

Studying Human Habits in Societal Context: Examining Support for a Basic Stimulus–Response Mechanism

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Abstract

Human habits are considered to be an important root of societal problems. The significance of habits has been demonstrated for a variety of behaviors in different domains, such as work, transportation, health, and ecology, suggesting that habits have a pervasive impact on human life. Studying and changing habits in societal context requires a broad view of behavior, which poses a challenge for applying basic models to complex human habits. We address the conceptualization and operationalization of habits in the current literature and note that claims about the role of habits in societal context rarely agree with the basic definition of habits as goal-independent behavior. We consider future directions that are important for making progress in the study of habit change in societal context.

Keywords

habit, goals, society, behavior change, interventions

Eating snacks in fast food restaurants, taking the car rather than public transportation to work, watching TV all night . . . a major part of our behavioral repertoire is frequently exhibited and executed in the same environment and has taken on a habitual character. Habits make performance efficient. Habits also underlie contemporary societal problems, such as health issues and climate change (Gifford, 2011; Kelly & Barker, 2016).

Studying the role of habits in societal context is important and challenging. The concept of habit is rooted in behaviorist approaches to learning theories (Skinner, 1953), according to which habits are formed when a motor behavior (e.g., pressing a lever) is repeatedly performed in response to a stimulus (a drop of sweet water). Psychological theories of behavior that address the role of habits in societal context take a more conceptual approach and analyze behavioral determinants that can be targeted by interventions producing changes in those determinants and ultimately behavior. Habits are broadly considered as behaviors that are directly cued by environments and are executed independently of people's goals. This general habit model of environment–behavior relations can account for a large body of findings suggesting that habits play a key role in different behavioral domains

(Verplanken, 2018; Wood & Rünger, 2016) and inspires governmental policies and practitioners to target habits by changing the environments in which they occur (Michie & West, 2013).

Here, we address the study of habits in societal context and discuss potential adverse implications of applying the basic principles of habits to a broader view of behavior in order to conceptualize and operationalize human habits. We first briefly address basic habit-learning models that dominate current research on habits. We then discuss how these models deviate from the level of analysis at which the concept of habits is applied in research on behavior change in societal

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context, and we close with a few challenges for future research.

Basic Models of Habits

Basic experimental research on habits has made much progress in detailing the behavioral, neural, and computational implementation of habit learning. In psychology, the original view on habits is that stimuli directly trigger responses, which are not controlled by outcome expectancies (Dickinson, 1985). These stimulus–response links are established through instrumental learning in which a specific motor behavior (e.g., pressing a key) is expressed in response to a specific cue (e.g., food) and reinforced by a positive outcome (e.g., pleasure). The role of the incentive gradually decreases with practice, rendering behavior independent of the anticipated value of its consequences. Action control is said to shift from the person’s goal to responses that follow a ballistic route to completion (i.e., difficult to control once triggered by stimuli).

Research in cognitive neuroscience has discovered two separated brain circuits—a corticobasal ganglia loop and a sensorimotor striatum loop—that largely correspond with a goal-directed system (deliberation and planning) and a habit system (bottom-up action selection). This research suggests that duality of the goal and habit systems also pertains to sequences of motor movement, such as repeatedly pressing a left and right key in response to stimuli (Yin & Knowlton, 2006). Thus, habits operate independently of goals not only in single motor movements but also in decision making, action selection, and execution.

A computational account of habit formation comes from reinforcement learning. Rooted in artificial intelligence, reinforcement-learning theories propose that goals follow a model-based algorithm that relies on an explicit causal model of the world (i.e., choosing actions on the basis of their likely direct outcomes; Daw, Gershman, Seymour, Dayan, & Dolan, 2011). Habits are derived from a model-free algorithm that chooses actions on the basis of the overall future reward and has no immediate sensitivity to changes in the value of outcomes.

Selection on the basis of anticipated future rewards suggests that habits are subject to hierarchical control, in which the model-based system selects a goal and then determines which habitual means reach it. The resulting habitual sequence of actions can be expressed quickly and efficiently (Aarts & Dijksterhuis, 2000; Cushman & Morris, 2015; Dezfouli, Lingawi, & Balleine, 2014). Although there is support that goal and habit systems interact, there is debate about how hierarchical control of habits can be implemented in a neural network or computational model (Botvinick, 2008; Miller, Shenav, & Ludvig, 2019).

The Conceptualization of Habits in Societal Context

Basic habit models have been tested mostly within carefully confined settings of actions and stimuli. Psychological research on habits and behavioral change in societal context is less concerned with specific details about the behavioral situation. From a behavioral-change perspective, it is difficult to know how to intervene selectively if all that is known are the physical movements and sensory input involved in an action (Baumeister, Vohs, & Funder, 2007). Research on behavioral change builds on a general habit model of environment–behavior relations and aims to modify habits by identifying behavior at a conceptual level (Aarts & Custers, 2009). It therefore moves away from a basic and well-defined model of habits to a broader view of behavior (eating healthy, traveling to work, saving the environment). Accordingly, this research is more lenient in covering the basic principles of habit learning (Aarts, Paulussen, & Schaalma, 1997; Wood & Neal, 2007).

A broader view of behavior, though, also creates ambiguity in the conceptualization and interpretation of habits (Marien, Custers, & Aarts, 2018). Take, for example, car use (Fuji & Gärling, 2007). Such behavior can be represented in different ways. First, it might refer to a routine that is akin to skill and includes subroutines (e.g., taking the car from the garage, driving to the highway, parking at office) that are executed without much attention and sufficient flexibility to adapt to (minimal) changes in the environment. Car use can also be seen as more simple, stimulus-induced responses (e.g., stepping on the brakes in response to a red light). In a related vein, car use can be considered at a low or a high level of identity, which broadly corresponds with the representation of action (driving the car) versus the outcome of action (commuting to the office). Notably, different individual construals not only give different meanings to habits (Goldman, 1970; Vallacher & Wegner, 1985) but also address whether one conceives of habits as under control of a personal goal or of the environment.

A general habit model of environment–behavior relations also offers multiple levels of abstraction for linking environments to behavior. For instance, habitual alcohol use (Mehrabian & Russell, 1978) can be seen as concrete actions in a concrete context, such as always ordering a martini on Thursdays at 6 p.m. in the local bar from the waiter with the red shirt and blond hair. It can also be understood in more general terms, for example, regularly having alcoholic drinks (e.g., beer, wine, cocktail) when being with friends (e.g., at a party, in the restaurant, at the beach). Thus, habits can be conceptualized as responses to specific features—resembling stimulus–response relations—or as a pattern of different actions that occur in diverse situations—addressing a more

complex and variable context in which people select options that have different values and outcomes in different settings. A broader conceptualization of habits thus allows people (including researchers) to have multiple interpretations of how behavior is selected and performed, which complicates the assessment of habits as goal-independent behavior.

The Operationalization of Habits in Societal Context

The gold standard for distinguishing habit from goals is the devaluation procedure. This procedure was first demonstrated in a study showing that rats kept pressing a lever that produced a devalued food outcome (e.g., through satiation or creating an aversion to the food) after extensive training of the instrumental response (Adams, 1982). High frequency of behavior after outcome devaluation is thus an indicator of habitual responding, corresponding with the principle that habits are not controlled by outcomes and thus goal independent. Outcome-devaluation procedures are also used to study simple human habits (de Wit, Ridderinkhof, Fletcher, & Dickinson, 2013).

In studies that address the role of habitual patterns of behavior in societal context, habits are rarely manipulated. Instead, measures of habit consider the history of learning within a person. A common procedure to measure habit is the self-reported frequency and consistency of past behavior (Danner, Aarts, & de Vries, 2008; Gardner, 2015). Another measure is the self-report habit index (Verplanken & Orbell, 2003). Rather than asking information about the history of learning, the index assesses a person's insights into the automatic nature of habits (i.e., lack of control, lack of awareness, efficiency).

Both measures seem to be good predictors of (self-reported measures of) future behavior at the group level, and changes in these measures are taken as indicator of individual habit change. However, they have important limitations. First, they capitalize on the human ability to introspect about internal processes and to rely on memory of past experiences. People likely recall experiences that are low in frequency, important, and occurred recently (e.g., "I parked the car one minute ago"). But with more repetition and when past experiences are fairly old (e.g., "How often did you use the car in the past month without thinking about it?"), such reports become guesses (Aarts & Dijksterhuis, 1999; Blair & Burton, 1987), which suffer from biases and errors that are hard to control (Bradburn, Rips, & Shevell, 1987; Nisbett & Wilson, 1977; see also Kahneman, 2011). Furthermore, these measures correlate with intentions, suggesting that goals can cause behavior or are inferred from behavior (Hassin, Aarts,

& Ferguson, 2005; Wood & Runger, 2016). This renders the causal relation among habit, goals, and future behavior ambiguous (which is illustrated by inconsistent contributions of habit and intention measures in regression models of behavior; e.g., Gardner, 2015) and decreases the internal validity as a demonstration of true habit formation and change.

Challenges and Future Directions

Psychological research on habits in societal context has been working hard in the past two decades to model the role of habit in explaining, predicting, and changing behavior. To achieve this goal, researchers stretch the conceptualization and operationalization of the original habit concept. This expansion mainly concerns the generalization of stimulus–response links to a broader environment–behavior link, motivated by a general model that allows researchers to study and measure habits at a level that is meaningful to interventions of behavioral change. Extrapolating the basic principles of habit to a broader view of habit has important implications. We discuss a few challenges that might be considered for future directions.

An important aspect of our analysis is the flexibility for researchers to conceptualize habits at several levels of operation: The broader and more abstract the conceptualization, the more likely the behavior is considered to be goal dependent (van der Weiden, Aarts, & Ruys, 2010). This flexibility hinders progress in testing the goal independency of human habits. It might therefore be fruitful to specify the level at which the behavior is habitual and is targeted by separating action-selection from action-execution conditions (Marien et al., 2018). Genuine habit formation involves both stimulus-controlled action selection and execution. This happens when habits comprise single responses to single cues that do not require many steps to complete (Aarts et al., 1997) and sensory information directly converts to execution of motor movement (Wolpert, Diedrichsen, & Flanagan, 2011). However, when the stimulus environment or the behavior is more complex, full habits are more difficult to establish. In that case, practice can lead to stimulus-induced action selection, whereas execution remains subject to goal-dependent processing and vice versa (Gardner, Phillips, & Judah, 2016). In this view, behavior does not reflect a strict dual-process model because several parts of habits are processed with varying degrees of automation (Melnikoff & Bargh, 2018). In the future, habit researchers could therefore pay more attention to the complexity and variability of human behavior in societal context.

It could be argued, though, that genuine habits can also be formed for complex behaviors in complex environments. In such a case, taking the car and driving to

work is chunked and routinized up to the level of being directly controlled by bottom-up processes that receive no feedback from goal states. Although this is conceivable, we do not know yet whether such a form of habit learning is possible (but see Miller et al., 2019, for a Hebbian account of habit formation).

A second important issue concerns the measurement of habits. Self-reports of (and reflections on) past behavior can be used to estimate the prevalence of habits, but they may be unreliable and inaccurate. Researchers can also turn to objective (observational) measures of past behavior. However, their informational value as a correlate of habit remains limited to examining whether repeated and consistent selection and execution of behavior become goal independent. A well-accepted and direct way for testing this experimentally is showing that habits are insensitive to outcome devaluation. This procedure requires precision and has proven to be informative in research on rodents. It is more difficult to demonstrate the same in human studies, and initial evidence has been questioned in the recent literature. In an important contribution to this debate, De Houwer and colleagues maintained and showed that when outcome devaluation directed at action execution (e.g., eating potato chips in response to a blue light) does not eliminate behavior, one may falsely conclude that the behavior is habitual if the behavioral response is actually selected by and under the control of general task goals (e.g., earning points for performing the action quickly; De Houwer, Tanaka, Moors, & Tibboel, 2018; see Hogarth, 2018, for a similar view on addictions). These findings have an important twist. Habit tests commonly employ task instructions that serve as goals to map stimuli to responses and also to provide context to the task. A recent study reveals the critical role of such task instructions, showing that animal models of outcome devaluation are difficult to directly replicate in experiments with human subjects (de Wit et al., 2018).

Dealing with instructions in human habit research is challenging. Recent developments might deal with this problem by modeling human behavior in terms of algorithms and running simulations to better estimate the role of goals in habit formation (e.g., Miller et al., 2019). These computational models currently study relatively simple (sequenced) behaviors that can be further advanced by systematically taking into account the complexity of human behavior in societal context. Despite this promising approach, though, the challenge remains to cross-validate these instruction-poor methods with behavioral and neural data at the individual level.

Finally, the present analysis of habits has implications for designing behavior-change interventions. Currently, there is a general tendency to consider repeated behavior

in the same environment as a habit that is insensitive to arguments, reasoning, or even punishment and that substantial modifications in the environment are needed to change people's habits. For example, in the battle to reduce private car use, urban planners and engineers are charged with the task of modifying existing city infrastructures in which car use usually occurs. Solutions include moving parking to remote places and changing the traffic network by increasing the number of one-way streets. Although well meant, such costly interventions may fail if the behavior is actually under the control of goals and if people quickly adapt to the situation and still drive their car to their travel destination. Thus, although driving a car might be a skill and habitual in itself, the way in which that skill is used can be strongly directed by goals. It is therefore important to better model when human behavior is habitual or goal dependent, not only for the sake of theory building but also because it matters which strategies are best to change behavior for the benefit of society.

Recommended Reading

- Custers, R., & Aarts, H. (2010). The unconscious will: How the pursuit of goals operates outside of conscious awareness. *Science*, *329*, 47–50. A review article presenting a commonly shared conceptualization of goals and how they operate without conscious awareness in the context at hand, proposing that goals can mediate environmentally driven habits.
- Melnikoff, D. E., & Bargh, J. A. (2018). (See References). An opinion article in which a better perspective on the automaticity of psychological processes is advocated, inspiring habit researchers to abandon the dual-process account of the habit–goal dichotomy.
- Verplanken, B. (Ed.). (2018). (See References). Most recent and extensive volume on habits highlighting the timeliness and importance of habit research and featuring many relevant experts in the field.

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