

# Automaticity In Situ and in the Lab: The Nature of Habit in Daily Life

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The marksman sees the bird, and, before he knows it, he has aimed and shot. A gleam in his adversary's eye, a momentary pressure from his rapier, and the fencer finds that he has instantly made the right parry and return. A glance at the musical hieroglyphics, and the pianist's fingers have ripped through a cataract of notes.

—*William James* (1890, p. 114)

## Abstract

This chapter examines the attributes of habits as they manifest in situ, or naturalistic environments, and contrasts these attributes with those that have been revealed using laboratory methods. The chapter is divided into two sections. In the first, key characteristics of habits are reviewed as they emerge in naturalistic data, such as provided by observational studies and diary-based behavior sampling. These approaches show that real-world habits tend to be tied to the context cues that were contiguous with prior performance and implemented relatively independently of people's goals and intentions. In the second section, the naturalistic profile of everyday habits is contrasted with data generated through laboratory studies of habit. Drawing on evidence from neuroimaging studies of habit formation, it is suggested that certain laboratory methods can inflate evidence for the goal-mediated nature of automated responding by directing participants' conscious attention to what are typically unattended responses. In so doing, lab procedures may yield evidence of goal mediation that does not hold in real-world, unattended habitual responding. In contrast, naturalistic designs that use unobtrusive or post hoc assessments avoid this potential confound because they do not necessarily alter participants' phenomenological orientation toward their actions. The value of naturalistic methods in the study of action control mechanisms is highlighted.

**Keywords:** habits, naturalistic data, real-world studies, laboratory studies, diary-based behavior, goals, intentions

As the reactions of the marksman, fencer, and pianist in James's description attest, the world around us can serve as a powerful and automatic trigger to behavior. With sufficient practice, the mere perception of a contextual cue—a bird in flight, an opponent's rapier, or the notes in a melodic sequence—can seem spontaneously to provoke the appropriate behavioral response. Moreover, this cuing of habits is not limited to those with special skills and talents. All of us have followed a familiar route to work or

school guided unthinkingly by well-known landmarks, and we have progressed mindlessly through a morning grooming ritual while conversing with a partner or family member.

In this chapter, we evaluate the attributes of such habits as they manifest in situ, that is, in the naturalistic settings in which they spontaneously occur. Our guiding premise is that naturalistic data can yield unique insights into the kind of automaticity underlying habitual behavior. However, we see

naturalistic data as augmenting, rather than substituting for, laboratory-based experimental paradigms designed to illuminate the basic psychological processes underlying habitual responding (e.g., Bargh & Chartrand, 1999; Hay & Jacoby, 1996; see Chapter 20). Laboratory paradigms provide powerful tools for understanding what *can* happen but provide less definitive information on what spontaneously *does* happen in everyday life. As we explain in this chapter, naturalistic data can provide this important piece of the puzzle and, in doing so, can help refine our understanding of the mechanisms underlying the habits and routines that compose much of daily life.

The chapter is divided into two sections. In the first, we review key characteristics of habits as they emerge in naturalistic data, such as provided by observational studies and diary-based behavior sampling. These approaches reveal a characteristic profile associated with habitual responding in everyday life. Specifically, real-world habits tend to be tied to the context cues that were contiguous with prior performance. Furthermore, naturalistic data show that habit performance can proceed with minimal conscious awareness and without compatible intentions guiding responding. We argue that this profile implies an underlying form of automaticity best described as context cued and non-goal-dependent<sup>1</sup> (Neal, Wood, & Quinn, 2006; Wood & Neal, 2007).

In the second section, we contrast the naturalistic profile of everyday habits with data generated through laboratory studies of habit. Findings from naturalistic and laboratory investigations are generally in agreement that context cues can trigger habit performance and that habit performance requires limited conscious awareness. However, a more complex picture emerges with respect to the role of goals and intentions as mediators of habitual control. Laboratory

studies in animal learning, neuroscience, and cognitive psychology support the naturalistic profile in which habits are subserved by a rigid, context-cued automaticity that proceeds with minimal involvement of people's goals and intentions (Dickinson & Balleine, 2002; Hay & Jacoby, 1996; Miller & Cohen, 2001; see Chapter 26). In contrast, some work in social psychology has subsumed habits into the burgeoning literature on automatic goal pursuit (e.g., Aarts & Dijksterhuis, 2000). In this second perspective, habits involve a more flexible, goal-dependent form of automaticity in which contexts prime responses indirectly via the activation of relevant goals or intentions. Instead, habits are most accurately understood within the rigid, non-goal-dependent framing. Nonetheless, we also suggest that habits can interact with goal systems in consequential ways (Wood & Neal, 2007).

To conclude the second section of the chapter, we offer a potential explanation for the fact that some laboratory research indicates habits are rigid and context cued, whereas other laboratory research indicates habits are flexible and goal-dependent. In brief, we draw on evidence from neuroimaging studies of habit formation to suggest that certain laboratory methods can inadvertently inflate evidence for the goal-mediated nature of automated responding by directing participants' conscious attention to what are typically unattended responses. In so doing, lab procedures may yield evidence of goal mediation that does not hold during real-world, unattended habitual responding. In contrast, naturalistic designs that use unobtrusive or post hoc assessments avoid this confound because they do not necessarily alter participants' phenomenological orientation toward their actions. We conclude by highlighting the value of naturalistic methods in the study of action control mechanisms.

## Habits In Situ

Naturalistic studies of habit draw from a variety of methods that seek to track people's real-world actions in minimally intrusive ways. These methods include direct observation, event- or signal-contingent sampling, and daily diaries (see Bakeman, 2000; Hektner, Schmidt, & Csikszentmihalyi, 2007). As we explain here, studies using these methods show that the habitual dimension of daily life exhibits distinct attributes within our broader behavioral repertoire. First, habits are linked to features of performance contexts, including places, and other actions, in a relatively rigid, inflexible way. Second, only limited awareness is required for habitual control. Although it might seem obvious that people pay only limited attention to habit performance, at the end of the chapter we explain that the naturalistic evidence on this issue has critical implications for interpreting experimental research on habits in laboratory contexts. Finally, we present real-world data suggesting that habits can be executed relatively independently of people's conscious goals and intentions.

### *Rigid Context Cuing of Performance*

Barker's (1968; see also Barker & Schoggen, 1978) classic work in ecological psychology provided some of the first empirical evidence of the rigid patterns of routine actions tied to physical settings that constitute much of daily life. In these now-famous studies, trained observers directly coded the details of children's daily activities in a small Midwest U.S. town. Analyses of these records revealed a high degree of context stability in daily routines, with two individuals in the same context often exhibiting greater behavioral similarity than the same individual measured across different contexts. Accordingly, as the most proximal ecological unit

to account for behavior, Barker (1968) proposed the concept of *behavior setting*, defined as "standing patterns of behavior-and-milieu" (p. 18).

Evidence that everyday responses are tied to context also emerged in our signal-contingent experience-sampling diary investigations. In these studies, college student and community participants recorded once per hour for several days what they were doing, thinking, and feeling (Quinn & Wood, 2005; Wood, Quinn, & Kashy, 2002). About 45% of the behaviors that college students listed in their diaries were deemed habitual insofar as they were consistently performed in a particular physical location almost every day. Although the community sample tended to list slightly different activities that were classified as habits, their overall profile also was one in which almost half of daily activities were repetitive and tied to particular contexts.

Additional evidence of the close link between responses and performance contexts comes from behavior prediction research in which people rated the frequency with which they performed various actions along with the stability of features of the performance context. For example, in Ji and Wood's (2007) investigation, participants who purchased fast food more frequently tended also to purchase it at the same times of day,  $r(222) = .19$ ; participants who watched television news more frequently tended to watch it at the same locations and times of day,  $r_s(222) = .29$ , and  $.32$  for location and time, respectively; and participants who took the bus more frequently tended to catch a ride at the same locations and times,  $r_s(114) = .45$  and  $.40$  for location and time, respectively. These data suggest that heightened frequency of performance goes hand in hand with heightened context stability, a pattern that is consistent with the context-cued nature of habitual responding.

The high degree of context stability typical of habits does not, of course, establish that those contexts play a causal role in triggering behavior. Causal arguments are difficult to test in natural environments, although suggestive evidence is available from quasi-experiments in which real-world contexts have undergone naturally occurring change. If contexts play a causal role in triggering habitual responses, then such changes should disrupt the performance of associated habits. Illustrating just this effect, Wood, Tam, and Guerrero Witt (2005) tracked disruptions to a number of students' everyday activities as they transferred enrollment from one university to another. Consistent with a causal role for contexts, students' everyday habits tended to be maintained across the transfer only if the performance context at the new university matched that at the old university. For example, students with habits to read the newspaper at the old university continued to do so at the new university only when their roommates' newspaper reading was stable across the transfer (i.e., roommates at both schools either read the paper themselves or did not). In contrast, when the reading context varied between old and new universities (i.e., when their roommates' behavior changed), students' reading habits were significantly less likely to persist at the new university. Moreover, students' intentions to read the paper were not systematically influenced by the context change, suggesting that the behavioral effects cannot be explained by reference to conscious decisions and planning. Instead, it appears that context change undermined the context–response associations underlying reading habits.

In addition to demonstrating the ways that habits can be tied to and triggered by contexts, naturalistic data provide insight into underlying cognitive and motivational processes. We turn now to consider two such process-level attributes of real-world habits: minimal awareness and insensitivity

to conscious intentions. These features help to illuminate the specific form of automaticity underlying habitual control.

### *Conscious Awareness of Performance*

The limited conscious awareness typically devoted to habit performance was demonstrated in Wood et al.'s (2002) behavior sampling study discussed in the previous section. Participants in this research recorded not only what they were doing at a particular point in time but also what they were thinking about during behavior performance. Two independent raters then judged whether participants were thinking about the behavior in which they were engaged at each recording period. Thoughts were classified as corresponding to behavior when they involved the specific actions being performed (e.g., when eating, “about how good the bread was”) or implicated abstract goals and outcomes that related in some way to the actions being performed (e.g., “how I need to start eating more healthy so I can get back in the shape I was during summer”). In the case of nonhabitual behaviors, participants were thinking about what they were doing for 70% of the reports. For habitual responses, thought–action correspondence was significantly lower, and participants were thinking about what they were doing for only 40% of the reports. Thus, although some habits still attracted conscious thought during performance, such thought was significantly less common than with nonhabitual actions. Thus, consciously attending to one's habits appears to be the exception rather than the norm.

The minimal awareness required for habit performance was evident also in participants' self-report ratings of the attention and thought required to perform each behavior (Wood et al., 2002, Study 2). Compared with more novel, unfamiliar actions or those that did not typically occur in a specific context, habits were rated as requiring

less attention and less thought. In addition, respondents rated the difficulty of performing each behavior listed in their diary. These ratings revealed greater ease of performing for habitual than nonhabitual actions. Thus, behaviors that people repeat in the same location almost every day possess a number of the attributes classically associated with automaticity (see Moors & De Houwer, 2006). They attract a relatively low level of thought and awareness and are experienced as easy to perform. Although perhaps not especially surprising in itself, this evidence of limited awareness of habit performance may, as we explain at the end of the chapter, be critical when interpreting the attributes of habits that have emerged in laboratory settings.

### ***Response-Related Goals and Intentions***

Naturalistic data also suggest that habit performance can proceed independently from people's current intentions. This is a significant finding because many prominent theories of behavioral control are predicated on the idea that intentions are key determinants of behavior (e.g., Ajzen & Fishbein, 2005; Austin & Vancouver, 1996; Gollwitzer & Moskowitz, 1996).

Before reviewing data on the role of intentions in habit performance, we note that real-world habits typically are *not* in conflict with intentions. This makes sense given that people's daily habits plausibly originate in purposive decision making and goal pursuit (e.g., a habit for reading a certain newspaper is likely the result of what was once a conscious, deliberative decision). Put differently, assuming that people usually repeat behaviors that serve desired outcomes, habits are likely to develop in line with intentions. Accordingly, in a meta-analytic estimate across 33 separate studies, measures of habit strength were positively correlated with the strength of intentions,  $r = .43$  ( $p < .01$ ; Ouellette & Wood, 1998). Thus, if rep-

etition initially was intentional and if intentions remained stable over time, then habit strength would correlate with intentions even when actions were repeated sufficiently to become cued by context, and hence triggered without recourse to intentions. As we discussed in detail elsewhere, a significant correlation between intentions and habit strength therefore does not, by itself, indicate that intentions are driving behavior (Wood & Neal, 2007). With respect to habits, the intention-behavior relationship is likely an epiphenomenon reflecting the fact that the habitual behavior was once an intention-driven response and thus remains consistent with intentions.<sup>2</sup>

Notwithstanding the overall positive relation between habits and intentions, it is obvious that habits do not always correspond with intentions. So-called bad habits reflect behaviors that are consistently out of line with what people wish they were doing. In addition, divergence between habits and intentions sometimes occurs in the form of accidental slips in everyday life. In an early example of such action slips, James (1890; see also Heckhausen & Beckmann, 1990) describes an absentminded man who enters his bedroom to change a tie for dinner and ends up getting undressed and getting into bed. While intending to change his tie, the subject of the story encountered context cues associated with a well-established habit of going to bed, and these cues co-opted or captured the stream of action in a manner that ran counter to his intentions. Using an event-sampling diary method, Reason (1990) found that such *habit capture errors* are relatively common in daily life and tend to occur when components of the intended action overlap with the habit that co-opts it (e.g., intending but failing to stop at the store on the usual drive home; see Chapters 5, 8, and 20). Thus, bad habits and action slips are exceptions to the overall tendency for habits to correspond with intentions.

Systematic evidence that well-practiced actions can be cued independently of intentions in daily life is provided in behavior prediction research. For example, Ji and Wood (2007) predicted how often college students would perform a number of everyday actions (e.g., purchase fast food) from students' earlier-reported intentions and strength of their habits (reflected in frequency of past performance and stability of performance contexts). Indicating that habitual behaviors are not guided by intentions, during the week of the study, students with stronger habits repeated their past behavior regardless of their reported intentions. Only for students with weaker habits did intentions guide actions. These findings echo those from a number of other behavior prediction studies indicating that real-world habits tend to be performed even when not aligned with current intentions and goals (e.g., Aldrich, Montgomery, & Wood, 2008; Danner, Aarts, & de Vries, 2008; Ferguson & Bibby, 2002; Ouellette & Wood, 1998; Verplanken, Aarts, van Knippenberg, & Moonen, 1998). It appears that when people have repeated actions frequently in stable contexts, context cues can activate the practiced response independently of what people intend to do. Note that these findings do not suggest that people are unable to override habitual response tendencies. When they have sufficient amounts of self-control available (Neal, Pascoe, & Wood, 2008a) and when they are using appropriate self-control strategies (Quinn, Pascoe, & Wood, 2008), people can inhibit the tendency to perform many everyday habits. However, behavior prediction research indicates that the typical pattern in everyday contexts is for people to fail to override habits that do not align with intentions.

That people perform habits in the apparent absence of a supporting intention might seem at odds with another form of real-world context-cued automaticity—implementation

intentions—in which people form plans to implement a given response when they encounter a specific context (e.g., “when X occurs, I’ll do Y”; Gollwitzer & Sheeran, 2006; see Chapter 29). Naturalistic data suggest that implementation intentions automate future context-cued responding and thereby increase the likelihood that people act on the relevant intentions. However, this form of automaticity differs from habits in that it depends on continued explicit endorsement of a relevant goal. Illustrating this dependence, Sheeran, Webb, and Gollwitzer (2005, study 1) had students form implementation intentions regarding the time and place at which they would study over the following week (versus control participants who did not). Participants forming these plans spent significantly more time studying only if they had a moderate or strong goal to study. Thus, although they share features of automatic cuing with habits, implementation intentions are distinct in depending on the strength of people’s underlying goals and intentions.

In summary, naturalistic data arising from observational and behavior-sampling techniques suggest that real-world habitual responses are relatively rigidly tied to specific contextual cues, are implemented with limited conscious awareness, and proceed in a manner that does not depend on the presence of a supporting goal or intention. The specific pattern of habitual responses in real-world data can be distinguished from other forms of context-driven automaticity, such as implementation intentions that do require the presence of response-consistent goals or intentions. In the second half of the chapter, we contrast habits as they emerge in situ with the forms in which they appear in laboratory experiments.

### **Habits in the Laboratory and In Situ**

Laboratory and naturalistic data converge on several points concerning the attributes

of habitual automaticity. As we explain, data from the lab and from everyday life agree that habits tend to be triggered by contexts, including places, other people, and preceding actions, with only minimal conscious awareness. However, it is less clear whether the evidence of habits in the lab aligns with naturalistic data demonstrating that habits are not flexibly moderated by conflicting intentions and goals. Laboratory studies have promoted two relatively distinct views of the role of goals in habit performance (see Wood & Neal, 2007). The first perspective, associated predominantly with work in neuroscience, animal learning, and cognitive psychology, frames habits as inflexible response dispositions that are triggered directly by stimuli and thus make minimal recourse to people's goals and intentions. The second view, associated predominantly with recent work in social psychology, frames habits as a more dynamic, goal-dependent form of automaticity. After outlining these two perspectives, we propose that naturalistic habit data provide reason to favor the non-goal-dependent definition of habits. Moreover, we provide a methodological explanation for why some laboratory paradigms could produce evidence seeming to indicate that habits are dynamic and dependent on goals.

### ***Points of Convergence: Context Cuing and Minimal Conscious Awareness***

Two features of habits—context cuing and minimal conscious awareness—emerge in generally consistent ways across the full spectrum of naturalistic and laboratory paradigms. In a typical laboratory study, the context-cued nature of habitual responding might be established by having participants generate a response immediately after exposure to some context feature (e.g., a word or picture that connotes the context) that has historically covaried with that response. Con-

text cuing of the response habit is evident if response speed or accuracy is facilitated by prior exposure to the context feature (as opposed to a no-exposure control condition). The underlying logic follows our definition of habits: Responses and contexts that have historically co-occurred will become associated in memory so that activation of the context can automatically facilitate the linked response. In these studies, context features take myriad forms, including abstract experimental stimuli (e.g., auditory tones; Rah, Reber, & Hsiao, 2000; tarot cards, Neal, Pascoe, & Wood, 2008b), physical settings (e.g., a shopping mall or university; Aarts & Dijksterhuis, 2000; a sports stadium, Neal, Lally, & Wood, 2008), and prior responses in a learned sequence (see Graybiel, 1998). In each case, exposure to the habit-relevant context cue has been shown to facilitate performance of the linked response.

The second attribute of real-world habits, limited awareness, also emerges reliably in laboratory settings. This attenuated awareness is found with respect to various features of the habitual response: A person may lack awareness of the context cue that triggered performance, awareness of the response itself, or awareness of the causal relationship between the context and response (or, conceivably, any combination of these features). Whereas naturalistic paradigms have limited power to tap these subtle process-level distinctions, laboratory studies have provided fine-grained tests of people's awareness of each feature. For example, masked priming studies have shown that visual cues (e.g., everyday objects such as a key or a mallet) can prime previously associated behavioral responses (i.e., a precision grasp for a key or a power grasp for a mallet) even when presented under conditions that preclude conscious awareness of the cue during response selection and execution (e.g., Tucker & Ellis, 2004). Other studies have shown that

elements of the response implementation itself also attract reduced awareness once the response has been rendered habitual. In particular, this pattern is evident in the fact that attention-demanding secondary tasks impair non-habit based responding while leaving habitual control intact (e.g., Foerde, Knowlton, & Poldrack, 2006). Neuroimaging studies of skill acquisition support a similar conclusion by showing that attention-related brain structures (e.g., dorsolateral prefrontal cortex) exhibit reduced activity during the execution of habitual compared with nonhabitual responses (e.g., Floyer-Lea & Matthews, 2004).

With respect to awareness of the causal connection between context and response, implicit learning studies have established that it is possible to attend consciously both to a cue and a response and yet to be unaware (a) that there is a pattern of historical covariation between the two and (b) that this pattern is facilitating responding (e.g., Lewicki, Hill, & Bizot, 1988; Rah et al., 2000). In illustration, Rah et al.'s (2000) participants completed a visual serial reaction time task while simultaneously performing a second, auditory tone-counting task. Participants were informed that the two tasks were unrelated. However, in reality, the visual stimuli were predicted probabilistically by the preceding auditory tone. After repeated exposure to the context–response pairings, participants showed faster reaction times in probe trials if the visual stimuli were presented after auditory cues with which they historically covaried. Thus, participants were consciously aware of the triggering cue (the auditory tone) and were consciously aware of the response (the button press), but they were unaware of the specific patterns of context–response covariation. Despite lacking this awareness, participants gave responses that were facilitated by the covariation information.

The attributes of context cuing and minimal conscious awareness that emerge in naturalistic studies of habit thus are largely mirrored in studies in the laboratory. Just as with habits in situ, laboratory-generated habits can be triggered by historically covarying context cues in a manner that bypasses conscious awareness. Furthermore, the control inherent in lab procedures has enabled researchers to identify the extent to which people are aware of each component of habitual responding (i.e., consciousness of context cues, responses, and the covariation of cues and responses).

### ***A Point of Divergence: Do Habits Depend on Goals and Intentions?***

The naturalistic behavior sampling data and the behavior prediction work presented at the beginning of this chapter suggest that habits emerge in the form of narrowly defined context–response mappings that are implemented in a manner that is not dependent on a supporting goal or intention. This pattern was evident in the close association between habits and the contexts in which they have historically occurred and in the failure of habits to be moderated by the favorability of intentions. Anecdotal observation suggests that real-world habits often exhibit additional features suggesting they are insensitive to current goals and intentions. First, people rarely substitute habitual behaviors (e.g., a habit of daily jogging) for alternative behaviors that meet the same ostensible goal (e.g., switching from jogging to cycling). Second, real-world habit performance often persists even when the value or relevance of the ostensible goal has changed or dissipated (e.g., when one has successfully lost the 15 pounds that initially inspired the daily running). Thus, both naturalistic data and anecdotal experience suggest that real-world habits proceed in a manner that is relatively rigid and not dynamically sensitive to people's current goals and intentions.



Unlike the two attributes discussed in the previous section (context cuing and reduced awareness), laboratory data provide mixed conclusions regarding the role of goals and intentions within habitual responding. As we explain here, some laboratory paradigms provide an image of habits as context-cued responses that proceed even in the absence of facilitating intentions and goals. However, other laboratory paradigms suggest that habits reflect a more dynamic goal-dependent form of automaticity.

#### LABORATORY DATA SUGGESTING THAT HABITS ARE RIGID AND CONTEXT CUED

Three laboratory-based approaches have played especially prominent roles in advancing the view that habits are subserved by rigid, context-cued automaticity. These approaches encompass (a) neuroimaging studies of behavioral automation (see Kelly & Garavan, 2005), (b) animal learning studies of reinforcer devaluation effects (see Dickinson & Balleine, 2002), and (c) cognitive studies of habit control (e.g., Neal et al., 2008b; Neal, Lally, & Wood, 2008). The first line of evidence that habits are context cued and not mediated by people's current goals comes from neuroimaging studies that have tracked the role of goal-related brain systems over the course of habit development. In a typical laboratory study in this area, the neural correlates of task performance are monitored as participants repeat a motor task until it becomes habitual according to some behavioral criterion (e.g., absence of dual task interference effects). The neural patterns that emerge in such studies typically reveal that habit formation is associated with a significant redistribution of brain activity (see reviews in Jonides, 2004; Kelly & Garavan, 2005). Importantly, this redistribution characteristically features reduced activation of the prefrontal cortex (PFC; Floyer-Lea & Matthews, 2004; Raichle et al., 1994; Sakai et al., 1998). Given

that the PFC is considered critical to the selection and pursuit of goals (Miller & Cohen, 2001), the relative quiescence of this system during habit performance suggests that goals play a limited role in habit performance.

Neuroimaging studies also have provided evidence of the relative rigidity of habitual control (see Foerde et al., 2006; Reber, Knowlton, & Squire, 1996). For example, Foerde et al.'s (2006) participants practiced a probabilistic learning task under conditions that encouraged reliance on either declarative or procedural (i.e., habit) memory. Specifically, they learned to predict two weather outcomes (rain or shine) via probabilistically associated visual cues under either single-task conditions or dual-task conditions (encouraging use of declarative or procedural/habit-based memory respectively). Imaging data confirmed that these variations in learning conditions determined whether participants relied predominantly on declarative memory (i.e., medial temporal lobe) or procedural/habit memory (i.e., striatum). Participants in the declarative and procedural learning conditions acquired similar levels of proficiency at the task, but those encouraged to use procedural, habit-based memory performed significantly worse in a post test of their ability to apply their skill flexibly in a new context (see also Reber et al., 1996). Thus, consistent with naturalistic research on habits, neuroimaging studies suggest that habits rely on a relatively inflexible form of automaticity that involves associations between specific responses and context cues and is not dynamically responsive to current goals or novel contexts.

A second source of laboratory evidence comes from animal learning studies addressing the changing impact of goals as responses are practiced into habits (see Dickinson & Balleine, 2002). These studies, conducted primarily with rats, suggest that habitual responses are relatively insensitive

to variations in the value of the reward-related outcomes of the responses, whereas nonhabitual responses vary dynamically with such variations. This *reinforcer devaluation insensitivity* phenomenon was established using a paradigm in which rats first underwent moderate training (e.g., 120 trials) or extended, habit training (e.g., 360 trials) in which they received reinforcement (e.g., food pellets) for performing a simple action (e.g., lever pressing). The outcome (e.g., food acquisition) was then devalued by overfeeding the rats or by pairing the food with a toxin. Such reinforcer devaluation depressed animals' subsequent performance of minimally trained responses but had little effect on habits (e.g., Balleine & Dickinson, 1998; Yin, Knowlton, & Balleine, 2004). This pattern typically is interpreted as evidence that habits involve behavioral control that has become autonomous from the specific goals and outcomes that initially motivated the response.

The third line of laboratory evidence for the non-goal-dependent view comes from behavioral studies of human habits. For example, we recently tested the effects of goal priming on habit-based automaticity through a study in which we adapted the weather prediction paradigm outlined above that is commonly used by cognitive neuroscientists studying procedural/habit based memory (Neal et al., 2008b). After learning to predict the weather using a method that fostered reliance on either declarative or procedural/habit-based memory, participants were primed with an achievement goal or no goal via a scrambled-sentence task. Activation of the achievement goal improved performance of those relying on declarative memory. However, achievement priming actually significantly impaired performance of those using habit-based procedural memory. We replicated this effect in a second study using an explicit goal priming technique (i.e., offering a cash bonus tied

to performance). These results suggest that, contrary to the pattern typically associated with goal-dependent responses, goal priming does not facilitate, and can actually impair, habit-based automaticity.

Providing further evidence that habits are not dependent on goals, in another line of work, we have focused specifically on the link between context cues and habitual responses (Neal, Lally, & Wood, 2008). The aim of the study was to test whether contexts exert their effects on habitual behaviors directly or whether they work indirectly by activating goals that then drive behavior. To address this, we used an experimental paradigm to test whether a simple behavioral response (habitual speech intensity in a given context) can be triggered by relevant contexts without changes in relevant goals. Participants were exposed to one of two contexts (*sports stadiums* or *kitchens*) as part of a "visual acuity test" similar to the *Where's Waldo* children's books. We reasoned that those who frequently attend sports stadiums may have acquired a habitual tendency to speak loudly in that environment. To assess the effect of context on goals, participants rated their desire to be represented to other participants by a loud versus quiet confederate (a pilot test confirmed that participants with the goal of speaking loudly preferred being represented by the loud confederate). Consistent with predictions, exposure to sports stadiums led to a significant increase in speech intensity, but only for participants who had a frequent and consistent behavioral history of visiting sports stadiums over the prior six months. Furthermore, path analyses confirmed that the effects of context on speech habits were not mediated by changes in participants' goals related to speech intensity (i.e., their desire to be represented by the loud confederate). Thus, these data support the view that contexts can trigger directly associated habits (in this case, simple speech intensity) without the mediating involvement of goals.

In summary, these three lines of laboratory-generated data present a relatively coherent case for the non-goal-dependent nature of habit-based automaticity. Despite varying paradigms that span multiple levels of analysis (neural, cognitive, and behavioral) and populations (human and nonhuman), habits emerge consistently as context-cued responses that are executed with minimal recourse to the goals and intentions that may initially have propelled responding. This pattern is evident in habits' reduced reliance on brain areas associated with goal pursuit, their persistence despite variations in goal relevant outcomes, and their failure to be facilitated by goal priming techniques that are known to facilitate goal-dependent responses.

#### **LABORATORY DATA SUGGESTING THAT HABITS ARE DYNAMICALLY DEPENDENT ON GOALS**

The rigid, context-cued profile outlined in the prior sections of this chapter stands in contrast with an alternative set of laboratory data in social psychology indicating that habits are a form of automatic goal pursuit. As the burgeoning literature on automatic goal pursuit has shown, goal-mediated forms of automaticity can be distinguished from more direct, context-cued automaticity along a number of dimensions (see Chartrand, Dalton, & Cheng, 2008; Moors & De Houwer, 2006). Particularly relevant for current purposes, automatic goal pursuit appears to be fluidly dependent on currently active goals (e.g., Bargh, Chen, & Burrows, 1996; Macrae & Johnston, 1998). That is, the intensity (e.g., persistence, speed, accuracy) of automatic goal pursuit appears to vary dynamically as a function of a person's currently active goal states. We have argued that habit automaticity lacks this attribute because it is implemented independently of goal states (see Neal et al., 2006; Wood & Neal, 2007).

A number of laboratory-based studies, however, have yielded data suggesting habits

possess this dynamic, goal-dependent feature (e.g., Aarts & Dijksterhuis, 2000; Sheeran, Aarts, Custers, Rivis, Webb et al., 2005). Aarts and Dijksterhuis (2000) conducted an ingenious series of studies exploring the impact of activating various travel goals (e.g., shopping at the city center mall) on the mental accessibility of people's habitual modes of travel to those destinations (e.g., bicycle, car). Specifically, participants judged as quickly as possible whether a given travel mode (e.g., bicycle) was a realistic means for getting to a previously presented location (e.g., Heuvelgalerie, a popular mall in the Netherlands city of Eindhoven). These judgments were made faster if (a) the relevant travel goal had been activated in an earlier task and (b) the bicycle was a habitual means for the participant to get to the location. The researchers interpreted this pattern as evidence that the activation of habitual associations in memory is dependent on goal activation and hence that habits are a form of automatic goal pursuit. An analogous pattern of results was reported by Sheeran, Aarts et al. (2005), who found that priming an alcohol consumption-related goal (socializing) made habitual drinkers but not nonhabitual drinkers respond more quickly to drinking-related action words and increase their likelihood of accepting a voucher for free drinks.

The pioneering laboratory studies of Aarts and Dijksterhuis (2000) and Sheeran, Aarts et al. (2005) appear to support the view that habits represent a goal-dependent form of automaticity. Although these studies offer a compelling demonstration of how goals can affect conscious, reflective decision making and behavior, in our view, their findings do not generalize to real-world habits. First, as we outlined in the first half of this chapter, naturalistic data suggest that habits are executed in a manner that pays little heed to people's currently active goals and intentions (e.g., Ji & Wood, 2007; Wood et al., 2005). Second, subsuming habits into the automatic

goal pursuit literature would run counter to the many laboratory studies in neuroscience, animal learning, and cognitive psychology that support the non-goal-dependent nature of habitual control (e.g., Dickinson & Balleine, 2002; Miller & Cohen, 2001). Third, as we elaborate here, at least some laboratory paradigms used to study the role of goals within habitual responding include methodological elements that may invoke goal-dependent control over responses that would otherwise be non-goal-dependent.

### ***Divergence Explained? Attention to Action in the Lab***

Why have some laboratory paradigms indicated that habits reflect a dynamic, goal-dependent form of automaticity whereas others indicate that habits are rigid and non-goal-dependent? We speculate that this divergence can be explained in part by a methodological feature concerning the level of conscious attention that participants are asked to devote to task elements. We based this suggestion on recent neuroimaging studies demonstrating that attention to action moderates whether or not goal-related brain systems are active during the performance of habitual responses (e.g., PFC; Jueptner et al., 1997; Rowe, Friston, Frackowiak, & Passingham, 2002). If some laboratory procedures require participants to devote greater conscious awareness to their habitual responses than is typical in naturalistic settings, then this heightened awareness may induce goal-oriented control over what are typically not goal-dependent responses. In such paradigms, non-goal-dependent habits may appear to be dependent on goals.

The neuroimaging studies relevant to this potential confound have first isolated the neural correlates of normal habit acquisition and then examined changes to these neural correlates when participants were forced to direct conscious attention to their habitual responses during performance. For

example, in Jueptner et al.'s (1997) study, positron emission tomography (PET) scans were taken as participants learned and then performed a habitual sequence of complex finger movements. As we mentioned in the prior section of the chapter, the established effect in the literature is that goal-related brain systems (i.e., the PFC) that were engaged while participants were first learning the task subsequently disengaged after the behavior became well learned and was executed habitually. Jueptner et al. (1997) replicated this basic effect. However, their study included an additional condition in which participants at the end of learning were asked to direct conscious attention to the performance of the habitual sequence. Specifically, they "were asked to 'think of the next movement' once they finished the previous one" (p. 1314). In this condition, the PET data showed that participants re-engaged PFC activation in a manner similar to initial learning. Thus, when consciously attending to the performance of their habitual response, brain activity consistent with goal-mediated control emerged despite this activity being absent when the response was performed without attention. These findings, along with comparable ones by Rowe et al. (2002), suggest that a habitual response that is otherwise executed with minimal attention and without recourse to goal-mediated control can appear to be goal mediated if tested under conditions in which the response is subject to conscious attention.

We believe that Jueptner et al.'s (1997) and Rowe et al.'s (2002) findings offer a potential explanation for the conflicting laboratory evidence regarding the role of goals within habitual responding. Their studies suggest that procedural manipulations that heighten conscious attention to action can lead to the recruitment of goal systems during a habitual response that would otherwise be executed without the involvement of those systems. As Wood et al.'s (2002) naturalistic

data suggest, during habit performance, people's conscious thoughts are often directed to something other than their actions. In contrast, paradigms like those used by Aarts and Dijksterhuis (2000) and Sheeran, Aarts et al. (2005) appear to require that participants attend to their habitual responses by, for example, judging whether the response is an appropriate means to some end. Such instructions presumably increased participants' conscious attention to their responses during testing, and the Jueptner et al.'s (1997) neuroimaging data suggest that this heightened attention could have artificially promoted goal-oriented control, thus generating the appearance that habits depend on goals.

To test more directly whether conscious attention can heighten goal-oriented control, Neal, Lally, and Wood (2008) tested the role of goals in habitual responding using two different paradigms. The study recruited habitual and non-habitual runners and tested associations between running and the idiosyncratic goals (e.g., "fitness") and contexts (e.g., "gym") that participants had previously reported as being linked to their running. One paradigm used a subliminal priming method that prevented participants from consciously attending to the associations being measured. In contrast, the second paradigm explicitly required participants to attend to these associations in a manner similar to Aarts and Dijksterhuis' (2000) participants. The non-conscious task demonstrated context-priming effects but no goal-priming effects, such that habitual runners responded faster to the word "run" when primed with relevant contexts but not when primed with relevant goals. On the conscious, explicit judgment task however, significant goal priming effects were found. These data support the idea that experimental methods that require participants to attend consciously to habitual responses can yield evidence for goal-dependant operation despite that such

evidence is absent when using techniques that allow for unattended responding.

If attention to action is in fact a potential confound in studies assessing the role of goals in habitual responding (or other automatic responses), then it is important for researchers to select methods that do not heighten conscious attention to levels that deviate from the relevant real-world context to which generalization is sought. Control participants in Jueptner et al.'s (1997) research who were simply asked to perform a habit in the PET scanner without altered attention did not recruit goal-related brain systems during response execution. Also, neuroimaging studies demonstrating the decreased involvement of goal-related brain systems in habit development typically require that participants simply perform their responses in the magnet without any instructions about conscious monitoring (Floyer-Lea & Matthews, 2004; Sakai et al., 1998). Other studies limit conscious monitoring by, for example, having participants engage in an attention-demanding secondary task during habit formation (e.g., Foerde et al., 2006) or by using techniques such as subliminal priming (see Bargh & Chartrand, 2000). Additionally, to avoid artificially directing attention to habitual responses, naturalistic paradigms collect data retrospectively rather than concurrently with the response under examination. For example, in behavior-sampling studies, participants reported on the attention required by habit performance at the end of the day or when cued randomly by a beeper (e.g., Wood et al., 2002). By this strategy, naturalistic paradigms can avoid directing participants to attend to responding during performance and thus avoided inadvertently engaging goal-directed control over that responding.<sup>3</sup>

In summary, in light of the potentially confounding role of attention to action in some previous laboratory studies, we believe that the weight of current evidence supports the non-goal-dependent, context-

cued definition of habitual control. This view is supported by naturalistic studies showing that habits are tied to narrowly defined contexts and implemented without compatible intentions and also by laboratory data showing that habits involve reduced reliance on goal-related brain systems and proceed despite changes in goal-related outcomes.

### **Summary and Implications for the Nature of Habitual Control**

We have argued that naturalistic data can provide valuable insights into the nature of habits that augments knowledge emerging from more controlled paradigms in the laboratory. We highlighted the many points of convergence between naturalistic and laboratory-based studies of habit. In particular, both approaches show that features of a person's context (e.g., people, places, preceding actions) can be powerful, automatic triggers of habit performance, and that habits are executed with minimal recourse to conscious awareness.

There is less agreement with respect to the role that people's goals and intentions play in determining habit performance. Although some forms of real-world automaticity (e.g., implementation intentions) are sensitive to people's current goal states, established habits in naturalistic settings appear to be context cued and do not depend on goals and intentions. This naturalistic profile is consistent with laboratory data generated in neuroscience, animal learning, and some cognitive paradigms. However, it conflicts with some recent social psychological laboratory data indicating that habits are a form of goal-dependent automaticity. In resolution of this inconsistency, we argued that some laboratory procedures used in social psychological lab studies may inadvertently inflate evidence for the role of goals by increasing participants' conscious attention to their action. When attention

is not artificially directed toward habit performance, habits emerge as a form of non-goal-dependent automaticity involving relatively direct, rigid associations between context features and responses.

On a broader level, we hope that this discussion highlights the value of using naturalistic methods to study basic mechanisms of action control. Perhaps most important, naturalistic methods allow researchers to subject laboratory-generated models to the crucible of the real world and thereby identify patterns of convergence and divergence across the two domains. As we have tried to show here, naturalistic data also can play a role in arbitrating between competing models emerging from the laboratory and, in doing so, can refine our understanding of basic mechanisms and processes.

### **Notes**

1. We use the term *context cued* in a manner similar to Moors and De Houwer's (2006) notion of stimulus-driven responding. That is, a context-cued response relies on direct cognitive associations between stimuli, in the form of context cues (e.g., people, places, and preceding actions), and responses. This form of automaticity can be distinguished from automatic goal pursuit, which is mediated through implicit or nonconscious goals. We have speculated elsewhere that these direct, context-cued responses, although not goal mediated, may sometimes exhibit motivational properties in the form of diffuse reward value that is not oriented toward acquiring a specific outcome (Neal, Wood, & Quinn, 2006; Wood & Neal, 2007). In this chapter, we do not address the distinction between motivated and nonmotivated context-cued responses, but, in principle, the attributes of habitual control we discuss here should be equally applicable to both subtypes of context-cued responding.

2. We note there are additional processes that may plausibly result in intentions predicting habit performance in an epiphenomenal, or non-causal, manner. One candidate is post hoc inferences (see Bem, 1972). People might infer their intentions from their past behavior, reasoning that "I did it in the past, I must intend to do it in the future." Following Bem's (1972) self-perception theory, people are especially likely to follow this reasoning process and to use behavior to infer internal states when internal dispositions are weak, ambiguous, or uninterpretable. We speculate that habits are especially suited to such inferences because people have only limited access to the associative mechanisms guiding such action. Thus, there are several factors that can explain why intentions sometimes predict, but do not actually drive, habitual behavior (see also, Wood & Neal, 2007).

3. Of course, such self-report procedures come with their own limitations; in particular, participants need to be willing and able to report on the features of automaticity under investigation.

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