EDITORIAL:

A matter of habit: recognising the multiple roles of habit in health behaviour

Health psychology is witnessing a resurgence of interest in the concept of habit (Verplanken, 2018). Habit can be defined as a process whereby a cue automatically triggers an impulse to act, based on cue-action associations learned through repeated performance; habitual behaviour refers to action generated by this process (Gardner, 2015). Habit impulses typically translate into action efficiently, potentially without intention, awareness, or control (Bargh, 1994), and can dominate over conscious motivation in regulating behaviour (Gardner, de Bruijn, & Lally, 2011). Much interest in habit stems from its behaviour change implications. If habit can override intentions, then habit formation may sustain health-promoting behaviours over time, even when people lose motivation (Rothman, Sheeran, & Wood, 2009). Conversely, disrupting an unhealthy habitual behaviour may require strategies that address cue-dependency (Gardner, Rebar & Lally, in press). The concept of habit disruption taps into current interest in non-conscious routes to behaviour change (Sheeran, Gollwitzer & Bargh, 2013): recognising the habitual nature of an unhealthy behaviour can inform the adoption of change strategies based on modifying environmental stimuli, which can be more feasible and effective than promoting consciously-mediated change (Marteau, Hollands & Fletcher, 2012).

Much research has explored the influence of habit on a multitude of health behaviours, including hand hygiene, medication adherence, dietary consumption, physical activity, and sun protection (for a review, see Gardner, 2015). Such studies have implicitly addressed similar underlying research questions, which can broadly be summarised as: "*To what extent could Behaviour X be determined by habit?*" If a behaviour is shown to be, or have the potential to be,

habitually enacted, this will have important implications for behaviour modification. Interventions that support adoption of that behaviour might fruitfully promote context-consistent performance so that cue-response associations may develop (Lally, Van Jaarsveld, Potts, & Wardle, 2010), while interventions that aim to discontinue habitual behaviour might focus on dismantling such associations or blocking their enactment (Gardner et al., in press). In this editorial, however, we argue that a more comprehensive understanding of habitual action requires moving beyond asking only to what extent a behaviour may be habitual, and towards exploring which aspects of a behaviour could be regulated by habit.

The possible roles of habit in health behaviour

Efforts to investigate habit solely by quantifying its influence on behaviour overlook an important related question: *"In what ways could Behaviour X be determined by habit?"* Recent developments in habit theory and application suggest that habit can play discrete roles in generating any behaviour. Consider, for example, physical activity. A wealth of research has concluded that physical activity can be regulated by habit (Rebar et al., 2016). This has typically been based on observed relationships between physical activity frequency and activity habit, usually assessed using an adaptation of Verplanken and Orbell's (2003) Self-Report Habit Index (SRHI) (e.g. 'engaging in active sports and/or vigorous physical activities during my leisure time is something I do without having to consciously remember' [strongly disagree–strongly agree]; Chatzisarantis & Hagger, 2007, p667). Such findings are usually taken as evidence that habit directly triggers an episode of physical activity (Verplanken & Melkevik, 2008). Yet, habit can also influence physical activity indirectly. Kaushal, Rhodes, Meldrum, and Spence (2017) distinguish between *performance habits*, which relate to the automatic triggering of an activity bout, and *preparatory habits*, which denote the habitual cuing of actions that support physical

activity at a later timepoint. For example, the directly-cued automatic activation of a session of gym-based exercise would represent a performance habit, and packing a gym bag the night before an intended exercise session, in response to an associated time cue, may represent a preparatory habit that facilitates gym-based exercise. Kaushal, Rhodes, Meldrum et al (2017) demonstrated that self-reported habitual preparation predicted subsequent exercise frequency over a six-week period, but habitual performance did not. A later intervention trial showed that promoting both habitual preparation practices and habitual performance increased accelerometer-measured activity in new gym members over an 8-week period (Kaushal, Rhodes, Spence & Meldrum, 2017). Crucially, a process evaluation indicated that activity increases were attributable to gains in preparatory but not performance habit (Kaushal, Rhodes, Meldrum, & Spence, 2018). From this perspective, a physical activity episode that arises from conscious deliberation may nonetheless reasonably be deemed to be determined by habit if a precursory action was elicited by habit.

Whereas Kaushal et al's approach focuses on habitual performance of actions that precede a target behaviour, habit can also play multiple roles *within* any given behaviour. Gardner, Phillips, and Judah (2016) distinguish between *habitual instigation* and *habitual execution* of a behaviour. This perspective acknowledges the hierarchical structure of action (Cooper & Shallice, 2000), whereby all actions are composed of discrete 'sub-actions' at fine-grained levels of analysis. For example, 'going to the gym' can be deconstructed into 'fetching gym bag', 'leaving house', 'travelling to the gym', 'exercising in the gym', and so on. Each of these may be deconstructed at yet finer-grained levels of analysis – 'fetching gym bag' may entail 'searching for gym bag', 'lifting up gym bag', 'carrying gym bag', and so on – to the level of activation of muscle fibres and beyond (Rhodes & Rebar, 2018). People tend to conceive of

actions at high levels of abstraction (i.e. at 'coarse grain' levels; Zacks & Swallow, 2007), such that all the finer-grained actions are perceptually 'chunked' at the coarse-grain level into a single 'unit' of action ('going to the gym'; Vallacher & Wegner, 1987). Activation of the coarse-grain action unit ('go to the gym') in turn activates the fine-grained procedural actions (e.g., 'fetch gym bag', 'leave house') that must be performed to complete the coarse-grain action. Habitual instigation pertains to the triggering of the selection of the coarse-grain action unit ('go to the gym') which, unless obstructed, will activate the first within a sequence of finer-grained actions required to perform the coarse-grain action unit to completion (e.g., 'fetch gym bag'). Habitual instigation commits an individual to pursuing a behaviour, in the potential absence of conscious decision-making; in crude terms, this is akin to 'habitually deciding' to act[1]. Habitual execution, however, relates to activation of one or more of the fine-grained sub-actions required to achieve the coarse-grain action goal; this equates to 'habitually doing' an action. For example, completion of 'fetching gym bag' habitually cues 'leaving house', which in turn habitually cues 'travelling to gym', and so on.

The distinction between instigation and execution is implicit in previous conceptualisations of habitual behaviour. Some have portrayed habit as the trigger for an episode of behaviour in the absence of a conscious decision to act (habitual instigation; Verplanken, Aarts, & Van Knippenberg, 1997), whereas others have characterised habitual action as mindlessly performed, freeing mental resources for deployment on more demanding concurrent tasks (habitual execution; Wood, Quinn, & Kashy, 2002). Some have argued that a behaviour

[1] 'Habitual deciding', while offering a description of habitual instigation easily understood by research participants (Phillips & Gardner, 2016), is an inherently problematic term. The term 'decision-making' implies a deliberation process that culminates in the generation of a conscious decision to act, but habitual instigation bypasses this process (Verplanken et al., 1997), rendering the term 'habitual deciding' an oxymoron. We have settled on the term 'commitment to act' to describe the common output of both conscious decision-making and habitual instigation.

should be deemed habitual only if it is both triggered and completed automatically (i.e., habitually instigated *and* executed; Aarts, Paulussen, & Schaalma, 1997). It is however perhaps more useful to view any action that is *either* instigated *or* executed by habit processes as a form of habitual behaviour. A person may be habitually cued to 'go to the gym' in the absence of deliberation (habitual instigation), yet make conscious decisions about which exercises to perform in the gym (non-habitual execution); alternatively, they may deliberate over whether to go to the gym (non-habitual instigation), but perform the same exercises in the same sequence each time they attend the gym (habitual execution).

The characteristic effects of habit on behaviour frequency may be attributable to habitual instigation. Using SRHI variants worded to specify instigation or execution for three discrete health behaviours, Gardner et al. (2016) showed that habitual instigation predicted behaviour frequency but execution did not (see too Phillips & Gardner, 2016). A study of people with cystic fibrosis showed that a measure of habitual instigation of nebuliser use discriminated between adherers to the nebuliser regimen and non-adherers, but a measure of habitual execution of nebuliser use did not (Hoo, Boote, Wildman, Campbell, & Gardner, 2017).

Distinctions between forms of habitual action defy attempts to assess the influence of habit on any given action solely by quantifying its strength. The concept of habitual execution poses especial problems for global assessments of habit strength, because it implies that all familiar behaviours are likely driven by habit in some way, if only at finer-grained levels. For example, while a person may consciously deliberate over whether to go for a run or consciously enact the sub-actions involved in completing the run, the muscle movements that propel the act of running will be highly habitual, with the completion of one step automatically cuing the next. The habitual nature of physical movement is revealed when everyday action is enacted using the

non-dominant hand: normal performance is disrupted, as greater attention must be paid to enacting the movements that are normally effortlessly and habitually executed by the dominant hand (Neal, Wood, Wu, & Kurlander, 2011). The development of habitual execution patterns for finer-grained sub-actions are akin to skill acquisition (Gobet et al., 2001).

INSERT TABLE 1 HERE

A synthesis of Kaushal et al.'s and Gardner et al.'s perspectives proposes four potential roles for habit in any given action (Table 1). Physical activity, for example, may be influenced by habit where: a preparatory action is habitually instigated (e.g., a person is habitually triggered to 'pack the gym bag', in the absence of deliberation); a preparatory action is habitually executed (e.g., habit facilitates movement through the sequence of actions involved in 'packing the gym bag'); the target behaviour itself is habitually instigated (e.g., the person is habitually triggered to initiate a gym-based activity session); or the target behaviour is habitually executed (e.g., movement through the sequence of activities within the gym is facilitated by habit). Attempts to investigate in what ways, and to what extent, any given behaviour may be determined by habit should focus on identifying the presence and strength of habit in one or more of these roles.

Implications and future directions

Broadening the scope of inquiry to address both strength and type of habitual action opens up new research avenues and intervention possibilities. Most health habit research to date has taken the form of predictive studies, in which habit is modelled as a potential determinant of behaviour (Gardner, 2015). A factor analysis showed that the originally-worded SRHI ("Behaviour X… […is something I do automatically]") loaded on the same factor as did an instigation variant ("Deciding to do Behaviour X…"), whereas an execution variant ("Once I have decided to do Behaviour X, the act of Behaviour X…") loaded on a separate factor

(Gardner et al., 2016). By implication, given that the SRHI is the most commonly used habit measure in health psychology (Gardner, 2015), much previous research in the habit domain has likely addressed habitual instigation, rather than execution. Further work is needed to better understand the contribution of each habit manifestation to behaviour frequency. Kaushal, Rhodes, Meldrum and Spence (2017) found that preparatory habit was a stronger determinant of physical activity than was performance habit, and studies have observed habitual instigation, but not execution, to predict behaviour frequency for dental hygiene, dietary consumption, and physical activity (Gardner et al., 2016; Phillips & Gardner, 2016). Research is needed to replicate such findings across behaviours and contexts. Especial attention should be paid to clarifying the potential role, if any, of habitual execution in sustaining behaviour.

Developers of habit-based interventions must specify the precise manifestations of habit being targeted. All behaviours are located within complex systems of other behaviours performed by the same individual (Michie, Atkins, & West, 2014). In some circumstances, forming habit for a key preparatory behaviour may have greater impact than automating the target behaviour itself (Kaushal et al., 2018). Interventions that seek to increase performance frequency via direct manipulation of the target behaviour should promote habitual instigation, which appears to be the habit mechanism responsible for behaviour maintenance (Hui et al., 2017). Targeting habitual instigation at population level is however likely to be difficult. Habitual instigation is triggered via activation of mental representations of action (Gardner, 2015), and people may differ in how they encode seemingly identical behaviours. For example, 'cycling to work' may reasonably be perceived to begin with 'leaving the house', 'retrieving the bicycle from the shed', or 'mounting the bicycle' (see Gardner & Tang, 2014). Subjective action perceptions will determine the nature of the 'first step' in any given habitually instigated

sequence. Further work is required to identify common 'points of choice' at which people instigate certain actions, and typical cues to instigation (see Pimm et al., 2016), around which interventions may be developed. For example, posters promoting stair use appear to be more effective when positioned at a presumed 'point of choice' approaching a lift and a staircase, rather than within the lift, by which point people have already committed to using the lift (Lewis & Eves, 2012).

Interventions designed to encourage frequent performance need not promote rigid performance; while this may foster habitual execution, it is unlikely to enhance the likelihood of performance (Gardner et al., 2016; Phillips & Gardner, 2016). Indeed, for strongly affect-driven behaviours, such as physical activity (Rhodes, Fiala, & Conner, 2009), an action performed in the same way on each occasion may become unenjoyable and so be discontinued (Sylvester et al., 2016). We speculate that execution may be the more appropriate target for interventions that seek to 'lock in' optimal performance of complex behaviours; for example, encouraging people to brush their teeth in a rigid sequence to improve oral health (Aunger, 2007), or automating comprehensive hand-washing routines (Aunger et al., 2010). Alternatively, interventions to break habits might target existing execution patterns so as to disrupt the efficiency with which coarser-grain health behaviours are performed and bring them under conscious control. For example, using the non-dominant hand to perform unwanted and normally-automated finer-grained actions can reduce engagement in that action (Neal et al., 2011).

Pursuing the research and intervention avenues we have identified may require innovations in habit measurement. The SRHI and its derivatives can be adapted to specify a target behaviour or preparatory behaviour (Kaushal, Rhodes, Meldrum & Spence, 2017), or to speak more to instigation or execution (Gardner et al., 2016). Yet, debate continues around

whether people have sufficient insight to accurately self-report habit strength (Hagger, Rebar, Mullan, Lipp, & Chatzisarantis, 2015; Orbell & Verplanken, 2015). This concern is likely to be exacerbated when focusing on the execution of finer-grained sequences of acts, to which people typically pay little conscious attention (Vallacher & Wegner, 1987). Technological advances and the proliferation of smartphones increasingly provide reliable objective data on behaviour and the consistency of locations and times in which the behaviour proceeds, from which habit may be inferred (Carden & Wood, 2018; Hoo, Wildman, Campbell, Walters & Gardner, 2019; Labrecque & Wood, 2015). These 'frequency-in-context' measures, which can also be estimated via self-report, can be relatively straightforwardly applied to specify a preparatory or target behaviour, but may be less suited to assessing the execution of finer-grained actions. Alternative methods may be required to capture habitual execution. One study used a novel 'script elicitation' method to assess routine behaviours, whereby participants listed their typical activities in a given setting (e.g., 'at bedtime') and subsequently organised them into conceptual clusters and sequences (Judah, Gardner, & Aunger, 2013). Additionally, measures that infer cue-behaviour associations from the speed and accuracy with which people respond to a purported cue should be suitable for observing instigation or execution responses for any behaviour, if likely cues are known.

Developing a comprehensive understanding of the effect of habit on any action requires a multidimensional view of habitual action, which distinguishes between the strength of influence of habit in any given role for any given action, and the type(s) of role that habit plays in that action. Habit is an inherently idiosyncratic process, being based on personally-relevant behaviours performed in personally-relevant contexts, and a behaviour may be habitually performed in one setting but not in another. Both of the research questions we have identified

("*to what extent could Behaviour X be determined by habit?*" and "*in what ways could Behaviour X be determined by habit?* ") thus require contextual qualification (e.g. "*in what ways could Behaviour X be determined by habit for Person Y in Context Z*?"; Sniehotta & Presseau, 2011). Nonetheless, recognising the multiple roles that habit may play in any given behaviour will help to advance the science of habit and the optimisation of habit-based interventions.

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Table 1. Illustrative examples of four different positions for habit in any behaviour

	Behaviour	**Preparatory behaviour**		**Target behaviour**	
	Habit manifestation	**Instigation**	**Execution**	**Instigation**	**Execution**
Behavioural domain					
Physical activity		Packing gym bag		Going to the gym	
		'Decision' to pack gym bag *	'Packing gym bag' sub-actions: Finding gym bag, putting shoes in gym bag, putting clothes in gym bag, fastening bag	'Decision' to go to the gym	'Going to the gym' sub-actions: Fetching gym bag, leaving house, travelling to gym, changing clothes, working out, showering, returning home
Dietary consumption		Buying fruit		Eating fruit	
		'Decision' to buy fruit	'Buying fruit' sub-actions: Going to supermarket, selecting fruit, paying for fruit, returning home	'Decision' to eat fruit	'Eating fruit' sub-actions: Fetching fruit, peeling fruit, inserting fruit into mouth
Medication adherence		Packing pillbox for coming week		Taking medication	
		'Decision' to pack pill box for the coming week	'Packing pill box' sub-actions: Finding pill box, opening bottles, inserting pills into pill box, putting pillbox away	'Decision' to take medication	'Take medication' sub-actions: Fetching pill box, fetching water, putting pills in mouth, swallowing pills, putting pillbox away

* See footnote 1.