

ARTICLE

Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis

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Abstract

Habitual behaviours are elicited when a familiar context activates cue-behaviour associations that have been learned through previous performance. A core hypothesis within habit theory is that, by virtue of its automaticity, habit weakens the impact of intention on action, such that in facilitating conditions, action will be guided more by habit than momentary intentions. This has led to recommendations that habit formation be harnessed as a mechanism for sustaining desirable behaviour over time, when people would otherwise relapse due to loss of motivation. This article reviews theory and evidence around the hypothesized interaction between habit and intention as determinants of behaviour. We first qualify the hypothesis by clarifying that it pertains only to determinants of the instigation of action, rather than execution. Next, drawing on a systematic review of 52 behaviour-prediction studies, we highlight mixed empirical support for the interaction. We argue that ostensibly inconsistent findings can be reconciled by recognizing the distinction between the direction and strength of intention, and identifying the “facilitating conditions” that may determine the relative influence of habit and intention on behaviour. Evidence demonstrates that when self-control is diminished, people act habitually regardless of intention direction or strength. When people possess self-control,

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habits can help people to act on favourable but weakened intentions, but intentions that oppose habitual tendencies can override habitual influence. This has important implications for behaviour change: even if habit has formed, a minimal level of favourable conscious motivation may be required to sustain behaviours over time. Social psychology might fruitfully move beyond asking *whether* habit moderates the intention-behaviour relationship, and instead probe *how* and *in which conditions* habits and intentions interact.

1 | INTRODUCTION

Many pressing global and societal challenges could be mitigated by changes in human behaviour. Climate change could be tackled by decreasing household energy use and switching to cleaner transport modes (Pacala & Socolow, 2004). Healthcare costs and early mortality could be reduced by improving dietary quality and increasing physical activity (Kelly et al., 2009; Nocon et al., 2008). Achieving meaningful change in such behaviours often requires disrupting repeatedly performed undesirable actions (e.g., high-calorie snack consumption) and promoting repetition of desirable actions (e.g., physical activity). Although expectancy-value models portray people as deliberative, much human behaviour is driven by non-reflective processes, such as habit (Evans & Frankish, 2009). Habit is a cognitive process whereby situations automatically trigger impulses to act, due to the activation of situation-action associations learned through repeated performance (Gardner, 2015a; Lally, van Jaarsveld, Potts, & Wardle, 2010).

Habitual behaviour is often defined in contrast to intentional behaviour. Intentional behaviour arises via a relatively slow and effortful reasoning process: contextual cues prompt deliberation over situational and task demands, which culminates in the formation of an intention to pursue the option judged most likely to achieve progress towards a valued goal, and subsequent mindful implementation. Habitual behaviour arises rapidly and efficiently: contextual cues trigger a network of cue-behaviour associations, which activate impulses to act in the potential absence of a valued goal, with little or no awareness or volitional control (Neal, Wood, Labrecque, & Lally, 2012; Wood & Neal, 2007). Unless wilfully inhibited, habit impulses translate directly into the associated behaviour without requiring conscious oversight, awareness, or control (Gardner, 2015b). The contrast between habit and intention as determinants of behaviour has been likened to a horse race: upon the situational cue firing the starting gun, the speedy and efficient habitual response dominates over its slower intention-based rival, winning the race to translate into behaviour (Adriaanse, Gollwitzer, De Ridder, de Wit, & Kroese, 2011).

The horse race metaphor encapsulates a key prediction within habit theory: in stable and familiar settings, habit impulses will preside over intentions in regulating behaviour (Landis, Triandis, & Adamopoulos, 1978; Neal et al., 2012; Triandis, 1977). This "habit-intention interaction hypothesis" arguably underpins much of the current interest in habit within the behaviour change field. If habit overrides intention, then habit formation should sustain new behaviours over time even if, as is typically observed, motivation lapses (Verplanken & Wood, 2006). Conversely, lasting cessation of unwanted behaviours will require strategies that address cue-dependency, because changing conscious motivation alone is unlikely to shift unwanted habitual behaviours (Verplanken & Wood, 2006). Given its centrality to current thinking on behaviour change (Gardner, Rebar, & Lally, 2020b; Orbell & Verplanken, 2020; Verplanken, 2018; Wood & Neal, 2016), this review examines theory and evidence around the interplay of habits and intentions in guiding behaviour.

2 | THE HABIT-INTENTION INTERACTION HYPOTHESIS

While a long history of research shows that learned actions can proceed in the absence of clear motive (James, 1890; Tolman, 1932), Triandis' (1977) theory of interpersonal behaviour (TIB) represents one of the earliest formal integrations of the interplay between habit and conscious motivation into an explanatory model. Triandis (1977) summarized the hypothesized relationship between habit – defined as “the number of times the response has occurred in the history of the organism” (p. 194) – and intention – a summation of all conscious motivational influences – in the equation:

$$P_a = (w_H H + w_I I) * F.$$

The probability (P) of an action (a) represents the function of the weighting (w_H) of habit strength (H) for the action and the weighting (w_I) of intention to undertake that action (I), as multiplied by facilitating conditions (F). The probability of action varies from 0–1 and so, by extension, weights w_H and w_I each range in value from 0–1 and sum to a total of 1 (i.e., $w_H = 1 - w_I$, and $w_I = 1 - w_H$). Thus, as the contribution of habit to action increases, the contribution of intention proportionally decreases, and vice versa. Triandis (1977) appended to the equation the prediction that the influence of habit will depend on how well-learned the focal act is in a given situation. In familiar settings, greater strength will boost the influence of habit, in turn diminishing the influence of intention. In unfamiliar settings, in which no performance history exists and behaviours are novel, intentions alone will determine behaviour. These effects are qualified by the conduciveness of conditions to enactment: “in an extreme case, the person's habits and behavioural intentions have no relevance if the situation does not permit him or her to behave” (Triandis, 1977, p. 207).

Although Triandis' equation focuses only on single action instances with a dichotomous outcome – either the behaviour is enacted or it is not – the hypothesis has been most commonly applied to predict the frequency with which an action is performed, or tendencies to act across multiple occasions (e.g., the number of car journeys undertaken in a given week; Gardner, 2009). In such instances, the outcome variable represents the summation of dichotomous action vs. non-action outcomes across multiple occasions.

Figure 1 depicts, *ceteris paribus*, the proposed interaction between habits and intentions to perform a given behaviour, in facilitating conditions, as predictors of behaviour frequency (Triandis, 1977).¹ The dominance of habit is most clearly demonstrated among those with strong habits and weak intentions, who are as likely to act as those with strong intentions. Figure 1 captures Triandis' original formulation of the habit-intention interaction hypothesis, which proposed only the dominance of habit over intention to perform *the same* action:

“the probability of an act is a function of [habit for] the response ... and the intention to *behave in that way*” (Triandis, 1977, p. 194, emphasis added).

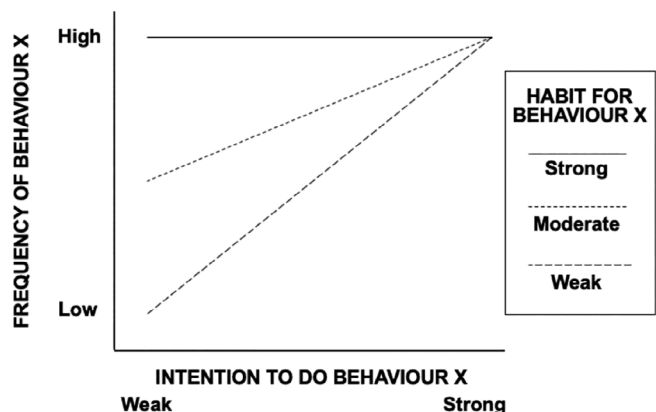


FIGURE 1 Triandis' (1977) Habit-Intention Interaction Hypothesis, as applied to behaviour frequency

However, Triandis later broadened the hypothesis, positing that habit may overcome intentions to perform *any* action:

“the probability [of an act] is some weighted function of...[habit for] the act in the behavioural history of the organism [and intention, which is defined as] the organism's self-instruction to *behave in a certain way*” (Landis et al., 1978; p. 228, emphasis added).

The latter has been adopted as the definitive account of the hypothesis (Rothman, Sheeran, & Wood, 2009; van't Riet, Sijtsma, Dagevos, & De Bruijn, 2011; Verplanken & Aarts, 1999; Wood & Neal, 2016).

Triandis' conceptualization of habit and its interplay with intentions requires qualification in several respects. The treatment of habit as a hypothetical cache of past performances is conceptually problematic; past behaviour can predict but does not explain future behaviour (Ajzen, 2002). Present-day definitions portray habit as a non-conscious construct (Fleetwood, in press; Gardner, 2015a; Verplanken, 2006). These conceptually distinguish habit from the behaviour that it generates, while also adding explanatory value to the hypothesis: it is because habit prompts behaviour automatically and rapidly that habit dominates over intentions (Neal et al., 2012; Verplanken, Aarts, & van Knippenberg, 1997).

The hypothesis is also qualified by the complex temporality of relationships between habit, intention and behaviour. When people can freely choose their actions, habit will form on the basis of repeated performance of intentional actions, such that intention influences behaviour and so habit (Lally et al., 2010). This has led some to question the portrayal of habitual responses as goal-independent, on the basis that habits represent historical goal-directed intentions (Aarts & Dijksterhuis, 2000; Trafimow, 2018; but see Wood & Neal, 2007). Over time however, intentions (e.g., to limit snacking) may diverge from habits (e.g., to eat snacks; Verplanken & Faes, 1999). The interaction hypothesis speaks only to the contribution of stable habits and intentions at the moment an action opportunity is encountered.

While some have interpreted the hypothesis to imply that behaviour is *either* “habitual” or “intentional” (e.g., Lheureux, Auzoult, Charlois, Hardy-Massard, & Minary, 2016), it is unlikely that complex sequences of actions unfold entirely due to habit. A distinction can be drawn between *instigating* and *executing* an act. For example, “driving to work” involves both selecting “driving” from available commuting options and performing a sequence of lower-level actions subservient to the goal of “driving to work” (e.g., “putting on seatbelt,” “putting key in ignition,” “pressing accelerator,” etc.; Cooper & Shallice, 2000). Recent evidence suggests that the hypothesis relates only to action selection (Gardner, Phillips, & Judah, 2016). One study demonstrated that the automaticity with which participants reportedly “decided” to be physically active predicted behaviour frequency, but the automaticity of “doing” physical activity did not (Gardner et al., 2016). Another study showed that participants trained in responding to a visuomotor task were able to adapt their performance to a subsequent switch in task demands; yet, reducing available response time led to greater expression of the learned action, indicating that habit training had instilled an action selection tendency (Hardwick, Forrence, Krakauer, & Haith, 2019). The interaction hypothesis can be reformulated to overcome this problem, by refocusing on the instigation of action, as distinct from its execution (Gardner et al., 2016; Verplanken & Melkevik, 2008): in stable and familiar settings, and where habit is strong, behaviour is likely to be *selected* by the habit process, rather than intentions.

3 | DOES EVIDENCE SUPPORT THE HABIT-INTENTION INTERACTION HYPOTHESIS?

Much research has been undertaken to test whether habits and intention interact, and studies across a range of domains have supported the hypothesis (for reviews, see Gardner, de Bruijn, & Lally, 2011; Ouellette & Wood, 1998; Rebar et al., 2016). We undertook a systematic literature search to identify published tests of the interaction

hypothesis in real-world settings. Two databases (PsycInfo, Web of Science) were searched in February 2020 to identify sources citing one of three seminal papers on habit measurement (Gardner, Abraham, Lally, & de Bruijn, 2012; Ouellette & Wood, 1998; Verplanken & Orbell, 2003). Forty-five papers, comprising 52 studies, reported primary quantitative real-world data regarding the effect of intention on behaviour at differing levels of habit strength (see Table 1). Further detail of search procedures and study findings is provided as Data S1.

Of the 52 studies, 12 focused solely on dietary consumption, eight on physical activity, eight on travel mode choice, five on information technology use, four on alcohol consumption, and two on environmental behaviours. Vitamin and mineral supplementation, saving money, sun protection use, screen time and breast self-examination were each the focus of one study. Eight studies assessed moderation across multiple behaviours.

The hypothesis has most commonly been tested by examining whether the product of intention and habit scores contributes uniquely to between-person variation in behaviour frequency (49 studies). In 44 of the 49 studies, significant moderation effects were probed by estimating intention-behaviour correlations at different levels of habit (e.g., at least one standard deviation above the mean [strong habit], within one standard deviation of the mean [moderate habit], or at least one standard deviation below the mean [weak habit]).

Of the 52 studies, 21 (40%) showed the influence of intention to weaken as habit strengthened, supporting Triandis' (1977) hypothesis. One study, for example, found that the influence of intention to commute by car on the proportion of car commutes over the following week was strongest for people with weak car commuting habit (Gardner, 2009). Where habit was strong, however, intention had no relationship with car commuting: those with weak intentions but strong habits drove as frequently as did those with strong intentions.

Findings from other studies, however, call the interaction hypothesis into question. Sixteen studies (31%) found no interaction. For example, one study showed that snack consumption habit and intentions to avoid snacking independently predicted snacking frequency, but did not interact (Gardner, Corbridge, & McGowan, 2015). Four studies (8%) found interaction in an opposing direction, with habit *strengthening* intention-behaviour relationships. Eleven (21%) found inconsistent results across multiple tests within the same study, detecting moderation among only some subsamples, or at only some timepoints, or using some habit or behaviour measures but not others. In one study, for example, while moderate intensity intentions were less strongly predictive of moderate physical activity frequency among those strong moderate activity habits in accordance with the hypothesis, vigorous activity intentions were *more* strongly predictive of vigorous activity frequency among people reporting stronger vigorous activity habit (Rhodes & De Bruijn, 2010).

Mixed support for the habit-intention hypothesis suggests that the strength or direction of any interaction between intention and habit may be influenced by additional variables. There is no clear evidence to suggest that the hypothesis explains some behaviours but not others. Indeed, mixed findings have been observed for the same behaviour: the eight reviewed studies of physical activity included three showing habit to attenuate intention-behaviour relations in accordance with the hypothesis, one demonstrating habit to strengthen the intention-behaviour link, two showing no interaction, and two showing moderation on some indices but not others.

Mullan and Novorodovskaya (2018) proposed that the influence of habit and intention may be moderated by behavioural complexity – defined as whether one or more sub-actions (“steps”) are involved in discharging the behaviour – and the immediacy of rewards delivered by performance. They noted that, for “one-step” actions that yield immediate hedonic rewards (e.g., drinking sugar sweetened beverages; de Bruijn & van den Putte, 2009), and “multi-step” actions that generate more distal benefits (e.g., using sunscreen; Allom, Mullan, & Sebastian, 2013), habit is often a stronger determinant than intention. Although Mullan and Novorodovskaya focused on between-study differences in the relative strength of habit and intention as independent predictors of behaviour, rather than habit-intention interaction, their conclusion can be challenged because the interaction hypothesis pertains only to instigation of action. There is no reason to expect the complexity of *executing* an act to completion to influence the extent to which it is *instigated* by habit or intention, other than that complexity may affect the appeal of an action, so influencing intention (Ajzen, 1991; Gardner, Rebar, & Lally, 2020a).

TABLE 1 Tests of habit as a moderator of the intention-behaviour relationship

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Dietary consumption						
Allom and Mullan (2012)	Fruit & vegetable consumption (SR)	Eating fruits & vegetables (SRHI)	To eat fruits & vegetables	209	.69	Participants non-schematic on healthy eating: I-B weakens as habit strength increases Participants schematic on healthy eating: No interaction found
de Bruijn (2010)	Fruit consumption (SR)	Eating fruit (SRHI - abbreviated)	To eat fruit	538	.69	I-B weakens as habit strength increases
de Bruijn et al. (2007)	Fruit consumption (SR)	Eating fruit (SRHI)	To eat fruit	521	.49	I-B weakens as habit strength increases
de Bruijn, Kroeze, Oenema and Brug (2008)	Saturated fat consumption (SR)	Watching fat in diet (SRHI)	To watch fat in diet	764	.63	I-B weakens as habit strength increases
Evans, Norman & Webb (2017, Sample 1)	Fruit and vegetable consumption (SR)	Eating fruits & vegetables (SRBAI)	To eat fruits & vegetables	115	.52	No interaction found
Evans, Norman & Webb (2017, Sample 2)	Unhealthy snack consumption (SR)	Unhealthy snacking (SRBAI)	To eat unhealthy snacks	109	.21	No interaction found
Gardner, Abraham, et al. (2012, Dataset 3)	Unhealthy snacking (SR)	Unhealthy snacking (SRBAI)	To avoid eating unhealthy snacks	188	-.39	No interaction found
Gardner et al. (2015)	Unhealthy snacking (SR)	Unhealthy snacking (SRBAI)	To avoid eating unhealthy snacks	239	-.18	No interaction found
Kothe, Sainsbury, Smith and Mullan (2015)	Gluten-free diet adherence (SR)	Eating a gluten-free diet (SRHI)	To eat a gluten-free diet	228	.20	I-B strengthens as habit strength increases

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size n ^c	Habit-intention correlation r	Habit a significant moderator?
McKee et al. (2019)	1. Parent's general healthy feeding (SR)	Healthy child-feeding (SRHI)	To feed child healthy food	235	1. .52	1., 3.-6.: No interaction found 2. I-B strengthens as habit strength increases
	2. Child fruit and vegetable consumption (parent-reported)				2. .25	
	3. Child healthy snacking (parent-reported)				3. -.03	
	4. Child unhealthy snacking (parent-reported)				4. .27	
	5. Child healthy drinking (parent-reported)				5. -.03	
	6. Child unhealthy drinking (parent-reported)				6. .08	
Menozi, Sogari, and Mora (2017)	Vegetable consumption (SR)	Eating vegetables (SRHI - abbreviated)	To eat vegetables	751	Not reported	I-B weakens as habit strength increases
	Healthy snacking (O)	Healthy snacking (SRHI)	To eat healthy snacks	537	Not reported	I-B strengthens as habit strength increases
Physical activity						
Allom, Mullan, Cowie, and Hamilton (2016)	Physical activity (SR)	Regular physical activity (SRHI)	To do regular physical activity	101	.70	No interaction found
	Vigorous physical activity (SR)	Vigorous physical activity (SRHI)	To do active sports and/or vigorous physical activity	226	.65	I-B weakens as habit strength increases
Chatzisarantis and Hagger (2007, Study 1)	Vigorous exercise (SR)	Exercising (SRHI - abbreviated)	To exercise	538	.67	I-B weakens as habit strength increases
	Vigorous exercise (SR)	Exercising (SRHI)	To exercise	415	.78	I-B strengthens as habit strength increases

(Continues)

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Rebar et al. (2014)	Physical activity (O)	Physical activity (SRBAI)	To be physically active	128	.37	1. Between-person: No interaction found 2. Within-person: I-B weaker for people with stronger habits
Rhodes and De Bruijn (2010)	1. Moderate physical activity (SR) 2. Vigorous physical activity (SR)	Physical activity (SRHI - abbreviated)	To be physically active	1. 158 2. 179	1. .40 2. .53	1. Yes - I-B weakens as habit strength increases 2. Yes - I-B strengthens as habit strength increases
Rhodes, de Bruijn and Matheson (2010)	Moderate or vigorous physical activity (SR)	Physical activity (SRHI)	To be physically active	153	.59	No interaction found
Van Bree et al. (2013)	Physical activity (SR)	Physical activity (SRHI)	To be physically active	1836	.52	I-B weakens as habit strength increases
Travel mode choice						
Danner, Aarts & de Vries (2008, Study 2)	Cycling (SR)	Cycling (Frequency in context)	To cycle	80	NR	I-B weakens as habit strength increases
de Bruijn et al. (2009)	Bicycle use (SR)	Cycling (SRHI)	To cycle	317	.72	I-B weakens as habit strength increases
Friedrichsmeier et al. (2013)	Car use (SR)	Car use (Frequency in context + Response-frequency measure)	To use a car	2,268	1. .38 2. .41	1. No interaction found 2. No interaction found
Gardner (2009, Study 1)	Car commuting (SR)	Car use (SRHI - abbreviated)	To use a car	107	.87	I-B weakens as habit strength increases
Gardner (2009, Study 2)	Bicycle commuting (SR)	Cycling (SRHI - abbreviated)	To cycle	102	.84	I-B weakens as habit strength increases

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Murtagh et al. (2012)	Walking to school (O)	1. Walking 2. Travelling by car or bus (both SRH)	To walk	126	1. .38 2. -.45	1. No interaction found 2. No interaction found
Staats, Harland, and Wilke (2004)	Increasing use of non-car transport (SR)	Non-car use (Staats measure)	To use non-car transport	150	.58	I-B weakens as habit strength increases
Thøgersen and Møller (2008)	Increasing use of non-car transport (SR)	Car use (Response-frequency measure)	To use public transport	920	Not reported	I-B weakens as habit strength increases
Information technology use						
Bhattacharjee and Lin (2015)	Information technology use (SR)	Information technology use (Limayem measure)	To use information technology	514	.51	I-B weakens as habit strength increases
Huang (2017)	Information technology use (SR)	Information technology use (Limayem measure)	To use information technology	1,154	Not reported	Group 1 (≤ 5 years experience of using Weibmail): No interaction found Group 2 (> 5 years experience): I-B weakens as habit strength increases
Kang, Min, Kim, and Lee (2013)	Information technology use (SR)	Information technology use (Limayem measure)	To use information technology	278	Not reported	I-B weakens as habit strength increases
Limayem and Cheung (2011)	Information technology use (SR)	Information technology use (Limayem measure)	To use information technology	100	.69	I-B weakens as habit strength increases
Moody and Siponen (2013)	Personal internet use at work (SR)	Using the Internet at work (SRH)	To use the internet at work	238	Not reported	I-B weakens as habit strength increases

(Continues)

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Alcohol consumption						
Gardner, Abraham, et al. (2012, Dataset 4)	Alcohol consumption (SR)	Alcohol consumption (SRBAI)	To drink alcohol	204	.75	I-B weakens as habit strength increases
Gardner, de Bruijn, and Lally (2012)	Binge drinking (SR)	Binge drinking (SRHI - Abbreviated)	To binge-drink	128	.44	I-B strengthens as habit strength increases
Murray and Mullan (2019)	Binge drinking (SR) ^f	Binge drinking (SRHI)	To binge-drink	392	.55	No interaction found
Norman (2011)	Binge-drinking (SR)	Binge drinking (SRHI)	To binge-drink	109	.70	No interaction found
Environmental behaviours						
Jorgensen, Martin, Pearce, and Willis (2013)	Household water consumption (assessed across four timepoints/quarters [Q] of the year) (O)	Water conservation (Jorgensen measure)	To conserve water	337	Not reported	Three timepoints (Q1, Q2, Q4): No interaction found One timepoint (Q3): I-B weakens as habit strength increases
Jorgensen, Martin, Pearce, and Willis (2015)	Household water consumption	Water conservation (Jorgensen measure)	To conserve water	415	Not reported	No interaction found
Miscellaneous						
Allom, Mullan, Clifford, and Rebar (2018)	Taking vitamin supplements (SR)	Using vitamin and mineral supplements (SRHI)	To use vitamin and mineral supplements	594	.51	No interaction found
Allom, Mullan, Monds, et al. (2018)	Money management (SR)	Saving money (SRBAI)	To save money	121	.57	No interaction found
Allom et al. (2013, Study 2)	Sun protection use (SR)	Sun protection use (SRHI)	To use sun protection	178	.49	I-B weakens as habit strength increases
Kremers and Brug (2008, Study 2)	TV and computer use (SR)	Screen time (SRHI)	To watch TV or use a computer	419	.37	I-B weakens as habit strength increases
Norman and Cooper (2011)	Breast self-examination (SR)	Breast self-examination (Frequency in context)	To examine breasts	66	.16	No interaction found

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Multiple behaviours						
Chatzisarantis and Hagger (2007, Study 2)	Active sports/vigorous physical activity for 40+min during leisure time (SR)	1. Active sports and vigorous physical activity 2. Binge drinking (both SR/HI)	1. To do active sports or vigorous activity 2. To binge drink	292	1. .66 2. .72	1. (Physical activity intentions and physical activity habit) I-B weakens as habit strength increases 2. (Binge-drinking intentions and binge-drinking habit) No interaction found
Danner, Aarts & de Vries (2008, Study 1)	1. Snacking (SR) 2. Milk consumption (SR) 3. Alcohol consumption (SR)	1. Snacking 2. Drinking milk 3. Drinking alcohol (Frequency in context)	1. To snack 2. To drink milk 3. To drink alcohol	139	NR	1.-3. I-B weakens as habit strength increases
Gardner et al. (2016)	1. Flossing (SR) 2. Snacking (SR) 3. Breakfast consumption (SR)	1. Flossing 2. Unhealthy snacking 3. Eating breakfast (all SR/HI)	1. To floss 2. To avoid unhealthy snacks 3. To eat breakfast	1. 229 2. 228 3. 228	1. .73 2. -.39 3. .75	1. No interaction found 2. No interaction found 3. No interaction found
Ji and Wood (2007)	1. Purchasing fast food (SR) 2. Watching TV news (SR) 3. Taking the bus (SR)	1. Buying fast food 2. Watching news on TV 3. Taking the bus (all Frequency in context)	1. To buy fast food 2. To watch news on TV 3. To ride the bus	233	Not reported	1. Location and mood measures: hyphen:B weakens as habit strength increases Time, other people measures: No interaction found 2. Location, mood, time, other people measures: I-B weakens as habit strength increases 3. Other people measure: I-B weakens as habit strength increases Time, mood, location measures: No interaction found

(Continues)

TABLE 1 (Continued)

References	Behaviour (self-report [SR] or objective [O])	Habit ^{a,b} (measure)	Intention ^a	Sample size <i>n</i> ^c	Habit-intention correlation <i>r</i>	Habit a significant moderator?
Mullan et al. (2015)	<ol style="list-style-type: none"> 1. Cooking food properly (SR) 2. Washing hands and cleaning cooking surfaces before food preparation (SR) 3. Keeping food at correct temperature (SR) 4. Avoiding unsafe foods (SR) 	<ol style="list-style-type: none"> 1. Cooking food properly 2. Handwashing 3. Food storage 4. Avoiding unsafe foods (all SRBAI) 	<ol style="list-style-type: none"> 1. To cook food properly 2. To wash hands 3. To store food properly 4. To avoid unsafe foods 	751	<ol style="list-style-type: none"> 1. .41 2. .50 3. .37 4. .31 	<ol style="list-style-type: none"> 1.-3.: No interaction found 4. I-B weakens as habit strength increases
Mullan et al. (2016)	<ol style="list-style-type: none"> 1. Physical activity during pregnancy (SR) 2. Eating fruit and vegetables during pregnancy (SR) 	<ol style="list-style-type: none"> 1. Physical activity 2. Eating fruit & vegetables (both SRHI - abbreviated) 	<ol style="list-style-type: none"> (1) To do physical activity (2) To eat fruit & vegetables 	195	<ol style="list-style-type: none"> 1. .72 2. .74 	<ol style="list-style-type: none"> 1. No interaction found 2. I-B strengthens as habit strength increases
Sheeran and Conner (2019, Study 1)	Various health behaviours (SR)	Various health behaviours (Frequency in context)	To perform the various health behaviours	633	Not reported	No interaction found
Sheeran and Conner (2019, Study 2)	Various health behaviours (SR)	Various health behaviours (Frequency in context)	To perform the various health behaviours	1,014	Not reported	I-B weakens as habit strength increases

Abbreviations: SRBAI, Self-Report Behavioural Automaticity Index; SRHI, Self-Report Habit Index.

^aVerbatim item wording reported where possible.

^bWhere both SRHI and SRBAI were used, results are reported for the SRBAI only (see Gardner, Abraham, et al., 2012).

^cWhere possible, sample size was derived from the same timepoint at which outcome.

4 | METHODOLOGICAL CONSIDERATIONS

Methodological factors may influence detection of interaction. Paradoxically, for example, the consistency with which people with strong habits are expected to enact a habitual action restricts the range of behavioural data available to be modelled by intention, so minimizes the possibility of adequately testing the moderation hypothesis (see Rebar, Rhodes, & Gardner, 2019). For example, the lack of impact of intentions to drive among habitual car commuters could plausibly reflect the true nature of habitual responding or a statistical artefact arising from a lack of variation in travel mode choice (Gardner, 2009).

Variation in the behavioural outcome is also restricted by controlling for multiple covariates. While modelling interaction requires adjustment for direct effects of habit and intention, studies adjusted for up to 12 further covariates. True interaction will not be observed where there is insufficient variance to be explained by the habit-intention interaction term. Adjusting for past behaviour is potentially particularly problematic, because the modelled outcome fundamentally shifts from behaviour frequency per se to post-baseline *change* in frequency (Ajzen, 2002). In stable contexts, however, habitual behaviour should by definition not vary. Yet, surprisingly, habit-intention interaction in accordance with Triandis' (1977; Landis et al., 1978) predictions has been observed in studies featuring numerous covariates, including past behaviour (Allom et al., 2013, Study 2; de Bruijn, Kremers, Singh, van den Putte, & van Mechelen, 2009). Conversely, some tests that adjusted only for habit and intention found no interaction (Friedrichsmeier, Matthies, & Klöckner, 2013; Gardner, Abraham, et al., 2012, Dataset 3). Choice and quantity of covariates do not seem to explain heterogeneous findings.

The operationalization of key variables could affect findings. Among the reviewed studies, while intention was solely self-reported, there was considerable variation in behaviour and habit measurement. Forty-seven (90%) of the 52 studies modelled self-reported behaviour, which is prone to response biases, as participants strive for consistency between reported cognitions and behaviour (Budd, 1987). Notably, none of the five studies (10%) that objectively measured behaviour found support for Triandis' (1977) hypothesis.

Commentators have suggested that some habit measures may be more sensitive to interaction (Labrecque & Wood, 2015; see Rebar, Rhodes, Gardner, & Verplanken, 2018). The Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003), used in 31 of the 52 studies (60%), assesses experiences of the "symptoms" of habitual responding, such as acting without awareness (Orbell & Verplanken, 2015). All four studies that found habit to unexpectedly strengthen intention-behaviour relationships employed the SRHI, though 13 SRHI studies found habit to weaken intention-behaviour relationships in line with the interaction hypothesis. Nine found no interaction, and five observed mixed results across behaviours, indices or subsamples. Of eight studies that used the Self-Report Behavioural Automaticity Index (SRBAI; Gardner, Abraham, et al., 2012), an automaticity subscale of the SRHI, one observed the hypothesized interaction, but four found no moderation, and three showed inconsistent findings. Seven studies used measures of behaviour frequency in stable contexts (e.g., location, presence of others; Ouellette & Wood, 1998), which infer habit strength from the likelihood of habit having developed. Of these, three showed habit to attenuate the intention-behaviour relationship as hypothesized, one observed interaction in some contexts but not others, and three found no interaction across multiple potentially relevant contexts. Our review thus offers no conclusions about the impact of specific habit measures on detection of moderation.

5 | DECONSTRUCTING INTENTIONS

Concerns have been raised about the sufficiency of modelling the influence of intention on action – and so habit-intention interaction – based on intention strength alone (Sheeran & Abraham, 2003; Sheeran & Conner, 2019; Sheeran, Orbell, & Trafimow, 1999). Additional properties of intention can affect intention-behaviour relationships: intention strength is more predictive of behaviour for intentions that are stable over time, or in which participants express greater certainty (Sheeran & Abraham, 2003). By extension, habit, which by definition should remain constant

in unvarying contexts, may be more likely to dominate over unstable or uncertain intentions in regulating behaviour. One study showed the attenuating effect of habit on the intention-behaviour relationship to be weaker for well-reasoned intentions (Sheeran & Conner, 2019), perhaps because intentions informed by greater consideration of action and its consequences are less liable to change (e.g., Petty & Cacioppo, 1986). To some extent, the impact of intention stability or certainty on the habit-intention interaction may be a methodological artefact: unstable or uncertain intentions at the time of measurement are less likely to capture intentions salient at the moment of action. This may be compounded by temporal distance between measurement and action. Thirty-seven of the 52 reviewed studies used baseline habit and intention measures to predict behaviour observed between 1 week and 2 years later, so may have overstated the dominance of habit over intention. Assessing intention in close temporal proximity to action permits truer tests of habit and intentions salient at the moment of action (Rebar, Elavsky, Maher, Doerksen, & Conroy, 2014).

The direction of intention may also contribute to habit-intention interaction. Forty-seven of the 52 reviewed studies assessed interaction between habits and concordant intentions; for example, fruit consumption habits and intentions to eat fruit (de Bruijn et al., 2007). The correspondence between habits and intentions can fluctuate within individuals over time; people may be less consciously motivated to pursue physically effortful actions when they are tired, for example (Conroy, Maher, Elavsky, Hyde, & Doerksen, 2013). However, when considering behaviour frequency over time, habit and intention are likely to be concordant: although discourse surrounding interaction depicts habit and intention in opposition, habitual actions are often intentional acts that have come under the control of automatic processes (Lally et al., 2010). When performance contexts and the appeal of the behaviour remain stable after habit has formed, intentions and habit will likely correspond. Attempting to model interactions between positively correlated habits and intentions is problematic because inferences about the likely behaviour of those for whom habit and intention conflict may lack ecological validity (Rebar et al., 2019). For example, in Gardner's (2009) study, car use habit and intention were near-perfectly correlated ($r = .87$), indicating that "habitual non-intenders," who were predicted to drive as often as those with strong intentions, did not exist within the dataset.

Even if "habitual non-intenders" can be identified, measures of the strength of intentions to enact one action do not reveal the strength of intentions to perform conflicting actions. Rhodes and Rebar (2017) distinguish between *intention directionality* (or "decisional intention"), which denotes whether or not the intention favours performing the action versus a competing action, and *intention strength*, which denotes the extent of determination to enact the intended action. Studies of habit-consistent intentions only model interplay between habit and the strength of favourable intentions, but a lack of determination to perform one action need not imply determination to inhibit the action or perform an alternative. Such studies cannot test Landis et al.'s (1978) prediction that habit will override *opposing* intentions.

Figure 2 visually depicts Landis et al.'s (1978) hypothesis, and portrays the interdependence of the strength of habit (to perform *Behaviour X*), intention directionality (intentions to perform *Behaviour X* or any opposing behaviour

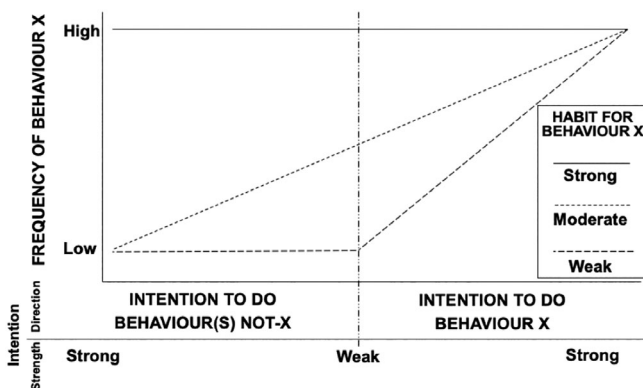


FIGURE 2 Landis et al.'s (1978) Habit-Intention Interaction Hypothesis, as applied to behaviour frequency

[*not-X*]), and intention strength, as determinants of the frequency with which *Behaviour X* will be triggered over multiple occasions. Intention to do opposing behaviours (*not-X*) represents a hypothetical summary of inclinations to perform any and all behaviours that would obstruct performance of the focal behaviour (*X*), including inaction. The central vertical line represents the point beyond which intention directionality becomes generally favourable towards performing the focal behaviour (*X*), or towards alternative action that would frustrate the focal behaviour (*not-X*). Values further from the vertical line indicate stronger determination to act. When habit is weak, the impact of intention on behaviour is more heavily weighted, and behaviour is dictated by the strength and direction of intention. As habit strength increases however, the influence of habit begins to outweigh that of intention, such that, where habit is strongest, the influence of intention strength, regardless of direction, is null. Forty-seven (90%) of the 52 reviewed studies focused on concordant habits and intentions as predictors of action, so testing relationships on the right-hand side of the central vertical line in Figure 2 but offering no evidence regarding relationships between habit and intentions to perform opposing actions. Adequately testing this hypothesis requires focusing on circumstances in which the direction of intention conflicts with habits.

None of the five relevant studies we reviewed supported the hypothesis that habits override counter-habitual intentions in predicting behavioural frequency. For example, two studies observed that both habitual consumption of snacking and intentions to avoid snacking predicted dietary intake but found no habit-intention interaction (Gardner, Abraham, et al., 2012; Gardner et al., 2015), and two found that habitual travel mode choice did not interact with intentions to use alternative modes (Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012; Thøgersen & Møller, 2008).

Experimental evidence suggests that forming counterhabitual intentions has the potential to overpower habit tendencies, by shielding against intrusion from unwanted habits (Danner, Aarts, Papies, & de Vries, 2011). Observational studies of counter-habitual motivation, which were excluded from our review for failing to assess intention directly, demonstrate support for the potential for intentions to overcome habit. A study of UK smokers showed that, after the 2007 pub smoking ban was introduced, many instigated cigarette smoking as a habitual response to drinking alcohol despite being motivated to comply with the ban (Orbell & Verplanken, 2010). Neal, Wood, Wu, and Kurlander (2011) showed that participants with stronger habits for eating popcorn in the cinema consumed as much stale popcorn while watching movie trailers as did those given fresh popcorn. All participants later reported the stale popcorn to have tasted unpleasant, suggesting that those with strong habits lacked conscious motivation to eat the popcorn.

6 | DECONSTRUCTING “FACILITATING CONDITIONS”

Disentangling seemingly inconsistent findings around the relationship between habit, intention directionality, and intention strength may require reconsideration of the “facilitating conditions” that shape the influence of habit and intention on action. While Triandis defined “facilitating conditions” broadly as factors that “permit [a person] to behave” (p. 207, 1977), Landis et al. (1978) specified the term as an umbrella construct incorporating “(a) the ability of the organism, relative to the difficulty of the task, (b) the action-specific arousal of the organism, and (c) the knowledge of the organism on how to carry out the behaviour” (p. 228). This focus on the actor's perceived or actual capability may adequately account for potential barriers to action in opportune circumstances when both habit and intention directionality favour the behaviour, because only a lack of physical or psychological capability will prohibit action. When the directionality of habit and intention conflict, however, the concept of “facilitating conditions” requires expansion. Habit impulses are more readily aroused than those generated by intention (Danner, Aarts, & de Vries, 2008; Neal et al., 2012), so acting in line with counterhabitual intentions requires that conditions facilitate two discrete processes: inhibition of the unwanted habitual response, and enactment of the intended response. These two processes are distinct: frustrating a habitual response removes a barrier to acting on intentions but is not sufficient to translate intentions into behaviour. Factors that facilitate intention enactment are outside the scope of this review (see for example, Sheeran & Webb, 2016). Here we focus on conditions that enable the overpowering of habit impulses.

Discontinuing exposure to cues disrupts habitual responding by removing opportunities for activation of habit impulses (Verplanken, Roy, & Whitmarsh, 2018). One study showed that, for habitual car commuters with high environmental concern, a residential relocation led to a decrease in car commuting, in line with their environmental values (Verplanken, Walker, Davis, & Jurasek, 2008).

Where cues cannot be avoided, however, self-regulatory strategies, such as self-control, must be deployed to inhibit habit impulses. Habit inhibition is an inherently effortful process; habitual responses are in part defined by being difficult to suppress, by virtue of proceeding non-consciously and spontaneously (Verplanken & Orbell, 2003). However, if people can at least momentarily exercise self-control, habits are less likely to dominate over intentions. A diary-based study showed that vigilantly self-monitoring behaviour, and reminding oneself of intentions to inhibit habitual responses, was the most reportedly effective spontaneously employed strategy for blocking unwanted and strongly habitual responses (Quinn, Pascoe, Wood, & Neal, 2010). Depleting self-control resources increases the likelihood of acting in line with habit, regardless of the desirability of the action (Neal, Wood, & Drolet, 2013). In an experimental study, participants trained to develop habits for approaching chocolate-related stimuli consumed more chocolate in a subsequent snack choice task following self-control depletion than did those who were not depleted (Lin, Wood, & Monterosso, 2016). Depletion had no impact on consumption among participants who formed habits for avoiding chocolate.

Self-control operates by inhibiting the mental accessibility of unwanted responses that might derail pursuit of desired actions (Danner et al., 2011). Exercising self-control upon encountering action opportunities requires prior awareness of cues, habitual actions, and the cue-action relationship (Hollands, Marteau, & Fletcher, 2016), and summoning willpower upon exposure to cues. Much unwanted habitual behaviour proceeds because external factors, such as stress and distraction, limit the capability to deploy momentary self-control (Schwabe, Dickinson, & Wolf, 2011; Wood & R nger, 2016). Animal learning studies have shown that acute stress both enhances responsiveness to habit cues and diminishes the executive functioning required to inhibit learned responses to those cues (Arnsten & Goldman-Rakic, 1998; Goddard & LeRi, 2006; Mika et al., 2012). Distraction can also derail attempts to exercise self-control efforts because, by default, people pay greater attention to contextual cues that, through repetition, have become associated with rewarding outcomes (Anderson, 2016). A study of consumers adopting a new laundry product found that those who did not give sufficient thought to their laundry-related actions were more likely to lapse back into pre-existing laundry habits, regardless of their intentions to use the new product (Labrecque, Wood, Neal, & Harrington, 2017).

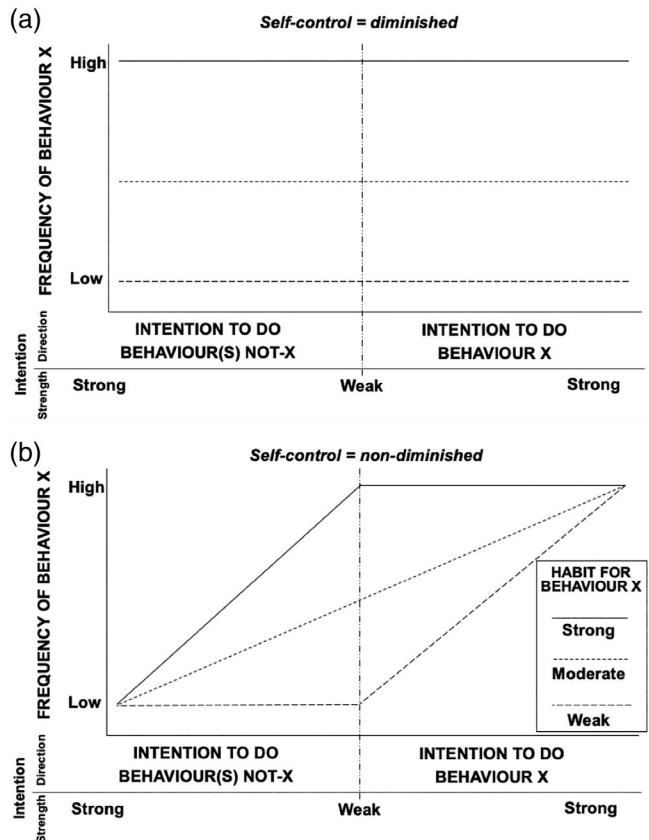
7 | REVISING THE HABIT-INTENTION INTERACTION HYPOTHESIS

As our review demonstrates, habits have the potential to dominate over intentions, and intentions have the potential to dominate over habits. These findings may be reconciled by expanding the habit-intention hypothesis to incorporate intention directionality and strength, momentary self-control, and other facilitating conditions that enhance opportunities or capabilities required to inhibit habit impulses or enact intentions.

Figure 3a,b visually depict habit-intention relations across differing facilitating conditions. Both figures assume that the actor has sufficient opportunity and capability to enact the habitual and intended responses, and that the impact of factors pertaining to opportunity and capability to inhibit habitual responses – such as stress or distraction – is encapsulated by levels of momentary self-control, or otherwise controlled.

Momentary self-control is required to translate momentary intentions into action; impaired self-control facilitates habitual action, regardless of conscious motivation (Lin et al., 2016; Neal et al., 2013). As Figure 3a shows, when self-control capacity is diminished, people typically fail to act on their intentions, such that instigation of Behaviour X is determined by habit strength for Behaviour X; neither the direction nor strength of intention influences action instigation. Notably, where intentions favour Behaviour X, habit facilitates wanted behaviour despite impaired self-control; while Behaviour X will not be directly *controlled* by momentary intentions, habit enables performance

FIGURE 3 (a,b) Revised Habit-Intention Interaction Hypothesis: intention direction-habit-intention strength relationships, moderated by self-control, as applied to behaviour frequency



consistent with such intentions (Galla & Duckworth, 2015; Neal et al., 2013). In this way, habit can operate as a self-regulatory mechanism under conditions of depleted willpower or volitional control (Galla & Duckworth, 2015; Wood, 2017).

Figure 3b depicts behaviour where people possess the momentary self-control needed to act on momentary intentions. In such circumstances, intention takes priority over habit, and the relationship between habit and intention strength will depend on the direction of intention. Specifically, when self-control is not diminished, people tend to act in line with the direction of their intentions, such that where habit and intentions both favour Behaviour X, habit weakens the impact of intention strength on instigation of Behaviour X. Under these circumstances, habit plays a compensatory role, instigating Behaviour X where intentions towards Behaviour X are favourable but weak. This reconciles observations that habit can override weak favourable intentions with work showing habit to support the enactment of favourable intentions (Gardner et al., 2011; Rhodes & De Bruijn, 2010). Figure 3b also shows that, when self-control is not diminished, people tend to act in line with the direction of their intentions, such that where habits favour Behaviour X but intentions oppose Behaviour X, stronger intentions diminish the influence of habit on instigation of Behaviours X or Not-X. This reflects evidence showing that people who are motivated and have the momentary self-control capacity can inhibit habit impulses (Danner et al., 2011; Quinn et al., 2010).

Incorporating self-control into the habit-intention interaction hypothesis, as demanded by evidence of the impact of self-control on the translation of habit and intention into action (Danner et al., 2011; Lin et al., 2016; Neal et al., 2013; Wood & Runger, 2016), generates important implications for behaviour change. Landis et al.'s (1978) hypothesis forms the basis of current thinking around the role of habit formation in behaviour change: if habit overrides the influence of conscious motivation on action, then forming a new habit should shield new behaviours from potential

losses in motivation, and motivation change will not disrupt undesirable habitual actions (Rothman et al., 2009; Verplanken & Wood, 2006). Yet, when people begin to *want to not* perform a habitual action, momentary self-control enables people to inhibit their habit tendencies. Although Landis et al.'s (1978) hypothesis implies that habit formation alone will sustain behaviour over time, incorporating self-control as a facilitating condition argues for the importance of maintaining a minimum level of favourable motivation to sustain interest in performing new behaviours. Where people can exercise self-control over their actions, habit may compensate for losses in determination to act on favourable intentions but is unlikely to override strong determination to perform an alternative action.

We have offered post-hoc explanations of ostensibly conflicting patterns within the evidence, and further work is required to more rigorously test the relationships we have set out. Additionally, whereas established habits are, by definition, resistant to change, intentions and self-control may fluctuate rapidly over time. Such dynamics make it difficult to test complex relationships between self-control, habit, and intention using the correlational survey design that dominates habit research within social psychology. One limitation of our review, more broadly, is its focus on behaviour prediction studies, which have predominantly used correlational, self-report survey designs (for critiques, see Hagger, Rebar, Mullan, Lipp, & Chatzisarantis, 2015; Labrecque & Wood, 2015). Experimental paradigms offer more rigorous and controlled tests of habits and conscious motives or goals (see, e.g., Neal et al., 2011), but can fail to capture competition between habit and intention in the ebb and flow of real-world contexts and actions.

8 | CONCLUSION

Much research has been implicitly guided by the question of *whether* habit reliably interacts with intention. Studies have however shown that habit has the potential to overpower intention, and intention has the potential to dominate over habits, so the more appropriate question may be *how and in which conditions* does habit interact with intention. The habit-intention hypothesis requires expansion to account for intention directionality and strength, and conditions that facilitate the expression or inhibition of habitual responses, and the enactment of intentions. One such facilitating condition is self-control. Empirical evidence suggests that if self-control is diminished, habit and intention will not interact, and if self-control is not diminished, the influence of habit on the relationship between intention strength and action will depend on whether intentions favour or oppose the habitual behaviour. This qualifies previous recommendations for using habit to promote behaviour change. Habit formation alone may not be sufficient for behaviour change maintenance; additional resources may be needed to ensure motivation remains favourable towards the new behaviour. Future research should consider investigating facilitating conditions that may affect habit-intention interplay, to maximize the potential for habit to sustain behaviour change over the long-term.

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ENDNOTE

¹Figures 1–3b can be straightforwardly adapted to denote the relationship between habit and intention in predicting the likelihood of action on single occasions, by relabelling the vertical axes to refer to the *probability* of *Behaviour X* on any given occasion.

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SUPPORTING INFORMATION

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How to cite this article: Gardner B, Lally P, Rebar AL. Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Soc Personal Psychol Compass*. 2020; e12553. <https://doi.org/10.1111/spc3.12553>