habit strength was initially predicted by consistent and frequent behavioral repetition (Verplanken

et al. 2021). At the final measurement habit strength was predicted by the degree to which participants associated the new habit with their identity, suggesting a process of internalization.

Habits may also be intrinsically rewarding because they simplify life, or make life easier by avoiding the need for new learning or decision making. The process of action repetition may in and of itself be rewarding as a consequence of the sense of ease, fluency and reduced mental effort that accrues as habit develops. This may lead the individual to enjoy their habit (Reber et al. 2004).

### **Planning to Create Habits**

An intuitively appealing vehicle in promoting habit formation is to supplement positive attitudes with deliberate self-regulation strategies such as planning to act in specific cue contexts (Hagger & Luszczynska 2014). For example, implementation intentions are specific plans of action in the form of "When encountering cue X, I will do Y" (Gollwitzer 1993). These simple self-instructions increase the likelihood of action by ensuring intentions are not forgotten or opportunities missed (Adriaanse, Gollwitzer et al. 2011). An implementation intention involves a single consciously formed plan to act when an imagined future performance cue is encountered. This type of planning increases the mental accessibility of situational cues, thereby installing a mechanism that, like a habit mechanism, automatically activates a representation of the associated behavior. Whereas in the case of habit the automatic propensity to act in response to cues is forged over a great many repetitions in stable contexts, an implementation intention forges the link via a single act of planning (Gollwitzer 1993; Holland et al. 2006).

If the action specified in a plan is sufficiently specific, remains functional and feasible beyond a single planned instance, and if the cue specified occurs in an ongoing stable context, it is possible that by extended repetition, the cue-response link initially forged by an

implementation intention may gradually become directly cued by habit (Holland et al. 2006; Keller et al. 2021). Orbell and Verplanken (2010, Study 3) showed that participants who formed an implementation intention to use dental floss were more likely to initiate and repeat the behavior during the next four weeks and began to habitize flossing more rapidly compared to controls. Implementation intentions seem to be efficient, strategic vehicles to promote repeated behavior by mentally anticipating a habit architecture. While attitudes may play an important role in initiating the formation of an implementation intention (Milne et al. 2002), the translation of action into habit will ultimately depend upon repetition in stable cue contexts over prolonged time periods.

### **Conclusion**

Habit formation may serve to consolidate behavior change that has been accomplished in interventions via changes in attitudes and intentions. It is unfortunate if behavior change interventions, usually requiring major resources, leave the hard-fought new behavior decaying over time or vulnerable to waning motivation or counter-persuasion. Habit formation should be incorporated as a goal of behavior change interventions and outcomes assessed for a sufficient duration to truly evaluate habit formation. What strategies foster habit formation? Given that a new behavior has been specified and accomplished, a primary tool should be to analyze and possibly design the environments that foster habit formation so as to establish an optimal habit architecture. Key features of habitization – repetitive, automatic, cue-driven - can become guiding principles to inform the design phase of interventions: targeting simple behaviors; optimizing cue-specific repetition of the behavior; providing a stable performance context; employing plans that are mapped onto the future habit architecture. Clearly, attitudes - especially strong attitudes - and motivation can be active ingredients in the initial phases of habit formation. Once established, however, control over behavior gradually shifts to the performance context.

## **DO HABITS SHIELD AGAINST THE OPERATION OF ATTITUDES?**

While attitudes and motivation play a major role in the formation of habits, what is their relation once habits are established and behavioral control has shifted to the performance context? Why does evidence suggest limits to the effects of attitude change interventions, particularly to change established habits? When attitudes are in operation, people are sensitive to available behavioral options and outcomes. In this section we explain what happens when habits are in place and a deliberate mode of functioning, in which an open mind to alternative courses of action is available, changes to a mode that instead fosters direct cue-driven action. We discuss different manifestations of the habit mode and the different paradigms employed to investigate habit mechanism; outcome insensitivity and habit slips, habit as protector of self-regulatory goals and habit as a source of behavioral persistence.

### **Insensitivity to Outcome Devaluation**

When engaged in evaluating options, attitude-driven systems are in operation. Habits, on the other hand, deal with regularity. In habit mode, people do not engage in passive or active information search (Verplanken et al. 1997) and are less sensitive to possible fluctuations in outcome values. A person who chooses a new tasty pizza may order this again next time. Upon repetition, ordering this pizza may become a habit, and the person may become less sensitive to quality fluctuations. In other words, if the value of an outcome diminishes or if better alternatives become available, once a habit has formed, the individual may not change their behavior. This has been denoted as devaluation insensitivity (Dickinson & Balleine 1995; de Wit et al. 2009). For instance, Lattarulo et al. (2019) demonstrated that commuters may stick to their travel mode even if it becomes a suboptimal option due to temporary restrictions. In testing insensitivity to the devaluation of outcomes, an individual is trained to obtain a valued outcome, which is then devalued. If the individual subsequently

adapts their action accordingly by avoiding the devalued option, the operation of a goal-directed system is assumed, while sticking to the original devalued outcome signifies a habit system in operation. Originating from animal learning research, this paradigm has been employed in research with humans (de Wit et al. 2009), including the study of pathological conditions (Gillan et al. 2016). Neal et al. (2011, Study 1) used the outcome devaluation paradigm in a field experimental study by presenting either stale or fresh popcorn during a cinema performance. Participants with weak cinema popcorn habits showed behavioral flexibility by eating less stale popcorn, whereas strong habit participants ate equal amounts of stale popcorn despite reporting they did not like it. In a non-cinema context, however, both strong and weak habit participants adapted their intake to the taste. This study demonstrated how context trumps attitudes in influencing behavior when strong habits are present.

Devaluation insensitivity as a feature of habitization has been studied to explain societal problems such as obesity. For instance, Horstmann et al. (2015) conducted a devaluation experiment among participants differing in weight status. They used a selective satiation procedure whereby participants were first trained to learn associations between abstract stimuli and two rewarding food items and were rewarded one of the two. Participants were then given *ad libitum* access to that item, which was thus devalued through satiation. Subsequently, responses to the abstract stimuli representing the two food items were re-assessed. The researchers found a reduced devaluation effect among those with higher BMIs, suggesting that these individuals did not adequately adapt to lower outcome values brought about by satiety, but continued to operate in habit mode, that is, performing a behavior that contributes to weight gain.

Devaluation insensitivity is not unequivocally demonstrated in humans. Participants have been found to be sensitive to devalued outcomes even after receiving extensive habit training (de Wit et al. 2018). Possibly the laboratory context cannot replicate the everyday

distractions that facilitate habit responding in real life. Also, it is not always easy to attribute behavioral inflexibility observed in the outcome devaluation paradigm to habitization alone. Devaluation insensitivity can be related to a compromised goal-directed system (Gillan et al. 2016). This may occur under conditions like stress (Fournier et al. 2017) or pathologies such as attention-deficit/hyperactivity disorder (Ceceli et al. 2020). Finally, the outcome devaluation paradigm itself has been criticized. For instance, evidence is based upon hypothesizing a null effect, that is, behavior will not change following devaluation (De Houwer et al. 2018, Hogarth 2018). Such hypotheses are hard to test. There are also alternative interpretations of devaluation insensitivity, such as a switch to an alternate goal than the one linked to the devalued option (De Houwer et al. 2018). This touches upon the wider question of whether habits can be performed independently of a goal (Aarts & Dijksterhuis 2000, Hommel 2019, Kruglanski & Szumowska 2020, Trafimow 2018, Wood et al. 2021, Wood & Neal 2007).

### **Habit Slips**

Another signature of habitization is the occurrence of habit slips. Occasional habit slips are familiar, such as when we find ourselves mistakenly setting off to drive toward work on a Sunday instead of to the countryside for a walk. A tendency to ‘slip back’ into old habits occurs once behavior has become controlled by cues and is less sensitive to changes in the desirability of behavioral outcomes. The cue contingent behavioral inflexibility conferred by habits represents a challenge for attempts to change behavior via attitudes such as campaigns by governments or companies wishing to introduce new products to consumers (Labrecque et al. 2017). However, resistance also confers protection of desired behavioral habits against the vicissitudes of daily attitudes or counter-attitudinal persuasion attempts (Itzhakov et al. 2018).

Habit slips are consequences of the habit cuing process. As habits gain strength, the cue context automatically activates the associated response in memory (brings it to mind), thereby provoking the behavior habitually performed in that context. Thus, instead of consciously deciding which street to turn onto at the crossing, you automatically take the route toward work. The power of context in contributing to habit slips despite people's intentions has been demonstrated in a few field studies. Orbell and Verplanken (2010, Study 2) observed naturally occurring habit slips following the introduction of a ban on smoking in public places. Smokers who had strong habits for lighting up inside pubs (public houses licensed to sell alcohol) measured before the smoking ban were more likely to make 'smoking slips' after the ban came into force, despite intending to comply with the law and step outside. The study also revealed the nature of habits that comprise action sequences; once the habit sequence was initiated (picking up a cigarette paper), it ran on to its conclusion (lighting up) even if individuals intended and expected that they would be able to interrupt the sequence and step outside before the final act. In a consumer context, Labrecque et al. (2017) report that a habit slip "I fell back on my old habit and did what I used to do" was the most frequent reason given by consumers for rarely using new products they had intentionally purchased.

Habit slips occur as a consequence of the passive, automated cueing of actions performed in that context in the past. They are distinct from an active decision not to adopt a novel behavior, perhaps because the new behavior requires a learning curve (Murray & Häubl 2007), and from passivity that might result from lack of awareness of alternatives or lack of personal relevance. In other words, habit slips do not occur as a function of unfavorable attitudes or lack of motivation. Habit slips are more likely to occur when an individual is distracted or acting mindlessly (Labrecque et al. 2017, Orbell & Verplanken

2010). The smokers in Orbell and Verplanken's field study reported that they found themselves lighting cigarettes indoors when they were distracted in conversation.

### **Protective Functions of Habits**

Habits are cognitive structures that preserve responses to recurring situations. Often habits align with the attitudes and goals from which the behavior originated yet keep us on track via mechanisms (i.e. automatic responses to context cues) that are independent of attitudes or motivation. When mental resources are depleted and an individual is less capable of exerting willpower to accomplish valued or desired outcomes, habits become the default behavior. While we may fall back on 'bad' or undesirable habits, if constructive habits are in place, the operation of these 'good' habits will protect goal accomplishment at times when they might otherwise have been derailed (Lin et al. 2016). Neal et al. (2013) demonstrated the operation of good and bad habits at times of resource depletion. These authors found that naturally occurring and experimentally induced depletion of resources increased the performance of existing habits. For instance, students with pre-existing healthy eating habits were more likely to enact these habits during a stressful exam period, but equally, students with unhealthy eating habits fell back on those 'bad' habits during that period.

Habits may also be functional in counteracting persuasion attempts when people are in a vulnerable condition. Itzhakov et al. (2018) found that when participants were resource depleted they were more susceptible to persuasion. However, depleted participants with strong habits performed their habit rather than acting on the newly formed attitude. While unsuccessful persuasion attempts are unfortunate if the target behavior is desirable and the existing habit undesirable, the opposite is true when 'good' habits keep an individual on track in the light of attempts to derail them. Habits therefore protect behavior that was originally established for good reasons.

Habit formation also plays an important role as a self-regulatory tool. Behaviors that serve desired goals such as eating a plant diet, progressing an article or minimizing one's carbon footprint may be derailed by tempting or easier alternatives that require willpower and effortful control to ignore, avoid or resist. However, an alternative, effective strategy is to create and rely upon functional habits that serve these goals. When a useful behavior (starting to study immediately after breakfast) that fulfills a goal (preparing for an exam) has become habitized, procrastination can be avoided. Without the habit the individual is vulnerable to producing excuses and rationalizations. Rather than engage in effortful inhibition, individuals who form habits can pursue desired outcomes with minimal effort (Hofmann et al. 2012). Galla and Duckworth (2015) found that students with strong study habits experienced fewer study-leisure conflicts and continued their study habits under difficult circumstances. Forming strong habits protects against the need to fight off obstacles. In other words, smartly developed habits are ways to make life work better for you (Orbell & Verplanken 2018), and are particularly useful under conditions of depleted mental resources (Allom et al. 2018). Lin et al (2016) showed that experimentally acquired habit cues induced habitual snacking behavior even when presented with a tempting alternative under resource depletion.

### **The Longevity of Habitual Behavior**

Habits are structures for the long haul. This is a reason why problematic behaviors such as those associated with obesity or environmental damage are difficult to overcome. In other cases, longevity of behavior is desirable and habitization might be crucial. This holds for behaviors that serve important goals, such as adhering to medication or behaviors that are the end product of behavior change interventions. If those behaviors have not been turned into habits they are vulnerable to attitudinal fluctuations, temptations or rationalizations.

Anecdotal evidence suggests that in the natural course of life some habits persist for long periods of time, but others are not maintained. Habits may decay when they are no

longer activated or are replaced by other actions. As long as the performance context remains stable, so that contextual cues are consistent, habits are likely to be 'protected' by strong cue-response associations. However, habits may cease to operate when cue-response links are not strongly established, for instance when the performance of behavior is not sufficiently frequent or consistent. Performance contexts may change or individuals may change contexts, as discussed in more detail in the next section. Individuals may also prioritize new goals and associated behaviors. In cases where a new habit replaces an old one, habit maintenance is also endangered by the presence of the old habit memory traces, which only fade slowly. This slow decay was illustrated among employees in an organization that relocated (Walker et al. 2015). Some employees embarked on an organized scheme to promote sustainable commuting. While the new commuting habit gained strength, the old habit became weaker but still existed over a period of four weeks.

What factors foster longevity of habits? The strength of cue-response links and the stability of the performance context are paramount. The former is for instance indicated by the speed of responding to habit cues (Neal et al. 2012) or the time it takes to switch to a non-habitized option (Luque et al. 2020) or a newly learned response (Hardwick et al. 2019). Context stability can be safeguarded by legislation, such as traffic regulations controlling motorists' behaviors. Longevity may also increase if the habit is linked to long-lasting structures such as another established habit, for instance linking dental flossing with teeth brushing (Judah et al. 2013), or to a social practice (Kurz et al. 2015).

While habits function primarily through the strength of the cue-response link in memory and the stability of the performance context, it is not unreasonable to suggest that in order for desirable habits to survive in the long run at least *some* habits benefit from motivational support. Those habits may originate from significant events, external threats, or issues that bring important values to the fore. For instance, coping habits may be instigated

by illness (Orbell & Phillips 2019), prosocial habits by the COVID-19 pandemic (Wolf et al. 2020) or by desire to challenge gender stereotypes (Croft et al. 2020), pro-environmental habits by worry about global warming (Verplanken et al. 2020). A habit may thus become intrinsically motivated and be internalized as an end in itself (Kruglanski et al. 2018). This internalization process may involve an element of self-perception. That is, people can observe their own habits, reflect on their meaning, and infer that they serve a purpose. Such attributions may be misguided (Adriaanse et al. 2018; Mazar & Wood 2021, Wood & R nger 2016) and amount to confabulations. However, it is not inconceivable that such reflections may form or strengthen a genuine intrinsic motivation. Charging for plastic carrier bags in the UK resulted not only in customers developing a habit of bringing their own bags but also in support for other initiatives to reduce the use of plastic, thus signaling a spillover effect indicative of an enhanced intrinsic motivation (Thomas et al. 2019). Slovinec D'Angelo et al. (2014) monitored physical exercise among coronary heart disease patients and found that self-efficacy and autonomous motivation were predictors in the short-term (6 months), while autonomous motivation continued to predict engagement in physical exercise in the longer term (12 months). A long-term habit may become 'mine' or part of my identity and may thus implicate the self (Udall et al. 2021). Verplanken and Sui (2019, Study 1) showed that the degree to which participants associated habits with their true self correlated with self-integration, self-esteem and an orientation towards an ideal self. Given the relative stability of the self, these results support the notion that linking a habit and the self may contribute to the stability and longevity of the habit.

## **Conclusion**

Habits are more than simple responses to a recurrent situation. Once established, habitized behavior may proceed without being influenced by fluctuations in attitudes caused by changing outcome structures, stress, or diminished willpower. Habits negate the need for

self-control. This rigidity is unfortunate when people lose out from obtaining better outcomes or persist after the original benefits of action have diminished. However, habits also foster stability and predictability. They shield against indecisiveness, attitude change, and the distraction by tempting alternative courses of action or stress. Habits can thus be important ingredients of successful self-regulation. The long-term survival of at least some habits may be optimized by support from values, intrinsic motivation, or connections to self-identity.

### **MOTIVATED HABIT CHANGE**

While habits may develop because they are instrumental or pleasant, changing them is notoriously challenging (Orbell & Verplanken 2020, Wakefield 2010). The cue-action memory traces that constitute habits cannot be suddenly erased and are difficult to override. Also, it is not easy to be aware of cues that trigger habits (Adriaanse, de Ridder, Evers 2011, Lin et al. 2016), given that many of these are a part of everyday contexts and actions. Relatedly, people may lack opportunities to change the action associated with that context. Yet, given sufficient motivation and opportunities, habits may change or be overcome. Habitization attenuates the role of attitudes and motivation in the operation of habits and consequently the ability of attitude-based interventions to change behavior. Yet it is possible to effortfully discontinue or not perform a habit, if a situation calls for it. That ability is important in the process of overcoming habits. In this section we discuss several avenues to motivated habit change that augment attitudinal strategies or emphasize the use of a targeting strategy in their implementation.

#### **Monitoring Unwanted Habits**

Intuitively, the most straightforward strategy to avoid or change an unwanted habit is to be alert, monitor the behavior and the circumstances of its occurrence and effortfully inhibit the performance of the habit. Quinn et al. (2010) identified 'vigilant monitoring' as the most frequently used and most effective strategy to inhibit unwanted habits. Other strategies,

in particular removing oneself from the performance situation and distracting oneself, were ineffective, consistent with observations that regression to habit (habit slips) is rendered more likely when people are distracted (Orbell & Verplanken 2010). In order for a vigilant monitoring strategy to succeed, a person needs to be sufficiently and consistently motivated and have mental resources available to execute the strategy, conditions that can easily be compromised. Also, vigilant monitoring is likely to be more effective if one intends to replace the inhibited habit by an alternative behavior (Labrecque et al. 2017). For instance, in 'habit reversal training', which is used to treat nervous habits such as nail biting and hair pulling (Bate et al. 2011), a first step is to monitor cues that trigger the habitual response and the context in which it occurs. Heightened awareness of one's habit is then combined with practicing competing responses, that is a response to the cue that is antagonistic to the original habitized behavior (Mancuso & Miltenberger 2016).

### **Retraining Cue-Action Links**

A potential intervention route to change habits might be to target the cue-response links in memory that constitute habits. To what extent is it possible to retrain habitual responses? Habitized behaviors may have associated cognitive biases, that is, above-average likelihoods to attend to, approach, or avoid certain types of stimuli (Greenwald & Lai 2020). Such biases are particularly ingrained in behaviors with addictive properties, such as the consumption of unhealthy but rewarding food, alcohol, cigarettes, or drugs. Hence, an intriguing question is whether modification of these biases can lead to behavior change.

A few studies have reported behavior changes in response to cognitive bias modification. However, while cognitive biases are malleable, there is no convincing evidence that cognitive bias modifications have profound effects on behaviors, such as food consumption, substance use relapse, or smoking cessation (Turton et al. 2016). There is somewhat more optimism with respect to approach bias modification (Kakoschke et al. 2017)

and using cognitive bias modification as part of larger treatment packages in clinical populations (Batschelet et al. 2020). For instance, Rinck et al. (2018) found that furnishing regular treatment of alcohol-dependent patients with retraining attentional and approach biases resulted in higher abstinence rates one year later. However, retraining programs are only effective through long and intensive training programs, which poses questions of feasibility and cost-benefit balances.

### **Planning to Change**

Is it possible to plan to willfully inhibit or disrupt habitized responding? So long as a habit cue can be correctly identified, which is by no means certain given that people often acquire habits to co-incidental cues (Lin et al. 2016) or misattribute habits to internal states such as stress (Adriaanse, de Ridder, Evens 2011; Mazar & Wood, 2021), it is plausible to supplement motivation to change behavior by planning a reaction to the cue other than the unwanted habit response. For example, an individual may plan to ignore the habit cue as soon as it is perceived, or resist acting upon the cue. In general, the use of implementations intentions to support adoption of a new behavior has been associated with larger effect sizes than their use to decrease or inhibit an unwanted behavior ( $d_+ = 0.51$  vs.  $d_+ = 0.29$ ; Adriaanse, Vinkers et al. 2011). This is commensurate with habit theory; it can be argued that ignoring or not performing is less likely to forge a cue-response link in memory compared with training to link a cue with a tangible response.

Alternatively, an individual might replace an undesirable habit, such as throwing waste paper in the refuse, with a new desirable habit, such as recycling the paper. The idea that an established habit might be replaced by a new response to an existing cue has rarely been examined in the field (Holland et al. 2006, Labrecque et al. 2017) and requires evidence of a pre-existing strong habit, together with evidence that a plan results in behavior change. If a new habit is to replace an old one, further evidence is required to establish that the new

habit is enduring and the previous habit has been consistently attenuated (Holland et al. 2006). This has been demonstrated for mental as well as behavioral habits. For instance, Thürmer et al. (2013) successfully used implementation intentions to replace self-handicapping thoughts and behaviors in anxiety-evoking test situations with positive self-talk. Targeting one of the toughest habits, Armitage (2016) had smokers form individually tailored implementation intentions to replace lighting a cigarette with alternative actions. In a follow-up one month later, a significantly larger proportion of smokers who had formed implementation intentions had avoided 'lighting up' (15%), whereas only 2% had done so in the no-implementation intention control group. This effect was mediated by a reduced sense of smoking automaticity in the implementation intention condition consistent with the idea that the act of lighting up had become more mindful, at least over a four-week period.

In a laboratory context, Adriaanse, Gollwitzer et al. (2011) employed a word recognition task to provide insight into the cognitive processes underlying implementation intentions that target unwanted habits. The authors hypothesized that due to the nature of implementation intentions, the planned automatic cue-response links may directly compete with existing habitized cue-response links in memory. By taking away the mental accessibility advantage of the existing habit over the new behavior, a 'level playing field' is created. This paves the way for an attitude-driven choice process, which may then establish a new behavior if there is sufficient and consistent motivation to do so, and if relapse is avoided while the new habit is being established (Walker et al. 2015).

Holland et al. (2006) and Labrecque et al. (2017) provide elegant tests of planning to adopt new desired habits that directly compete with existing habits. Holland et al showed that over a two month period during which behavior was objectively and unobtrusively monitored, participants of an organization who planned how, where and when to dispose of their waste paper in a recycling bin were more likely to establish a new consistent behavior

than controls. Labrecque (2017) installed a novel laundry product use behavior, showing that it was necessary to supplement an implementation intention to use the new product with a plan to monitor and inhibit the existing habit in order to establish a new behavior.

### **Habit Discontinuities**

Habits function so long as the performance context remains intact and stable. However, there are times when contexts are disrupted, enabling attitude-led behavior change strategies. This may occur by choice, such as when an individual is relocating or changing jobs. Other disruptions come from 'natural' life course changes, such as leaving school, starting a family or retirement. External events such as the COVID-19 pandemic may also cause disruptions, as may legislation, such as the ban on smoking in public houses (Orbell et al. 2009) or the introduction of a charge on plastic bags (Thomas et al. 2019). When a disruption alters the performance context and habit cues are disorganized or removed, so that habitual behavior is no longer feasible, this may, in Lewin's (1947) terms, 'unfreeze' existing habits. This means a disruption of the smooth operation of a habit, such as caused by changes in a computer platform (Anderson & Wood 2021). Disruption may initiate a shift to deliberate processing and a more open mindset, contrary to the 'tunnel vision' mindset that characterizes strong habits (Verplanken et al. 1997). In order to adapt to the new situation, the individual may consider goals, acquire information, and form new attitudes which then guide new behavior. For instance, when a person retires, the cue for going for a drink with colleagues on Fridays after work is removed and this habit is disrupted. If socializing is important for this person, they need to consider new ways of fulfilling that goal.

In some instances a disruption is known to be temporary. Individuals may endure the disturbance, cope with its immediate consequences, and return to old habits once the situation is restored. This happened for instance with travel mode behaviors in London in 2012 that were temporarily distorted by the Olympic Games (Parkes et al. 2016). In those cases old

habits remain activated, but are temporarily blocked from execution. Discontinuities that are the result of life course changes may lead to more permanent changes and new habits, such as a transition from education to work (Busch-Geertsema & Lanzendorf 2017), changing jobs (Clark et al. 2016), relocating businesses (Walker et al. 2015), changes in family circumstances (Janke & Handy 2019), or retirement (Barnett et al. 2014).

Although an individual may find familiar cues in the new environment that trigger an existing habitual response (Wood et al. 2005), major discontinuities more often than not require replacing old habits by new behaviors. By becoming temporarily more mindful and deliberate, attitudes toward available new courses of action have to be formed. In this process important goals and values may come to the fore and guide the new choices (Verplanken et al. 2008). For instance, Clark et al. (2016) found that in the context of employment changes and residential relocations, environmental values predicted switches to public transport or active commuting. A discontinuity may also change the priority of certain values, such as prioritization of security over environmental values amongst new parents (Thomas et al. 2018).

Discontinuities provide unique opportunities for behavior change interventions. Given that discontinuities pave the way for more deliberate processes, behavior change interventions are more likely to attract attention and effectively convey information. This *Habit Discontinuity Hypothesis* (Verplanken et al. 2008) was tested in a field experiment among 800 households (Verplanken & Roy 2016). Half the households received an intervention designed to promote more sustainable behaviors whereas the other half served as control group. In each condition half of the households had relocated in the previous six months. The intervention was found to be more effective among those who had relocated than those who had not, compared with no-intervention control groups. A more detailed analysis revealed that the effect was confined to those who had relocated in the previous three

months, raising two questions; what makes a 'window of opportunity' last and when does a window 'open'? The latter may well be in advance of an expected discontinuity, for instance when people start planning how to commute prior to moving house (Haggart et al. 2019).

## **Conclusion**

There are several routes to support deliberate efforts to control unwanted habitual behavior by augmenting and strategically targeting attitude change approaches; monitoring and willfully changing a habit, retraining cue-action links, creating plans that are tied to the cues activating the unwanted habit and supplemented by efforts to inhibit previous habits. Habit discontinuities provide interesting windows of opportunity, both for individuals to initiate change and for larger attitudinally based behavior change programs. Insights from this research provide important boundary conditions for situating effective attitudinally based interventions. Strong attitudes are likely an important additional facilitator in persistent efforts to inhibit strong habits (Sheeran et al. 1999). In the next section we turn to change processes where attitudes play a minimal or no role.

## **LEVERAGING HABIT ARCHITECTURE TO CREATE OR CHANGE HABITS**

People who are effective at controlling their consumption, managing their recycling or staying in regular contact with older relatives, do so by outsourcing action control so that their actions are triggered automatically by recurring contexts in their environment. These established habits are broadly insensitive to vicissitudes of attitude and protect action even under conditions of stress or distraction, or when the originating goals of action are less salient, so long as the context remains intact and stable. By outsourcing behavioral control to the environment, habits are maintained by the habit architecture that supports them.

Certain environments are more prone to elicit habits, in particular environments that are stable, contain consistent cues, and deliver positive outcomes for an individual. This section considers the features of context that might be functional in the creation,

maintenance, and disruption of habits. These features relate first, to the management of action cues and second, to management of the feasibility of actions associated with those cues, by increasing or decreasing action friction. In these processes the role of attitudes is minimal or absent.

### **Cue Contexts**

The prerequisite for habit development is a stable environment that contains available, consistently recurring cues. Habit cues may take many forms including locations, visual cues, or preceding actions. However, when strong habits are established, people are usually not aware of the actual cues that govern their habitual behavior. Consequently, an individual may incorrectly confabulate reasons for their automatically cued actions or attribute automated habitized behavior to internal motivations such as stress relief (Adriaanse et al. 2011, Mazar & Wood 2021, Wood & R nger 2016). This lack of awareness of context-cue contingency in habit may diminish strategic efforts to identify and design optimum architecture required to develop a new habit, and limit effective context-based public health intervention. For example, reliance upon ‘stickies’ or mobile phone alerts as cues may provoke a single act such as ‘phoning mum’ or ‘getting up in time to eat breakfast’ but will fail as contextual tools for long-term habit development because the cue contingency between the reminder and action will not meet the requirements of a consistent, stable contextual cue. Devices such as these may instigate action but will impede automaticity. Medical interventions to promote adherence, by employing text message reminders for example, may similarly have limited capacity to create enduring habits cued by the patient’s own environment. Consequently, when the intervention texts cease, so may adherence (Stawarz et al. 2015).

How might context be leveraged to promote habit development? Effective habit development necessitates repetition of action in relation to context cues that naturally and reliably occur with an appropriate frequency. Piggy backing on existing daily routines, by

inserting new actions may be a solution (Labrecque et al. 2017, Orbell & Verplanken 2020). For example, if tooth brushing is a reliable activity, a flossing habit may be established as a new action to be performed at the end - but not before - brushing (Judah et al. 2013). Potent cues also exist at naturally occurring boundaries between action sequences such as upon arrival home in the evening. Interventions that build upon existing practices and cue contexts, be they individual or cultural, will facilitate habit development (Orbell & Phillips 2019).

Consumer habits and accompanying tendencies to resist change can be a powerful source of passive resistance to trying new products (Heidenreich & Kraemer 2016). If supermarkets seek to increase new sales, they may choose to capitalize upon the habit discontinuity effect by disrupting the existing layout and location of products, thereby forcing the customer to look around, deliberate and attend to different products.

Cues themselves may be manipulated in order to modulate behavior. A demonstration is the 'portion size effect', which comprises the tendency to consume relatively more from larger and less from smaller portions of food. People acquire a habit to 'clear their plate' or to 'finish their drink' during childhood irrespective of the amount consumed and consider it appropriate behavior (Herman et al. 2015). When presented with smaller portions, glasses, or spoons in a variety of contexts, people consume less food (Zlatevska et al. 2014), alcohol (Kersbergen et al. 2018), and sugar (Venema et al. 2020). Hollands et al. (2015) concluded that the portion size effect would equate to a 12-16% change in adult daily energy consumption. The effect is robust and occurs even after participants are informed about this phenomenon (Cavanagh et al. 2014), consistent with habitually and automatically clearing a plate, particularly when distracted by a simultaneous activity.

### **Feasibility of Action in Context**

Habits rely upon the possibility of their frequent, consistent execution in the environment context. An important tool to promote or diminish the likelihood of repeated

behavior is to introduce *friction* for a less desired course of action by making it seem more difficult, or by reducing friction for a more desired course of action by making it the simpler, more readily available, or default course of action. In both cases the environment is manipulated to decrease or increase, respectively, the likelihood of frequent and consistent execution. This can be accomplished in microenvironments such as one's house or office (e.g. not stockpiling unhealthy snacks), by organizations (e.g. creating open-plan offices), by governmental bodies (e.g. closing city centers for automobiles), or by legislation (e.g. smoking bans in public places).

Increases in friction might include imposition of waiting times. For example, the introduction of a 16 sec time delay in closing a lift (elevator) door was more effective in prompting employees to take the stairs, leading to a one third reduction in electricity use, than a persuasive message posted on a sign. Moreover, the stair climbing habit persisted after the study ended (Houten et al. 1981). Appelhans et al. (2018) retrofitted snack vending machines such that unhealthy snacks were announced to be delivered with a 25 seconds delay whereas healthy snacks were delivered immediately. This led to an increase in the purchase of the healthier snacks. Smoking bans inside public buildings, restaurants and pubs increase friction for smokers, forcing more mindful processing and search for alternative arrangements. Studies suggest that this results in a decline in smoking among those who regularly visit those places (Anger et al. 2011, Orbell et al. 2009). Ejlerskov et al. (2018) demonstrated that habitual purchases of small packages of less-healthy food for immediate consumption could be readily disrupted by increasing friction. Purchase of these products was more than 70% lower if supermarkets adopted a policy of not presenting those items at check-out points but elsewhere in the store. Friction may be altered by manipulating 'default' choices or actions. For example, people are more likely to grab food items that are nearer to them, even if preferred items are available further away. If the nearby items constitute low calorie and the

less proximate high calorie food, this arrangement promotes healthier habits (Privitera & Zuraikat 2014).

Habit acquisition is also more likely and faster if the required action is simple rather than complex (Kaushal & Rhodes 2015). Policies can reduce friction by simplifying behavior into the 'smallest doable action' (Sanghvi et al. 2016). Behaviors requiring multiple actions can be habitized but require extended action repetition. In an experimental study, participants practiced making sushi in an online game so as to acquire a habit (Labrecque et al. 2020). The authors showed that this multiple action sequence could not be automatized merely by conscious mental rehearsal, but had to be repeatedly performed to create strong cue-action links in memory. Similarly, an opera singer must rehearse by singing their words. Once the word sequences are habitized, it is possible to be free to think about the acting performance, once on stage.

The built environment may provide considerable potential for facilitation of habit by reducing friction. Nicosia and Datar (2018) used the quasi-experimental variation in the environments of adolescents' military families who regularly had to relocate, to demonstrate how the presence or absence of fitness and recreation facilities in these locations affected physical exercise frequencies. Particular districts may impact upon the feasibility of development of a walking habit in everyday life via presence of footpaths, proximity to a preferred school, shop or bus stop (Fleig et al. 2016, Le et al. 2019). Interventions to reduce friction by addressing the built environment and its services may also need to address affordability and equality of provision. Similarly, at a microenvironment level, development of a habit to consume fruit and vegetables requires the availability of these items in the home environment, which may be limited by financial cost (Daniel 2016).

## **Conclusion**

Habit architecture refers to features of the performance context that foster specific cue-action links. Whether by personal choice, via a group intervention, or organizational or public policy, it is possible to intervene to create or modify habit via an appreciation of habit context cueing. Manipulations can target the occurrence, salience or features of cues and manipulate behavior in context by increasing or decreasing action friction. Increased friction passively dissuades, whereas reduced friction passively induces action.

## **CONCLUSIONS**

Reliance upon attitude-based strategies to accomplish behavior change without regard to habit mechanisms diminishes their likely impact. Attitude-based strategies will have limited impact on behavior change if they fail to translate temporary behavior into new long term habits, or if they are employed to try to change existing habits that are insensitive to changes in attitude. However, with recognition of the context-dependent operation of habits, we have outlined approaches that exploit the potential of both attitudinally based and habit-based strategies.

The creation of new habits requires attention to those features that lead to cue contingent automaticity, namely consistent repetition in a stable, friction-minimizing context. Once formed, habits protect behavior against fluctuating attitudes and are resilient under stress or fatigue. Habit change may be assisted by strong attitudes and effortful monitoring, but slips are inevitable so long as strong cues to the original habit remain in place. Awareness of this contingency permits behavior change efforts to be targeted to exploit habit discontinuities, or interruptions in existing habits due to changes in the performance context (e.g. life course transitions, changes in the external environment). Such habit discontinuities may put deliberative strategies in the driving seat and provide prospects for more effective interventions. Finally, understanding of the role of habit architecture provides the opportunity

to manipulate cue contexts and to introduce or reduce friction or to embed new habits in old cue contexts.

It should be noted that even when habits are strong and a habit is automatically brought to mind by a cue, habitual action is not obligatory. If a situation calls for it, we are usually (unless distracted, stressed or fatigued) able to discontinue a habitized action and think about alternatives. Habitual action also does not preclude episodes when we do think or evaluate, even for a split second. The origins of habits often leave them attitude-aligned. Thus, in real life it may not be possible to draw as strict a distinction between habit-based and attitude-based behavior as models may suggest.

How might habit research progress? A good deal of research effort to date relies upon correlational observational studies in the field, using self-reported explicit measures of habit, attitude, and behavior. Laboratory-based work, on the other hand, while providing an opportunity to examine the mechanics of habit, may not be conducive to testing the slow development of realistic human habits, nor their destruction via various strategies. A good deal of prior research has established the necessity to manipulate distraction or ego depletion in order to distinguish habit from deliberate processes. Advancing knowledge on the relations between attitudes and habits requires research that combines controlled laboratory work with field studies investigating real-life behaviors (Marien et al. 2019). Further work is required that employs longitudinal and experimental designs, as well as techniques such as experience sampling and within-person statistical analyses. While a multitude of measurements are available in the attitude domain, this is less the case in habit research. The available self-report measures are limited to reporting experiences that arise from habitual processes. Reaction time-based and cognitive neuroscientific methods are confined to laboratory-based contexts. Therefore, more work on developing valid and reliable habit measures is needed.

Further work is also needed to identify optimal techniques to change attitudes and habits (Hagger et al. 2020, Kok et al. 2015), capitalizing on the integrative approaches outlined in this article. Taken together, considering the separate and interacting functions of attitudes and habits provides powerful and new perspectives on how people behave and how behavior may change. We hope that this review provides further inspiration to attitude and habit researchers to combine forces and develop this intriguing field.

## LITERATURE CITED

- Aarts H, Dijksterhuis A. 2000. Habits as knowledge structures: Automaticity in goal-directed behavior. *J. Pers. Soc. Psychol.* 78: 53-63
- Aarts H, Verplanken B, van Knippenberg A. 1998. Predicting behavior from actions in the past: Repeated Decision Making or a matter of habit? *J. Appl. Soc. Psychol.* 28, 1355-74
- Adriaanse, MA, Gollwitzer, PM, De Ridder TDT, de Wit JBF, Kroese FM. 2011. Breaking habits with implementation intentions: A test of underlying processes. *Pers. Soc. Psychol. Bull.* 37: 502-13
- Adriaanse MA, de Ridder DTD, Evers C. 2011. Emotional eating: Eating when emotional or emotional about eating? *Psychol. Health* 26: 23-39
- Adriaanse MA, Kroese FM, Weijers J, Gollwitzer PM, Oettingen G. 2018. Explaining unexplainable food choices. *Eur. J. Soc. Psychol.* 48: O15-O24
- Adriaanse MA, Vinkers CDW, De Ridder DTD, Hox JJ, De Wit JBF. 2011. Do implementation intentions help to eat a healthy diet? A systematic review and meta-analysis of the empirical evidence. *Appetite* 56: 183-93
- Ajzen I. 2011. Is attitude research incompatible with the compatibility principle? In *Most Underappreciated*, ed. RM Arkin, pp. 151-54. Oxford: Oxford University Press
- Albarracin D, Shavitt S. 2018. Attitudes and attitude change. *Annu. Rev. Psychol.* 69: 299-327
- Allom V, Mullan BA, Monds L, Orbell S, Hamilton K, et al. 2018. Reflective and impulsive processes underlying saving behavior and the additional roles of self-control and habit. *J. Neurosci. Psychol. E.* 11: 135-46
- Amaya KA, Smith KS. 2018. Neurobiology of habit formation. *Curr. Opin. Behav. Sci.* 20: 145-52

- Anderson IA, Wood W. 2021. Habits and the electronic herd: The psychology behind social media's successes and failures. *Consum. Psychol. Rev.* 4: 83-99
- Anger S, Kvasnicka M, Siedler T. 2011. One last puff? Public smoking bans and smoking behavior. *J. Health. Econ.* 30: 591-601
- Appelhans BM, French SA, Olinger T, Bogucki M, Janssen I, et al. 2018. Leveraging delay discounting for health: Can time delays influence food choice? *Appetite* 126: 16-25
- Armitage CJ. 2016. Evidence that implementation intentions can overcome the effects of smoking habits. *Health Psychol.* 35: 935-43
- Barnett I, van Sluijs EMF, Ogilvie D. 2012. Physical activity and transitioning to retirement: A systematic review. *Am. Prev. Med.* 43: 329-36
- Bate KS, Malouff JM, Thorgeinsson ET, Bhullar N. 2011. The efficacy of habit reversal therapy for tics, habit disorders and stuttering: A meta-analytic review. *Clin. Psychol. Rev.* 31: 865-71
- Batschelet HM, Stein M, Tschuemperlin RM, Soravia LM, Moggi F. 2020. Alcohol-specific computerized interventions to alter cognitive biases: A systematic review of effects on experimental tasks, drinking behavior, and neuronal activation. *Front. Psychiatry* 10: 871
- Blanton H, Burrows CN, Jaccard J. 2016. To accurately estimate implicit influences on health behaviour, accurately estimate explicit influences. *Health Psychol.* 35: 856-60
- Busch-Geertsema A, Lanzendorf M. 2017. From university to work life - Jumping behind the wheel? Explaining mode change of students making the transition to professional life. *Transport Res. A* 106: 181-96

- Cavanagh, K, Vartanian LR, Herman CP, Polivy J. 2014. The effect of portion size on food intake is robust to brief education and mindfulness exercises. *J. Health Psychol.* 19: 730-39
- Ceceli AO, Natsheh JY, Cruz D, Tricomi E. 2020. The neurobehavioral mechanisms of motivational control in attention-deficit/hyperactivity disorder. *Cortex* 127: 191-207
- Clark B, Chatterjee K, Melia S. 2016. Changes to commuter mode: The role of life events, spatial context and environmental attitude. *Transport Res. A-Pol.* 89: 89-105
- Courtois C, Montrieux H, De Grove F, Raes A, De Marez L, Schellens T. 2014. Student acceptance of tablet devices in secondary education: A three-wave longitudinal cross-lagged case study. *Comput. Hum. Behav.* 35: 278-86
- Croft A, Atkinson C, Sandstrom G, Orbell S, Aknin L. 2020. Loosening the GRIP (Gender Roles Inhibiting Prosociality) to promote gender equality. *Pers. Soc. Psychol. Rev.* in press
- Dalege J, Borsboom D, van Harreveld F, van der Maas HLJ. 2019. A network perspective on attitude strength: Testing the connectivity hypothesis. *Soc. Psychol. Pers. Sci.* 10: 746-56
- Daniel C. 2016. Economic constraints on taste formation and the true cost of healthy eating. *Soc. Sci. Med.* 148: 34-41
- Deci EL, Ryan RM. 1985. *Intrinsic motivation and self-determination in human behavior.* New York: Plenum
- De Houwer J, Tanaka A, Moors A, Tibboel H. 2018. Kicking the habit: Why evidence for habits in humans might be overestimated. *Motiv. Sci.* 4: 50-59

- de Wit S, Corlett PR, Aitken MR, Dickinson A, Fletcher PC. 2009. Differential engagement of the ventromedial prefrontal cortex by goal-directed and habitual behavior toward food pictures in humans. *J. Neurosci.* 29: 11330-8
- de Wit S, Kindt M, Knot SL, Verhoeven AAC, Robbins TW, et al. 2018. Shifting the balance between goals and habits: Five failures in experimental habit induction. *J. Exp. Psychol. Gen.* 147: 1043-65
- de Wit S, Watson P, Harsay HA, Cohen MX, van de Vijver I, Ridderinkhof KR. 2012. Corticostriatal connectivity underlies individual differences in the balance between habitual and goal-directed action control. *J. Neurosci.* 32: 12066-75
- Dickinson A, Balleine B. 1995. Motivational control of instrumental action. *Curr Dir Psychol Sci* 4: 162-67
- Eagly AH, Chaiken S. 1993. *The Psychology of Attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich
- Ejlerskov KT, Sharp SJ, Stead M, Adamson AJ, White M, Adams J. 2018. Supermarket policies on less-healthy food at checkouts: Natural experimental evaluation using interrupted time series analyses of purchases. *PLOS Med* 15: e1002712
- Fleig L, Ashe MC, Voss C, Therrien S, Sims-Gould J, et al. 2016. Environmental and psychosocial correlates of objectively measured physical activity among older adults. *Health Psychol.* 35: 1364-72
- Fournier, M, d'Arripe-Longueville, F, Radel R. 2017. Effects of psychosocial stress on the goal-directed and habit memory systems during learning and later extinction. *Psychoneuroendocrino.* 77: 275-83
- Galla BM, Duckworth AL. 2015. More than resisting temptation: Beneficial habits mediate the relationship between self-control and positive life outcomes. *J. Pers. Soc. Psychol.* 109: 508-25

Gardner B, Lally P. 2013. Does intrinsic motivation strengthen physical activity habit?

Modeling relationships between self-determination, past behaviour, and habit strength. *J. Behav. Med.* 36: 488-97

Gardner B., Lally P, Rebar AL. 2020. Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Soc. Personal. Psychol. Compass* 14: e12553

Gillan CM, Robbins TW, Sahakian BJ, van den Heuvel OA, van Wingen G. 2016. The role of habit in compulsivity. *Eur Neuropsychopharm* 26: 828-40

Giles EL, Robalino S, McColl E, Sniehotta FF, Adams J. 2014. The effectiveness of financial incentives for health behaviour change: Systematic review and meta-analysis. *PLOS ONE* 9: e90347

Glasman LR, Albarracín D. 2006. Forming attitudes that predict future behavior: A meta-analysis of the attitude-behavior relation. *Psychol. Bull.* 132: 778-822

Gollwitzer PM. 1993. Goal achievement: The role of intentions. *Eur. Rev. Soc. Psychol.* 4: 141-85

Greenwald AG, Lai CK. 2020. Implicit social cognition. *Annu. Rev. Psychol.* 71: 419-45

Greenwald AG, Poehlman TA, Uhlmann EL, Banaji MR. 2009. Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *J. Pers. Soc. Psychol.* 97: 17-41

Hagggar P, Whitmarsh L, Skippon SM. 2019. Habit discontinuity and student travel mode choice. *Transport Res. F-Trav.* 64: 1-13

Hagger MS, Cameron LD, Hamilton K, Hunkonen N, Lintunen T, eds. 2020. *The Handbook of Behavior Change*. Cambridge, UK: Cambridge University Press

- Hagger MS, Luszczynska A. 2014. Implementation intention and action planning interventions in health contexts: State of the research and proposals for the way forward. *Appl. Psychol.-Hlth. We.* 6: 1-47
- Hardwick, R. M., Forrence, A. D., Krakauer, J. W., & Haith, A. M. (2019). Time-dependent competition between goal-directed and habitual response preparation. *Nat. Hum. Behav.* 3: 1252-62
- Heidenreich S., Kraemer T. (2016). Innovations—doomed to fail? Investigating strategies to overcome passive innovation resistance. *J. Prod. Innov. Manag.* 33: 277–297
- Herman CP, Polivy J, Pliner P, Vartanian LR. 2015. *Physiol. Behav.* 144 129-136
- Hogarth L. 2018. A critical review of habit theory of drug dependence. In *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*, ed. B. Verplanken, pp. 325-41. Cham, Switzerland: Springer
- Hofmann W, Baumeister RF, Förster G, Vohs KD. 2012. Everyday temptations: An experience sampling study of desire, conflict, and self-control. *J. Pers. Soc. Psychol.* 102: 1318-35
- Holland RW, Aarts H, Langendam D. 2006. Breaking and creating habits on the work floor: A field-experiment on the power of implementation intentions. *J. Exp. Psychol.* 42: 776-83
- Hollands GJ, Shemilt I, Marteau TM, Jebb SA, Lewis HB, et al. 2015. Portion, package or tableware size for changing selection and consumption of food, alcohol and tobacco. Cochrane Database of Systematic Reviews, Issue 9. Art. No.: CD011045
- Hommel. B. 2019. Binary theorizing does not account for action control. *Front. Psychol.* 10: 2542
- Hornsey MJ, Harris EA, Bain PG, Fielding KS. 2016. Meta-analyses of the determinants and outcomes of belief in climate change. *Nat. Clim. Change* 6: 622-626

- Horstmann A., Dietrich A, Mathar D, Pössel M, Villringer A, Neumann J. 2015. Slave to habit? Obesity is associated with decreased behavioural sensitivity to reward devaluation. *Appetite* 87: 175-83
- Houten, R.V., Nau, P.A., Merrigan, M. 1981. Reducing elevator energy use: A comparison of posted feedback and reduced elevator convenience. *Journal of Applied Behavior Analysis*. 14: 377-387.
- Howe LC, Krosnick JA. 2017. Attitude strength. *Annu. Rev. Psychol.* 68: 327-51
- Itzhakov G, Uziel L, Wood W. 2018. When attitudes and habits don't correspond: Self-control depletion increases persuasion but not behavior. *J. Exp. Soc. Psychol.* 75: 1-10
- James W. 1887. The laws of habit. *Pop Sci Mon* 31: 433-51
- Janke J, Handy S. 2019. How life course events trigger changes in bicycling attitudes and behavior: Insights into causality. *Travel Beh. Soc.* 16: 31-41
- Judah G, Gardner B, Aunger R. 2013. Forming a flossing habit: An exploratory study of the psychological determinants of habit formation. *Brit. J. Health Psychol.* 18: 338-353
- Kakoschke N, Kemps E, Tiggemann M. 2017. Approach bias modification training and consumption: A review of the literature. *Addict. Behav.* 64: 21-28
- Kaushal N, Rhodes RE. 2015. Exercise habit formation in new gym members: A longitudinal study. *J. Behav. Med.* 38: 652-63
- Keller J, Kwasnicka D, Klaiber P, Sichert L, Lally P, Fleig L. 2021. Habit formation following routine-based versus time-based cue planning: A randomized controlled trial. *Brit. J. Health Psychol.* Published online, doi: 10.1111/bjhp.12504

- Kersbergen I, Oldham M, Jones A, Field M, Angus C, Robinson E. 2018. Reducing the standard serving size of alcoholic beverages prompts reductions in alcohol consumption. *Addiction* 113: 1598-1608
- Kok G, Gottlieb NH, Peters G-JY, Dolan Mullen P, Parcel GS, et al. 2015. A taxonomy of behaviour change methods: An Intervention Mapping approach. *Health Psychol. Rev.* 10: 297-312
- Kruglanski AW, Fishback A, Wooley K, Bélanger JJ, Chernikova M, et al. 2018. A structural model of intrinsic motivation: On the psychology of means-end fusion. *Psychol. Rev.* 125: 165-82
- Kruglanski AW, Szumowska E. 2020. Habitual behavior is goal-driven. *Psychol. Sci.* 15: 1256-71
- Kurdi B, Seitchik AR, Axt JR, Carroll TJ, Karapetyan A. et al. 2018. Relationship between the Implicit Association Test and intergroup behavior: A meta-analysis. *Am. Psychol.* 74: 569-86
- Kurz T, Gardner B, Verplanken B, Abraham C. 2015. Habitual behaviors or patterns of practice? Explaining and changing repetitive climate-relevant actions. *WIREs Clim. Change* 6: 113-128
- Labrecque JS, Lee K, Wood W. 2020. *How habits stick*. Manuscript in preparation.
- Labrecque JS, Wood W, Neal DT, Harrington N. 2017. Habit slips: When consumers unintentionally resist new products. *J. Acad. Market. Sci.* 45: 119-33
- Lally P, Gardner B. 2013. Promoting habit formation. *Health Psychol. Rev.* 7: sup1, S137-S158
- Lally P, van Jaarsveld CHM, Potts HWW, Wardle J. 2010. How are habits formed: Modelling habit formation in the real world. *Eur. J. Soc. Psychol.* 40: 998-1009

- Lattarulo P, Masucci V, Paziienza MG. 2019. Resistance to change: Car use and routines. *Transp. Policy* 74: 63-72
- Le HTK, Buehler R, Hankey S. 2019. Have walking and bicycling increased in the US? A 13-year longitudinal analysis of traffic counts from 13 metropolitan areas. *Transportation Research Part D: Transport And Environment*. 69:329-345
- Lee K, Kwan MP. 2018. Physical activity classification in free-living conditions using smartphone accelerometer data and exploration of predicted results. *Comput. Environ. Urban Syst*. 67: 124-31
- Lewin K. 1947. Frontiers in group dynamics: Concept, method and reality in social science; social equilibria and social change. *Hum. Relat.* 1: 5-41
- Lin P-Y, Wood W, Monterosso J. 2016. Healthy habits protect against temptations. *Appetite* 103: 432-40
- Luque D, Molinero S, Watson P, López FJ, Le Pelley ME. 2020. Measuring habit formation through goal-directed response switching. *J. Exp. Psychol. Gen.* 149: 1449-59
- Maki A, Burns RJ, Ha L, Rothman AJ. 2016. Paying people to protect the environment: A meta-analysis of financial incentive interventions to promote proenvironmental behaviors. *J. Environ. Psychol.* 47: 242-55
- Mancuso C, Miltenberger RG. 2016. Using habit reversal to decrease filled pauses in public speaking. *Appl. Behav. Anal.* 49: 188-92
- Mantzari E, Vogt F, Shemilt I, Wei J, Higgins JPT, Marteau TM. 2015. Personal financial incentives for changing habitual health-related behaviors: A systematic review and meta-analysis. *Prev. Med.* 75: 75-85

- Marien H, Custers R, Aarts H. 2019. Studying human habits in societal context: Examining support for a basic stimulus-response mechanism. *Curr. Dir. Psychol. Sci.* 28: 614-18
- Mazar A, Wood W. 2021. *Illusory feelings, elusive habits: Behavioral attributions overlook habit*. Manuscript submitted for publication.
- McCloskey K, Johnson BT. 2019. Habits, quick and easy: Perceived complexity moderates the associations of contextual stability and rewards with behavioral automaticity. *Front. Psychol.* 10: 1556
- Milne S, Orbell S, Sheeran P. 2002. Combining motivational and volitional interventions to promote exercise participation: Protection motivation theory and implementation intentions. *Brit. J. Health Psych.* 7: 163-84
- Moscovici S. 1963. Attitudes and opinions. *Annu. Rev. Psychol.* 14: 231-60
- Murray KB, Häubl G. 2007. Explaining cognitive lock-in: The role of skill-based habits of use in consumer choice. *J. Consum. Res.* 34: 77-88
- Neal DT, Wood W, Drolet A. 2013. How do people adhere to goals when willpower is low? The profits (and pitfalls) of strong habits. *J. Pers. Soc. Psychol.* 104: 959-75
- Neal DT, Wood W, Labrecque JS, Lally P. 2012. How do habits guide behavior? Perceived and actual triggers of habits in daily life. *J. Exp. Soc. Psychol.* 48: 492-98
- Neal DT, Wood W, Wu M, Kurlander D. 2011. The pull of the past: When do habits persist despite conflict with motives? *Pers. Soc. Psychol. Bull.* 37: 1428-37
- Nicosia N, Datar A. 2018. Neighborhood environments and physical activity: A longitudinal study of adolescents in a natural experiment. *Am. J. Prev. Med.* 54: 671-78

- Orbell S, Lidiert P, Henderson CJ, Geeraert N, Uller C, et al. 2009. Social–cognitive beliefs, alcohol, and tobacco use: A prospective community study of change following a ban on smoking in public places. *Health Psychol.* 28, 753–61
- Orbell S, Phillips LA. 2019. Automatic processes and self-regulation of illness. *Health Psychol. Rev.* 13: 378-405
- Orbell S, Verplanken B. 2010. The automatic component of habit in health behavior: Habit as cue-contingent automaticity. *Health Psychol.* 29: 374-83
- Orbell S, Verplanken B. 2018. Progress and prospects in habit research. In Verplanken B, ed. 2018. *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*, ed B Verplanken, pp.397-409. Cham, Switzerland: Springer
- Orbell S, Verplanken B. 2020. Changing behavior using habit theory. In *The Handbook of Behavior Change*, ed. MS Hagger, LD Cameron, K Hamilton, N. Hankonen, T Lintunen, pp. 178-92. Cambridge UK: Cambridge University Press
- Oswald FL, Mitchell G, Blanton H, Jaccard J, Tetlock PE. 2013. Predicting ethnic and racial discrimination: A meta-analysis of IAT criterion studies. *J. Pers. Soc Psychol* 105: 171-92
- Ouellette JA, Wood W. 1998. Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychol. Bull.* 124: 54-74
- Parkes SD, Jopson A, Marsden G. 2016. Understanding travel behaviour change during mega-events: Lessons from the London 2012 Games. *Transport Res. A* 92: 104-19
- Privitera GJ, Zuraikat FM. 2014. Proximity of foods in a competitive food environment influences consumption of a low calorie and a high calorie food. *Appetite* 76: 175-79
- Quinn JM, Pascoe A, Wood W, Neal, DT. 2010. Can't control yourself? Monitor those bad habits. *Pers. Soc. Psychol. Bull.* 36: 499-511

- Rebar A, Gardner B, Rhodes RE, Verplanken B. 2018. The measurement of habits. In *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*, ed. B. Verplanken, pp. 31-49. Cham, Switzerland: Springer
- Rebar A, Rhodes RE, Gardner B. 2019. How we are misinterpreting physical activity intention-behavior relations and what to do about it. *Int. J. Behav. Nutr. Phy* 16: 71
- Reber R, Schwarz N, Winkelman O. 2004. Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Pers. Soc. Psychol. Rev.* 8: 364-82
- Rhodes RE, Dickau L. 2012. Experimental evidence for the intention-behavior relationship in the physical activity domain: A meta-analysis. *Health Psychol.* 31: 724-27
- Rinck M, Wiers RW, Becker ES, Lindenmeyer J. 2018. Relapse prevention in abstinent alcoholics by cognitive bias modification: Clinical effects of combining approach bias modification and attention bias modification. *J. Consult. Clin. Psych.* 86: 1005-16
- Sanghvi T, Haque R, Roy S, Afsana K, Seidel R, et al. 2016. Achieving behavior change at scale: Alive and Thrive's infant and young child feeding programme in Bangladesh. *Matern. Child Nutr.* 12: 141-54
- Schneider W, Shiffrin RM. 1977. Controlled and automatic human information processing: I. Detection, search, and attention. *Psychol. Rev.* 84: 1-66
- Sheeran P, Godin, G, Conner, M, Germain M. 2017. Paradoxical effects of experience: Past behavior both strengthens and weakens the intention-behavior relationship. *J. Assoc. Consum. Res.* 2: 309-18
- Sheeran P, Maki A, Montanaro E, Avishai-Yitshak A, Bryan A, et al. 2016. The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. *Health Psychol.* 35: 1178-88

- Sheeran P, Orbell S, Trafimow D. 1999. Does the temporal stability of behavioral intentions moderate intention-behavior and past behavior-future behavior relations? *Pers. Soc. Psychol. B.* 25: 721-30
- Slovinec D'Angelo ME, Pelletier LG, Reid RD, Huta V. 2014. The roles of self-efficacy and motivation in the prediction of short- and long-term adherence to exercise among patients with coronary heart disease. *Health Psychol.* 33: 1344-53
- Stawarz K, Cox AL, Blandford A. 2015. Beyond self-tracking and reminders: Designing smartphone apps that support habit formation. *CHI '15: Proceedings of the 33rd Annual ACM Conference on Human Factors in Computer Systems April*: 2653-62
- Thaler RH, Sunstein CR. 2008. *Nudge: Improving decisions about health, wealth and happiness*. New Haven, CT: Yale University Press
- Thomas GO, Fisher R, Whitmarsh L, Milfont TL, Poortinga W. 2018. The impact of parenthood on environmental attitudes and behaviour: A longitudinal investigation of the legacy hypothesis. *Popul. Environ.* 39: 261-76
- Thomas GO, Sautkina E, Poortinga W, Wolstenholme E, Whitmarsh L. 2019. The English plastic bag charge changed behavior and increased support for other charges to reduce plastic waste. *Front. Psychol.* 10: 266
- Thürmer JL, McCrea SM, Gollwitzer PM. 2013. Regulating self-defensiveness: If-then plans prevent claiming and creating performance handicaps. *Motiv. Emot.* 37: 712-25
- Trafimow D. 2018. The automaticity of habitual behaviours: Inconvenient questions. In *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*, ed. B. Verplanken, pp. 377-95. Cham, Switzerland: Springer
- Triandis HC. 1977. *Interpersonal behavior*. Monterey, CA: Brooks/Cole

- Turton R, Bruidegom K, Cardi V, Hirsch CR, Treasure J. 2016. Novel methods to help develop healthier eating habits for eating and weight disorders: A systematic review and meta-analysis. *Neurosci. Biobehav. R.* 61: 132-55
- Udall AM, de Groot JIM, De Jong SB, Shankar A. 2021. How I see me: A meta-analysis investigating the association between identities and pro-environmental behaviour. *Front. Psychol.* 12: 582421
- Venema TAG, Kroese FM, Verplanken B, de Ridder DTD. 2020. The (bitter) sweet taste of nudge effectiveness: The role of habits in a portion size nudge, a proof of concept study. *Appetite* 151: 104699
- Verplanken B, ed. 2018. *The Psychology of Habit: Theory, Mechanisms, Change, and Contexts*. Cham, Switzerland: Springer
- Verplanken B, Aarts HAG. 1999. Habit, attitude, and planned behaviour: Is habit an empty construct or an interesting case of automaticity? *Eur. Rev. Soc. Psychol* 10: 101-34
- Verplanken B, Aarts H, van Knippenberg A. 1997. Habit, information acquisition, and the process of making travel mode choices. *Eur. J. Soc. Psychol* 27: 539-60
- Verplanken B, Aarts H, van Knippenberg A, Moonen A. 1998. Habit versus planned behaviour: A field experiment. *Brit. J. Soc. Psychol.* 37: 111-28
- Verplanken B, Friberg O, Wang CE, Trafimow D, Woolf K. 2007. Mental habits: Metacognitive reflection on negative self-thinking. *J. Per. Soc. Psychol.* 92: 526-41
- Verplanken B, Marks E, Dobromir AI. 2020. On the nature of eco-anxiety: How constructive or unconstructive is habitual worry about global warming? *J. Environ. Psychol.* 72: 101528
- Verplanken B, Orbell S. 2003. Reflections on past behavior: A self-report index of habit strength. *J. Appl. Soc. Psychol.* 33, 1313-30

- Verplanken B, Roy D. 2016. Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *J. Environ. Psychol.* 45: 127-34
- Verplanken B, Sui J. 2019. Habit and identity: Behavioral, cognitive, affective, and motivational facets of an integrated self. *Front. Psychol.* 10: 1504
- Verplanken B, Walker I, Davis A, Jurasek M. 2008. Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *J. Environ. Psychol.* 28: 121-27
- Verplanken B, Wood W. 2006. Interventions to break and create consumer habits. *J. Public Policy Mark.* 25: 90-103
- Verplanken B, Yang M, Sui J, Bentley J, Min A. (2021). *Habit formation: The role of performance frequency and self-identity*. Unpublished data.
- Walker I, Thomas GO, Verplanken B. 2015. Old habits die hard: Travel habit formation and decay during an office relocation. *Environ. Behav.* 47: 1089-1106
- Wakefield MA, Loken B, Hornik RC. 2010. Use of mass media campaigns to change health behaviour. *Lancet* 376: 1261-71
- Webb TL, Sheeran P. 2006. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol. Bull.* 132: 249-268
- Wolf LJ, Haddock G, Manstead ASR, Maio GR. 2020. The importance of (shared) human values for containing the COVID-19 pandemic. *Brit. J. Soc. Psychol.* 59: 618-27
- Wood, Mazar, Neal. 2021. Habits and goals in human behavior: Separate but interacting systems. *Perspect. Psychol. Sci.* in press
- Wood W, Neal DT. 2007. A new look at habits and the habit-goal interface. *Psychol. Rev.* 114: 843-63

Wood W, Runger D. 2016. The psychology of habit. *Annu. Rev. Psychol.* 67: 289-314

Wood W, Tam L, Guerrero Witt M. 2005. Changing circumstances, disrupting habits. *J.*

*Per. Soc. Psychol.* 88: 918-33

Zlatevska, N, Dubelaar C, Holden SS. 2014. Sizing up the effect of portion size on

consumption: A meta-analytic review. *J. Marketing* 78: 110-54

## FIGURE CAPTION

**Figure 1**

Schematic representation of ways in which attitudes and habits may relate. The upper larger arrow represents how attitudes may initiate habit formation and a transition from attitude-driven to habit-driven. The lower larger arrow represents how habit disruption may initiate a transition from habit-driven to attitude-driven behavior. The boxes on the far left and right represent influences on attitudes and habits, respectively. The dotted arrow in the middle represents attitudinal inferences from habitual processes.

