

Changing Circumstances, Disrupting Habits

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The present research investigated the mechanisms guiding habitual behavior, specifically, the stimulus cues that trigger habit performance. When usual contexts for performance change, habits cannot be cued by recurring stimuli, and performance should be disrupted. Thus, the exercising, newspaper reading, and TV watching habits of students transferring to a new university were found to survive the transfer only when aspects of the performance context did not change (e.g., participants continued to read the paper with others). In some cases, the disruption in habits also placed behavior under intentional control so that participants acted on their current intentions. Changes in circumstances also affected the favorability of intentions, but changes in intentions alone could not explain the disruption of habits. Furthermore, regardless of whether contexts changed, nonhabitual behavior was guided by intentions.

Keywords: habit, behavior change, behavior prediction, stimulus cues, intention

Daily life is characterized by repetition. People repeat actions as they fulfill everyday responsibilities at work and at home, interact with others, and entertain themselves. Many everyday activities not only are performed frequently but also are performed in *stable circumstances*—meaning in particular locations, at specific times, in particular moods, and with or without certain interaction partners. Attesting to the regularity of everyday action, Quinn and Wood's (2004) diary investigation with a community sample revealed that a full 47% of participants' daily activities were enacted almost daily and usually in the same location (see also Wood, Quinn, & Kashy, 2002). The consistency of everyday life establishes *habits*, or behavioral dispositions to repeat well-practiced actions given recurring circumstances.

Habits reflect the cognitive, neurological, and motivational changes that occur when behavior is repeated (Wood, Quinn, & Neal, 2005). With repetition, associations form in memory between the practiced action and typical performance times, locations, or other stable features of context. These associations guide habitual action so that it is triggered automatically by stable cues. As we explain, habit associations are represented in learning and memory systems separately from *intentions*, or decisions to achieve particular outcomes. Thus, walking into a dark room can trigger reaching for the light switch without any decision to do so. The separation of habitual and intentional guides to action is

consistent with the historically popular view that instrumental behaviors initially are acquired as goal-directed acts but with continued performance become less dependent on explicit goals (e.g., Allport, 1937; James, 1890). In short, repetition induces a shift in the motivational control of action from outcomes to triggering stimuli.

Behavior prediction research provides some of the most direct evidence that well-practiced actions are performed with little guidance from conscious intentions. In a standard prediction study, people report on their intentions to perform a behavior in the future and on the strength of their habits, and these measures are used to predict future performance. The typical finding is that strong habits are repeated relatively independently of intentions and personal norms. This pattern usually emerges in an interaction between habits and other predictors indicating that people tend to repeat well-practiced actions regardless of their intentions or normative beliefs (Albarracín, Kumkale, & Johnson, 2002; Ferguson & Bibby, 2002; Ji Song & Wood, 2005; Klöckner & Matthies, 2004; Klöckner, Matthies, & Hunecke, 2003; Ouellette & Wood, 1998; Verplanken, Aarts, van Knippenberg, & Moonen, 1998). In these various studies, the tendency for habits to continue regardless of intentions has emerged in a number of behavioral domains, in meta-analytic as well as primary research, and with habit strength assessed via a variety of measures (Verplanken & Aarts, 1999).

Despite the accumulating evidence that behavior repetition induces a motivational shift away from intentional control, only limited support is available for the complementary process in which repetition induces a shift toward stimulus control. The present research was designed to address this deficit and to examine the stimulus control of well-practiced action. Our strategy was first to identify the contextual cues that trigger everyday habits and then to test whether changing the cues disrupted performance. By demonstrating that habits are context dependent, we hope to augment existing attitude and intention models of action (e.g., Ajzen & Fishbein, 2000; Fazio, 1990; Sheeran, 2002; Sutton, 1998).

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Preparation of this article was supported by National Institute of Mental Health Award 1R01MH619000-01 to Wendy Wood. We thank Dolores Albarracín and Bas Verplanken for their thoughtful comments on an earlier version of this article.

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The present research tested the stimulus control of action among people who were undergoing a natural disruption in their lives—transfer students to a new university. Our study of ongoing behavior embedded in natural contexts is congenial with ecological analyses that relate the structure of everyday behaviors to the structure of the natural environments in which they occur (e.g., Barker & Associates, 1978). In the research, students first reported on their intentions, behaviors, and performance contexts for the following three domains: exercising, reading the newspaper, and watching TV. We obtained these measures 1 month before and 1 month after the transfer. We could then assess how habits changed or maintained with changes in the structure of the performance environment.

Repetition and Control of Action

With repetition of action, shifts occur in the cognitive and neurological mechanisms that guide action (Wood et al., 2005). As we explain, these cognitive and neurological changes provide the processing architecture for the motivational shift toward stimulus control of repeated action.

With respect to cognition, a number of models address what people learn from action repetition, how this knowledge is represented in memory, and how it influences future responding. At essence, most models contrast an efficient, low effort, slow-to-change process that guides what people do most of the time with a more fluid, attention-driven process that guides novel or difficult action. Within this two-process structure, repeated action is represented in some perspectives in terms of specific action patterns within cognitive schemas (Cooper, 2002; Cooper & Shallice, 2000; Norman & Shallice, 1986) and in others in terms of distributed connectionist networks (Botvinick & Plaut, 2004; Gupta & Cohen, 2002; McClelland, McNaughton, & Reilly, 1995). Basic to these various frameworks is the logic of associative learning, in which events that occur in temporal and physical contiguity come to be associated in memory. That is, repeated actions become linked with the times, places, and people that are typically present during performance. These contextual cues then acquire the ability to automatically prompt the associated response through (a) a schema activation mechanism in which environmental triggers stored in lower level schemas activate the response or (b) a pattern-completion mechanism in which past patterns are activated when components of the pattern are present. In these ways, the stimulus control of repeated action can be represented in memory.

With respect to neurological structures, it appears that particular brain systems are specialized for associative learning from repeated experiences. That is, the neocortex and related areas of the brain are oriented to the slow accrual of associative connections that typifies repetition of responses in stable contexts, whereas the hippocampus and other temporal medial lobe structures are specialized for the fast acquisition of arbitrary conjunctions of events that typifies decision making about action (McClelland et al., 1995; Packard & Knowlton, 2002; Squire, Stark, & Clark, 2004). In summary, repetition brings about changes in cognitive processing and in the brain systems involved in action control, and these changes underlie the motivational shift from decision making about action to stimulus control.

Stimulus Cues Trigger Repeated Behaviors

We are not aware of any direct evidence for the idea that repeated behaviors in daily life are cued immediately by recurring stimuli. However, considerable evidence exists for the related phenomenon in which stimulus cues prime associated goals and constructs, often outside of conscious awareness (Bargh & Chartrand, 1999). For example, mental representations of one's significant others (e.g., mother) can prime the goals that these others chronically have held for one in the past (e.g., achievement). In this way, others' presence can automatically trigger goal pursuit (Shah, 2003).

To what extent are goals activated in habit performance? There is every reason to believe that goal intentions and habits are related. Given that most habits initially were intended, thinking about everyday goals and life tasks is likely to activate practiced responses. In support, Aarts and Dijksterhuis (2000) reported that habitual bicyclers responded faster in a word recognition task to action-related words (e.g., bicycle) only when the relevant goals had been primed (e.g., go to class) and not in the absence of those goals.¹ Thus, goals can activate representation of previously repeated choices. However, there also is good reason to believe that stimulus cuing of habits differs from goal priming (Bargh, 2001; Wood et al., 2005). Repetition is not necessary for goals and constructs to become activated as primes in memory and to direct action, whereas repeated pairing of stimulus and response is a central component of habit development (Bargh, 2001). Furthermore, even when goals and constructs become automated through repeated use, the form of automaticity differs from habits (see Gupta & Cohen, 2002). That is, automatically activated goals typically can be met through a variety of means and not just a specific action pattern. In addition, unlike habits, nonconscious goal pursuit can operate over an extended time period, so that goals remain active or even intensify in strength until they are met. In these ways, goal activation can be separated from stimulus cuing of habits. The separation is consistent with the idea that habits are cued relatively directly by recurring stimuli.

Support for the idea that habits depend on recurring stimuli comes from work on habit change. Anecdotally, people sometimes report that changing well-practiced behavior (e.g., quitting smoking) is easiest while traveling or otherwise removed from everyday circumstances. The change in context presumably disrupts the automatic cuing of action and thereby frees it from stimulus control. Context change in the form of stimulus control also is a central component of behavior modification therapies (see Follett & Hayes, 2001; Naugle & O'Donohue, 1998). Empirical evidence for the power of stimulus cues in everyday action comes from Heatherton and Nichols's (1994) investigation of people's attempts to change some aspect of their lives. Approximately 36% of reports of successful change attempts involved moving to a new location, whereas only 13% of reports of unsuccessful attempts

¹ Aarts and Dijksterhuis (2000) also used the word recognition task to evaluate whether repetition increased the strength of associations in memory between a situation and a response. However, the situation cues in their study were not stimuli that trigger habitual responding (e.g., time of day, fellow cyclists) but instead were travel destinations (e.g., the university) that are a component of behavior goals (e.g., attend lectures). Thus, it is no surprise that the situation destination had minimal effect on recognition of habit-related words independently of the travel goal itself.

involved moving. Also, 13% of successful change reports involved altering the immediate performance environment, whereas none of the unsuccessful reports involved shifts in environmental cues. These effects of context on behavior change are consistent with the idea that performance of everyday actions is tied to the circumstances in which the actions typically occur.

Only some changes in circumstances should yield change in habitual behavior. Changes in features not central to performance should produce minimal disruption because they can be assimilated into existing patterns in memory (e.g., via connectionist pattern-completion processes). However, shifts in features consistently tied to performance in the past should interrupt fundamentally the activation of the learned response pattern. We anticipate that this removal of relatively automatic triggers for performance is a central mechanism underlying the effects of context change.

In addition to removing cues to performance, new circumstances also might bring about behavior change by activating new intentions and goals. Suggestive evidence that intentions change with contexts comes from research on goal priming. For example, the goals activated in a current situation (e.g., the need to be on time) have been found to override the effects of earlier primed goals (e.g., the desire to help others; Macrae & Johnston, 1998). Additional evidence comes from Bamberg, Ajzen, and Schmidt's (2003) behavior prediction research in which the introduction of a prepaid bus pass increased college students' favorability toward using the bus. Apparently, this shift in the context of bus use increased the favorability of students' attitudes, normative beliefs, and perceptions of efficacy. Consistent with our expectations, the changed context also disrupted students' bus riding habits, as represented in the frequency with which they rode the bus. However, because Bamberg et al. did not evaluate whether the disruption in behavior emerged separately from or as a result of intention change, it is not clear whether the changed intentions were responsible for changed habits.

In general, the changes in intentions that arise from changes in performance contexts may have limited impact on habit performance. As we noted at the beginning of this article, behavior prediction research has demonstrated that people continue to exhibit strong habits in daily life even when the habits conflict with intentions (e.g., Ji Song & Wood, 2005; Ouellette & Wood, 1998; Verplanken et al., 1998). This perpetuation of habits by contexts is a frustrating reality of many New Year's resolutions and other everyday decisions to change well-practiced behavior. In sum, we hypothesize that habit change is instigated by removal of cues to performance and that intentions may or may not change as part of this process.

The Present Research

In the present research, we examined the habits of college students as they underwent naturally occurring changes in performance contexts through a transfer to a new university. One month before the transfer and 1 month after, students reported on their habits, intentions, and aspects of the performance context with respect to three behavioral domains: exercising, reading the newspaper, and watching TV. These behaviors were selected because our college student participants were likely to vary in the strength of their habits within each domain. Furthermore, because the domains differ in a number of respects (e.g., intentions to exercise are generally more favorable than intentions to watch TV; see

Table 1), including several behaviors allowed us to evaluate the generality of the effects of context change.

We anticipated that, when the context for performance changed with the transfer, students' habits would be disrupted. Specifically, the change in context should reduce the likelihood of the practiced response being triggered automatically by associated contextual cues. To test this prediction, we constructed regression models predicting frequency of exercising, reading the paper, or watching TV at the new school from (a) habit strength at the old school, (b) the extent to which important features of the performance context changed with the transfer, and (c) the interaction between these predictors. The disruption of habits with changed contexts should emerge in a two-way interaction such that students should continue to perform habits only to the extent that circumstances do not change; in contrast, performance of nonhabitual actions should not necessarily be disrupted by context change.

With changes in context, behavior can no longer run off automatically in response to stimulus cues, and habits come under the control of alternative mechanisms. One possibility is that people will rely on their current intentions and goals to determine how to act. To evaluate this, we included behavioral intentions at the new university as a predictor in the regression models.² If the changed circumstances oriented participants with strong habits to act on their current intentions, then three-way interactions should emerge as follows: For participants with strong habits, the practiced behavior should continue to be performed when important features of the context did not change, whereas it should be disrupted and behavior guided by intentions when contexts did change. For participants with weak or no habits, behavior should be guided by intentions regardless of context.

Our expectation was that changes in important components of context would directly disrupt habit performance. However, it is also possible that context changes would disrupt habits because of their impact on intentions. For example, if students can no longer watch TV at a friend's house at the new university, the shift in location might decrease the favorability of their intentions to watch and thus disrupt their TV habits. If intention change is this kind of catalyst behind change in habits, then contexts that disrupt habit performance also should be the ones in which intentions change. We tested this idea through regression equations that predicted whether intentions changed across the transfer from (a) habit strength at the old university and (b) change in the performance context.

We evaluated several aspects of circumstances that might moderate habit performance. It is beyond the scope of the present work to develop a general model of the features of context that can serve as cues for habit performance (for reviews, see Barnett & Ceci, 2002; Belk, 1975; Bouton, Nelson, & Rosas, 1999; Proctor & Dutta, 1993). Instead, we limited our investigation to several global and several specific features of context. Given that the global measures of context plausibly encompass a variety of specific features, we anticipated that

² We used current intentions in these models rather than intentions at the old university because the transfer may have changed students' intentions. Furthermore, when behavior at the new university was predicted from habits at the old university and intentions at the new university, the time frames of the intention and behavior measures were compatible, and thus these analyses provided an especially strong test of the relative impact of habit strength (as opposed to intention) on action.

Table 1
Means and Standard Deviations

Variable	Exercise		Television		Newspaper	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Intention favorability						
At old university	7.89	1.59	6.39	2.11	5.34	2.24
At new university	7.72	1.66	5.59	2.14	6.39	2.11
Behavior frequency at new university						
4-point scale	1.96	0.94	2.39	0.81	2.03	1.01
9-point scale	5.51	2.23	6.33	2.45	5.40	2.68
Habit strength at old university, based on						
Stable location	5.12	3.08	7.41	2.14	3.40	3.05
Stable location and roommates' behavior	4.29	2.61	7.18	2.08	2.93	2.56
Stable location and presence of others	4.30	2.60	6.92	1.94	2.63	2.26
Perceived change in performance circumstances	2.64	1.08	2.24	1.14	2.80	1.12
Perform behavior in the same location						
At old university	2.41	1.05	2.69	0.61	1.73	1.31
At new university	2.47	0.92	2.74	0.62	2.02	0.99
Change in location	0.76	0.79	0.30	0.63	1.25	0.79
Roommates' behavior						
At old university	1.71	0.89	2.55	0.79	1.55	0.83
At new university	1.71	0.99	2.17	1.06	1.57	0.96
Change in roommates' behavior	2.29	0.71	2.29	1.01	2.23	0.79
Presence of others						
At old university	1.68	1.06	2.33	0.75	0.97	0.82
At new university	1.95	1.01	2.21	0.76	1.12	0.68
Change in presence of others	1.03	0.93	0.52	0.69	0.59	0.74

Note. Intention to perform behavior at the new university was measured on a 9-point scale, with higher numbers reflecting stronger intentions. On the behavior measures, higher numbers indicated greater frequency of performance. Habit was calculated on a 9-point scale, with higher numbers indicating greater strength. Perceived change in performance circumstances was calculated on a 4-point scale, with higher numbers reflecting greater change. Change in location was calculated on a 3-point scale, with higher numbers indicating that the behavior was more likely to be performed at different locations between universities. Change in roommates' behavior was calculated on a 3-point scale, with higher numbers indicating greater difference in behavior between universities. Change in presence of others was calculated on a 3-point scale, with higher numbers indicating greater difference between universities.

they would most successfully moderate habits across the three behaviors. Our global measures involved (a) student reports at the new university of how much the context for performing each behavior had changed with the transfer and (b) student reports at the old and the new universities on the general location in which each behavior was performed—which allowed us to compare reports and thereby assess directly context change. Our measures of specific features focused largely on the social context of performance. Specifically, at the old and new universities students reported on two features: whether they typically performed the action alone or with others and whether their roommates typically performed the action. We guessed that the social circumstances of performance might be more important for some actions than others, although we did not have predictions about which domains would be especially dependent on social cues.³

Method

Participants

One hundred fifteen students (57 men, 58 women) transferring to Texas A&M University in the Spring 2002 semester participated in order to receive \$30 payment. An additional 47 participants who completed the first but not second session were excluded from the analyses.⁴ For approximately 70% of the sample, the transfer involved moving to a new community, and for the remainder it involved moving between colleges within the same community.⁵

³ To identify the components of context to test in the present research, we initially included several additional measures, including the change participants perceived in their overall lifestyles with the transfer and the change in their activities immediately prior to performing the behavior. Demonstrating the sensitivity of behaviors to specific facets of context, these aspects of circumstances did not moderate habit performance. Further demonstrating this sensitivity, we initially collected information on breakfast habits, and we were unable to determine the exact features of context that cued eating breakfast. After talking with our participants, it was apparent that time of day was a common cue for this behavior, and we did not assess performance time in the present study. Thus, we recommend that future research assess a broad array of stimulus features that might possibly moderate habit performance.

⁴ We conducted additional analyses to compare the first-session responses of participants who did versus did not return for the follow-up session. No differences emerged between these groups, suggesting that students' failure to participate in the second session was not systematically related to responses assessed in the present research.

⁵ Because some participants transferred from a local junior college, they might have experienced only minimal shift in living contexts with the transfer. To evaluate whether this was a factor in our results, we conducted analyses comparing the responses of participants who moved to a new community with those who moved within the community. No significant differences emerged between these two groups. In addition, we conducted analyses including sex of participant and found no significant effects for participant sex.

Procedure

Participants were recruited from an orientation session for transfer students that occurred approximately 1 month prior to the beginning of the semester. A consent form explained that participants would provide details about their everyday thoughts, feelings, and actions. After completing the initial questionnaire (see below), students provided contact information for the second session. Four weeks after the beginning of the semester, participants showed up at the lab and individually completed a second set of questionnaires (see below). Upon completion of both sessions, participants were debriefed and paid.

Measures

In the first set of questionnaires, participants answered a number of questions about exercising, reading the newspaper, and watching TV at their old university, and predicted their reactions when they transferred to the new university.⁶ The second set of questionnaires, completed after the beginning of the semester, focused on their performance of these behaviors at the new university.

Intentions. At the first session, participants rated on a scale whether they intended to perform each behavior when moving to the new university. At the second session, they rated whether they intended to perform each behavior now that they were at the new university. Response options on both scales ranged from 1 (*strongly disagree*) to 9 (*strongly agree*).

To calculate the stability of intentions across the two assessment periods, we followed the procedure outlined by Conner, Sheeran, Norman, and Armitage (2000).⁷ In this analysis, each participant received a stability score for each behavioral domain represented by the aggregated value of (a) the absolute difference between intentions at the old and new schools, (b) whether the intention items exhibited change (0 = no, 1 = yes), and (c) the absolute difference adjusted for maximum possible change (i.e., maximum change equals 8 when initial intentions are 1 or 9 but equals 5 when initial intentions are 4 or 6). The reliabilities across these three methods of calculating stability were comparable to those reported by Conner et al. ($\alpha = .89, .88, \text{ and } .90$ for exercise, newspaper, and watching TV, respectively). Thus, we calculated the sum across the three measures as our indicator of intention stability.

Perceived context change across transfer. At the second session, participants reported on the similarity of the context in which they performed each behavior at the two universities. Response options ranged from 1 (*very similar*) to 4 (*very dissimilar*). Participants also could indicate that they did not perform the behavior.

Change in physical location across transfer. Participants indicated whether they typically performed each behavior in the same location with response options 1 (*rarely or never in the same location*), 2 (*sometimes in the same location*), and 3 (*usually in the same location*). If they indicated that they did not perform a behavior, they received a score of 0. Participants also noted in a free-response format the specific location in which they performed each behavior most often (e.g., home, friend's house). At the initial session, these ratings were given for the previous semester at the old university; at the second session, these ratings were given for the preceding month at the new university. A location change index was formed from these ratings so that a value of 0 indicated that participants sometimes or usually performed the behavior in the same specific location at the two universities, and a value of 2 indicated that participants usually performed the actions in different locations at the two universities. A value of 1 indicated moderate stability (i.e., they reported sometimes performing the behavior in the same location at each university and marked different locations).

Change in presence of others across transfer. At both sessions, participants reported whether they performed the behavior alone or with other people with response options 1 (*I was usually alone; I rarely performed the behavior with anyone else*), 2 (*I sometimes performed the behavior with other people*), and 3 (*I usually performed the behavior with other people*). If participants indicated that they never performed the behavior, they

received a score of 0. At the initial session, these ratings were given for the previous semester at the old university; at the second session, these ratings were given for the preceding month at the new university. A change index was calculated from the absolute value of the difference between these ratings so that higher numbers represented greater change in social context with the transfer.

Change in roommates' behavior across transfer. At both sessions, participants reported whether people they lived with performed the behavior, with response options 1 (*they rarely or never performed the behavior*), 2 (*they sometimes performed the behavior*), and 3 (*they usually performed the behavior*). Participants who indicated that they lived alone received a score of 0. At the initial session, these ratings were given for the previous semester at the old university; at the second session, these ratings were given for the preceding month at the new university. A change index was calculated from the absolute value of the difference between these ratings so that higher numbers represented greater change in roommates' behavior.

Habit strength at the old university. Habit measures were created for each behavior from participants' reports of the frequency of performance and stability of supporting circumstances at their old university. Specifically, at the first session, participants reported how often they performed each behavior during the last semester at their old university. Response options were 1 (*monthly or less often*), 2 (*at least once a week*), 3 (*just about everyday*), or 0 (*I never perform the behavior*).

As in prior research by Wood and colleagues (e.g., Ji Song & Wood, 2005; Wood et al., 2002), we estimated habit strength from the frequency of past behavior and the stability of the performance context at the old university. The important aspect of the performance context varied across analyses. Our hypothesis that changes in a contextual cue across the transfer would disrupt habits required that our estimates of context stability at the old university be tailored to the specific feature of context under investigation. For example, in the analysis to determine whether change in location disrupted habit, strong habits were defined as those performed often at the old university and in stable locations. In the analysis to determine whether habits were disrupted when participants perceived a change in context with the transfer, we used stability of location as the context cue given that change in location across the transfer was the aspect of context most closely related to perceptions of change (see Table 2). To lend some constancy to our definition of context stability at the old university for the remainder of the habit measures, we aggregated across the specific feature of context in the analysis (e.g., stability of roommates' behavior) and stability of location. In all analyses, the mean stability scores at the old university potentially ranged from 0 to 3.

To estimate habit strength, we multiplied each participant's score for past behavior frequency by his or her score for stability of circumstances. This yielded a relatively continuous habit scale that potentially could range from 0 to 9, with higher scores reflecting frequent performance in stable circumstances (i.e., strong habits) and lower scores reflecting either infrequent performance or variable circumstances (i.e., weak or no habits). Past research has sometimes used just frequency of performance as an indicator of habit strength (e.g., Triandis, 1977). In general, we anticipate that this is appropriate for actions that typically are performed in a particular context (e.g., brushing teeth in one's bathroom). To determine whether it was

⁶ In addition to the measures reported in the text, the first questionnaire also assessed participants' attitudes, subjective norms, and perceptions of control with respect to reading the newspaper, watching TV, and exercising. We did not have any specific hypotheses concerning these measures, and thus they are not discussed further.

⁷ The index developed by Conner et al. (2000) aggregated across four methods of calculating the temporal stability of intentions. Two of these were redundant when applied to our data, given that we had only one measure of intention at each point in time. Thus, our aggregated index of the temporal stability of intentions included only the three methods noted in the text.

Table 2
Bivariate Correlations Between Variables

Variable	Intention at old school	Intention at new school	Intention stability	Behavior at new school	Habit, stable location	Habit, stable roommate behavior	Habit, stable presence of others	Change in roommate behavior	Change in presence of others	Perceived change in context
Exercising										
Intention at new school	.13 [◇]									
Intention stability	.55**	.56**								
Behavior at new school	.11	.49**	.28**							
Habit, stable location	.38**	.35**	.27**	.31**						
Habit, stable roommate behavior	.32**	.32**	.18 [◇]	.22*	.92**					
Habit, stable presence of others	.34**	.30**	.23*	.23*	.93**	.88**				
Change in roommate behavior	-.06	.01	-.07	.06	-.08	-.10	-.12			
Change in presence of others	-.02	-.12	-.07	-.07	-.21*	-.15	-.25**	-.02		
Perceived change in context	-.18 [◇]	-.02	-.22*	-.11	-.12	-.14	-.12	-.02	-.10	
Change in location	-.16 [◇]	-.30**	-.20*	-.46**	-.61**	-.54**	-.56**	-.09	.33**	.24*
Watching TV										
Intention at new school	.47**									
Intention stability	.11	.31**								
Behavior at new school	.22*	.58**	.27**							
Habit, stable location	.22*	.08	.20*	.25**						
Habit, stable roommate behavior	.21*	.14	.18 [◇]	.32**	.82**					
Habit, stable presence of others	.21*	.10	.19*	.24*	.83**	.77**				
Change in roommate behavior	.05	.12	.07	.04	-.14	-.12	-.09			
Change in presence of others	-.13	.19*	.04	.06	-.19*	-.13	-.16	.19		
Perceived change in context	-.12	-.27**	-.23*	-.34**	-.13	-.18 [◇]	-.14	.06	.15	
Change in location	-.18 [◇]	.10	-.28**	-.20*	-.48**	-.35**	-.35**	.13	.34**	.26**
Reading the newspaper										
Intention at new school	.50**									
Intention stability	.38**	-.02								
Behavior at new school	.35**	.66**	-.21*							
Habit, stable location	.47**	.26**	.16 [◇]	.26**						
Habit, stable roommate behavior	.49**	.27**	.17 [◇]	.26**	.93**					
Habit, stable presence of others	.47**	.24**	.16 [◇]	.23*	.96**	.95**				
Change in roommate behavior	.19*	-.29**	-.15	-.16 [◇]	.15	.18 [◇]	.16 [◇]			
Change in presence of others	-.16 [◇]	.13	-.24**	.08	-.14	.07	.03	.16		
Perceived change in context	-.15	.17 [◇]	-.24*	-.21*	-.27**	-.24**	-.27**	.09	.16	
Change in location	-.27**	-.20*	-.14	-.14	-.58**	-.59**	-.60**	.12	.06	.32**

Note. The variables were scaled so that higher numbers reflect more favorable intentions, more frequent behavior, stronger habits, and greater change in circumstances.

[◇] $p < .10$. * $p < .05$. ** $p < .01$.

necessary to include stability of context in calculating habit strength in the present research, we reestimated all of the analyses reported in the results, substituting a measure of performance frequency for habit strength. Typically, simple frequency was not as effective as the habit measure based on frequency plus stability of circumstances. With simple frequency as the indicator of habit strength, our primary findings, in which changed contexts disrupted habit performance, emerged only with reading the paper and only with the presence of others as the context cue. Thus, our measure of habit was optimized by considering both frequency of performance and stability of context.

Frequency of behavior at the new university. At the second session, participants reported on two scales how often they performed each behavior at the new university. On a 4-point scale, response options were 0 (*I never perform the behavior*), 1 (*monthly or less often*), 2 (*at least once a week*), or 3 (*just about every day*). On a 9-point scale, response options were from 1 (*never*) to 9 (*every day*). The scales were standardized and, because they were highly correlated ($r_s = .70, .73$, and $.71$ for exercise, newspaper, and TV, respectively), were aggregated into a mean frequency score.

Results

Mean Ratings and Bivariate Correlations

As can be seen in Table 1, participants generally reported favorable intentions to exercise, read the newspaper, and watch TV. Some differences were evident across domains: Within each time period, intentions were generally more favorable to exercise than to read the paper or watch TV ($p_s < .01$). In addition, participants generally had established the strongest habits for watching TV, the next strongest for exercising, and the weakest habits for reading the newspaper ($p_s < .01$). Furthermore, when compared across the transfer, participants' intentions to read the newspaper generally became more favorable at the new university, presumably because of the availability of a popular student newspaper, $t(114) = 4.63, p < .01$. In contrast, their intentions to watch TV became less favorable, perhaps because of increased demands of schoolwork at the new school, $t(114) = 2.43, p < .05$. The mean

Table 3
Regression Analysis Predicting Exercising at New University
From Intention, Habit, and Change in Location

Variable	<i>B</i>	<i>SE</i>	β
Intention favorability	0.21	0.06	.37**
Habit strength	0.00	0.03	.01
Change in location	-0.52	0.12	-.45**
Intention \times Habit	-0.02	0.03	-.10
Intention \times Change in Location	0.06	0.09	.10
Habit \times Change in Location	-0.08	0.04	-.20*
Intention \times Habit \times Change in Location	0.02	0.03	.11

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Intention refers to students' intentions to exercise at the new university. Habit refers to students' exercising at the old university. Change in location refers to where students exercised at the old and new universities. $R^2(N = 114) = .32$.

* $p < .05$. ** $p < .01$.

favorability of participants' intentions to exercise did not change with the transfer.

Table 2 displays the bivariate correlations between the variables in the study. In general, positive associations were found between habits at the old school, intentions at the old school, and intentions at the new school. The one exception is the modest relation between intentions to exercise at both universities, which presumably reflected the transitory nature of people's commitment to adopt a healthy lifestyle. Furthermore, as would be expected, the various methods of evaluating habit were closely related. Also, stronger habits at the old school tended to be associated with smaller changes in context with the transfer. In addition, although students tended to perceive that the context had changed across the transfer when changes occurred in performance location, other aspects of transfer-induced context change were not consistently related across the three behavioral domains. Thus, it appears that these aspects of context did not shift in a coordinated fashion, suggesting that it is appropriate to treat each separately in the analyses reported below.

Effects of Context Changes on Behavior

To examine the disruption of habits, we constructed regression models to predict students' behavior at the new university from (a) the favorability of their intentions to perform the behavior at the new university, (b) the strength of habits at their old university, (c) the transfer-related change in an aspect of the supporting circumstances, and (d) the two-way and three-way interactions among these predictors. With four indicators of change in supporting circumstances and three behavioral domains, we calculated 12 regression models using ordinary least squares regression procedures (SPSS Version 11). We followed the suggestions of Cohen, Cohen, West, and Aiken (2003) and centered all predictors.⁸

Exercise habits. For exercise, two of the regression models yielded the predicted interaction between habit strength and context change. First, when context was represented by location, a two-way interaction emerged between strength of exercise habits and context change (see Table 3). To interpret the interaction, we calculated simple regression slopes between habit strength and behavior at varying levels of location change (Cohen et al., 2003).

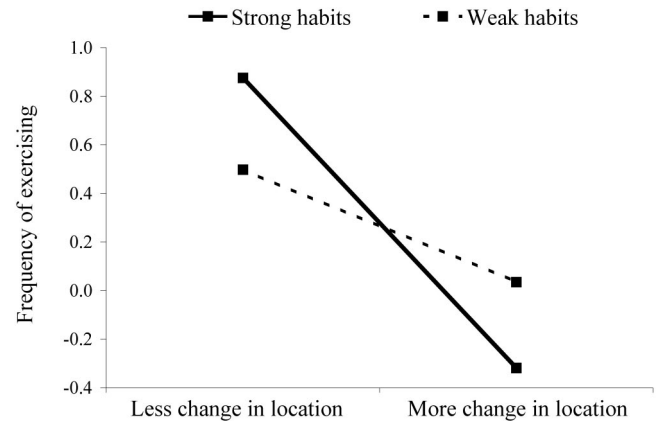


Figure 1. Decomposition of two-way interaction: Frequency of exercising as a function of strength of exercise habits at old university, intentions at the new university, and change in performance location.

To identify the levels of habit to use in the simple regressions, we estimated scores one standard deviation above the mean and one standard deviation below the mean. This allowed us to calculate the relation between behavior and shift in context separately for participants with stronger and with weaker or no habits. As depicted in Figure 1, location change had a greater effect on behavior when participants had strong habits than when they had weak or no habits. Thus, students maintained strong exercise habits across the transfer when they continued to exercise in the same location (e.g., home, gym) but not when they changed locations, whereas location change had minimal effect on students with weaker exercise habits.

The disruption of habits by context also was evident when context change was represented by perceptions of change across the transfer. In this case, a three-way interaction emerged among intention to exercise at the new university, strength of exercise habits, and perceived change (see Table 4). As we explain, this interaction essentially indicates that changes in contexts not only disrupted habits but also brought behavior under intentional control. To interpret this interaction, we calculated the simple regression slopes between intention and frequency of performance at varying levels of habit at the old university and at varying levels of context change (Cohen et al., 2003). To identify the levels of habit and context change to use in the simple regressions, we calculated scores on these variables that were one standard deviation above the mean and one standard deviation below the mean. Thus, the relation between behavior and intention was calculated for four separate combinations of habit strength and context (strong habits/greater perceived change, weak or no habits/greater perceived

⁸ In addition to the change score analyses reported in the text, we tested our hypotheses with two-stage hierarchical regression models in which we predicted students' behavior at the new university from a first stage of (a) their intentions to perform the behavior; (b) habit strength; (c) the stability of context cues at the old university; and (d) the two-way and three-way interactions among these predictors and a second stage of (e) the stability of context cues at the new university and (f) the two-way and three-way interactions among intentions, habit strength, and context stability at the new university. The results essentially supported those we report in the text.

Table 4
Regression Analysis Predicting Exercising at New University From Intention, Habit, and Perceived Change in Circumstances

Variable	B	SE	β
Intention favorability	0.23	0.05	.39**
Habit strength	0.04	0.03	.16 \diamond
Perceived change in circumstances	-0.21	0.09	-.27*
Intention \times Habit	-0.02	0.02	-.10
Intention \times Perceived change	0.16	0.07	.28*
Habit \times Perceived Change	-0.09	0.03	-.36**
Intention \times Habit \times Perceived Change	0.06	0.02	.33**

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Perceived change refers to participants' judgments of the context for exercising at the old versus new university. $R^2(N = 109) = .26$.

$\diamond p < .10$. * $p < .05$. ** $p < .01$.

change, strong habits/little perceived change, weak or no habits/little perceived change). The results of the simple slope decomposition are graphed in Figure 2. As predicted, the simple slope of the relation between exercise behavior and intentions was relatively flat for participants who had strong exercise habits at the old university and who perceived little change in context with the transfer ($B = -0.16$). These participants continued to follow their habits at the new university regardless of their intentions. For the other three combinations of habit strength and perceived change, intention was positively related to behavior. That is, for participants with (a) weak or no habits and (b) strong habits who perceived that the context changed with the transfer, intentions guided exercise so that those with more favorable intentions exercised more frequently ($B_s = 0.27, 0.30, 0.51$, for weak or no habit/little perceived change, weak or no habit/greater change, and strong habit/greater change, respectively).

TV watching habits. For watching TV, two of the regression models yielded the predicted interaction between habit strength and context change. When context change was represented by

Table 5
Regression Analysis Predicting Watching TV at New University From Intention, Habit, and Perceived Change in Circumstances

Variable	B	SE	β
Intention favorability	0.19	0.03	.46**
Habit strength	0.10	0.03	.24**
Perceived change in circumstances	-0.19	0.06	-.24**
Intention \times Habit	-0.04	0.01	-.22**
Intention \times Perceived Change	-0.01	0.03	-.02
Habit \times Perceived Change	-0.05	0.03	-.14 \diamond
Intention \times Habit \times Perceived Change	0.00	0.01	.02

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Intention refers to students' intentions to watch TV at the new university. Habit refers to students' TV watching at the old university. Perceived change refers to participants' judgments of the context for watching TV at the old versus new university. $R^2(N = 98) = .42$.

$\diamond p < .10$. ** $p < .01$.

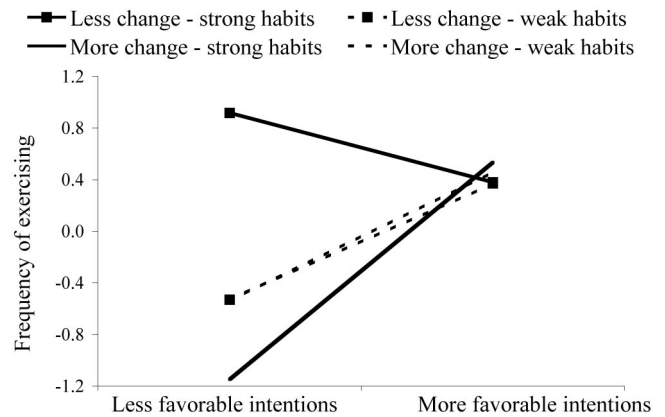


Figure 2. Decomposition of three-way interaction: Frequency of exercising as a function of strength of exercise habits at old university, intentions at the new university, and perceived change in performance circumstances.

perceived change in performance context, a marginally significant two-way interaction emerged between strength of TV watching habits and context (see Table 5). We interpreted the interaction as noted above with exercise, and the regression model and simple effects are displayed in Figure 3. As anticipated, perceived change had a greater effect on behavior when participants had strong habits than when they had weak or no habits. Thus, students maintained strong TV watching habits across the transfer when they perceived the performance context to be similar at the old and new universities but not when they perceived it to differ. In contrast, perceived change had minimal effect on students with weaker habits.

When context change was represented by location, a three-way interaction emerged among intention to watch TV at the new university, strength of TV watching habits, and change in location (see Table 6). As in the analyses on exercise, the interaction revealed that changes in contexts not only disrupted habits but also brought behavior under intentional control (see Figure 4). As predicted, the simple slope of the relation between intention and

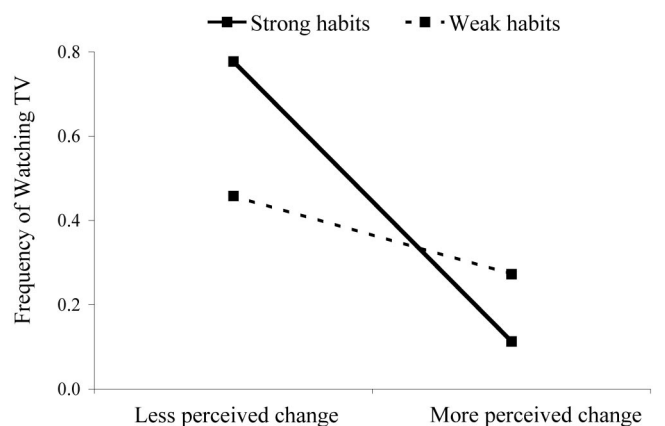


Figure 3. Decomposition of two-way interaction: Frequency of watching television as a function of strength of TV watching habits at old university, intentions at the new university, and perceived change in performance circumstances.

Table 6
Regression Analysis Predicting Watching TV at New University From Intention, Habit, and Change in Location

Variable	B	SE	β
Intention favorability	0.22	0.03	.52**
Habit strength	0.08	0.04	.19*
Change in location	-0.21	0.13	-.15
Intention \times Habit	-0.02	0.02	-.12
Intention \times Change in Location	-0.12	0.05	-.22*
Habit \times Change in Location	-0.00	0.04	-.02
Intention \times Habit \times Change in Location	-0.03	0.02	-.26*

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Change in location refers to where students watched TV at the old and new universities. $R^2(N = 114) = .32$.

* $p < .05$. ** $p < .01$.

behavior was smallest for participants with strong TV watching habits at the old university who reported watching TV in similar contexts across the transfer ($B = 0.05$). This relatively flat slope indicates that these participants continued to follow established habits and were not strongly influenced by their intentions. For the other three combinations of habit strength and location change, intention was positively related to behavior. That is, for participants with (a) weak or no TV watching habits and (b) strong habits who changed locations, intentions guided TV watching so that those with more favorable intentions watched more ($B_s = 0.24, 0.30$, and 0.30 for weak or no habit/same location, weak or no habit/changed location, and strong habit/changed location, respectively).

Newspaper reading habits. For reading the paper, three of the regression models yielded the predicted interaction between habit strength and context change. When context change was represented by perceived change and when it was represented by the presence of others, two-way interactions emerged between strength of newspaper reading habits and context. We interpreted the interactions as noted above, and the regression models and

Table 7
Regression Analysis Predicting Reading Newspaper at New University From Intention, Habit, and Perceived Change in Circumstances

Variable	B	SE	β
Intention favorability	0.23	0.04	.55**
Habit strength	0.02	0.02	.08
Perceived change in circumstances	-0.10	0.07	-.14
Intention \times Habit	-0.01	0.03	-.08
Intention \times Perceived Change	0.01	0.01	.08
Habit \times Perceived Change	-0.06	0.02	-.25**
Intention \times Habit \times Perceived Change	0.01	0.01	.11

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Intention refers to students' intentions to read the newspaper at the new university. Habit strength refers to students' newspaper reading at the old university. Perceived change refers to participants' judgments of the context for reading at the old versus new university. $R^2(N = 98) = .42$.

** $p < .01$.

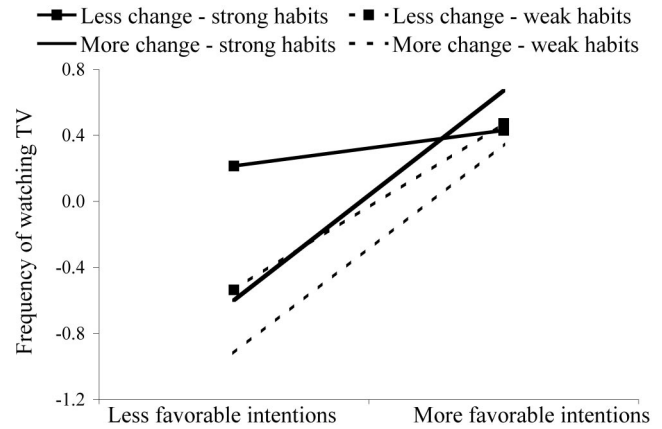


Figure 4. Decomposition of three-way interaction: Frequency of watching television as a function of strength of TV watching habits at old university, intentions at the new university, and change in performance location.

simple effects are displayed in Tables 7 and 8 and Figures 5 and 6. As anticipated, perceived change had a greater effect on behavior when participants had strong habits than when they had weak or no habits. Also as anticipated, change in the presence of others—so that others either were no longer present or joined the student when reading the paper—had a stronger effect on participants with strong habits than on participants with weak or no habits. Thus, students maintained strong newspaper reading habits across the transfer when the perceived context or the social context was similar at the old and new universities but not when it differed. In contrast, these aspects of context change had minimal effect on students with weaker habits.

When context change was presented by roommates' behavior at the old and new universities, a three-way interaction emerged among intention to read the paper at the new university, strength of newspaper reading habits, and change in roommates' reading behavior (see Table 9). As in the analyses on exercise, our interpretation of the interaction revealed that changes in contexts not only disrupted habits but also brought behavior under intentional control (see Figure 7). As predicted, the simple slope of the

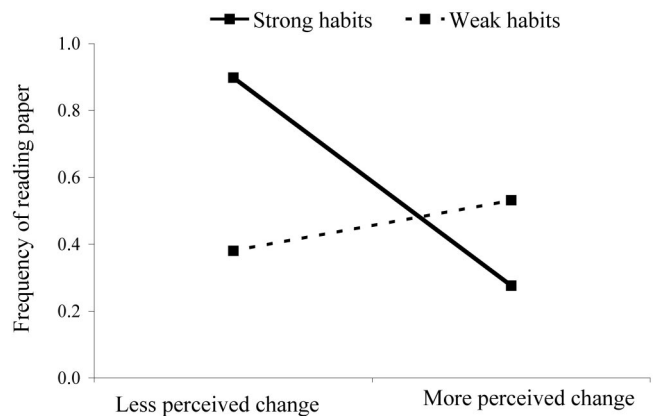


Figure 5. Decomposition of two-way interaction: Frequency of reading newspaper as a function of strength of reading habits at old university, intentions at the new university, and perceived change in performance circumstances.

Table 8
Regression Analysis Predicting Reading Newspaper at New University From Intention, Habit, and Change in Presence of Others

Variable	B	SE	β
Intention favorability	0.27	0.03	.60**
Habit strength	0.04	0.03	.10
Change in others' presence	-0.10	0.09	-.08
Intention \times Habit	-0.02	0.01	-.09
Intention \times Change in Others' Presence	0.06	0.05	.10
Habit \times Change in Others' Presence	-0.10	0.04	-.21**
Intention \times Habit \times Change in Others' Presence	0.04	0.02	.14

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Intention refers to students' intentions to read the newspaper at the new university. Habit refers to students' reading at the old university. Change refers to whether others typically were or were not present at the old versus new university. $R^2(N = 115) = .52$. ** $p < .01$.

relation between intention and newspaper reading was smallest for participants who had strong newspaper reading habits at the old university and who reported little change in their roommates' newspaper reading behavior—either they read it or they did not—across the transfer ($B = 0.06$). This relatively flat slope indicates that these participants continued to follow their habit to read the newspaper and were not strongly influenced by their intentions. For the other three combinations of habit strength and location change, intention was positively related to behavior. That is, for participants with (a) weak or no newspaper reading habits and (b) strong habits whose roommates' behavior changed so that they either began to read the paper or did so no longer, intentions guided reading so that those with more favorable intentions read more (B s = 0.31, 0.31, and 0.33 for weak or no habit/no change in roommates' behavior, weak or no habit/roommates' behavior changed, and strong habit/roommates' behavior changed, respectively).

Interpreting the two-way interactions between habit strength and context change. Analyses in each of the behavioral domains

Table 9
Regression Analysis Predicting Reading Newspaper at New University From Intention, Habit, and Change in Roommates' Newspaper Reading

Variable	B	SE	β
Intention favorability	0.25	0.03	.57**
Habit strength	0.03	0.03	.08
Change in roommates' behavior	-0.12	0.09	-.10
Intention \times Habit	-0.02	0.01	-.13 \diamond
Intention \times Change in Roommates' Behavior	0.08	0.04	.15 \diamond
Habit \times Change in Roommates' Behavior	-0.08	0.04	-.16 \diamond
Intention \times Habit \times Change in Roommates' Behavior	0.03	0.02	.16*

Note. The regression model was estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. Intention was assessed at the new university. Habit strength was assessed at the old university. Change refers to whether roommates continued their newspaper reading behavior across the transfer. $R^2(N = 115) = .50$. $\diamond p < .10$. * $p < .05$. ** $p < .01$.

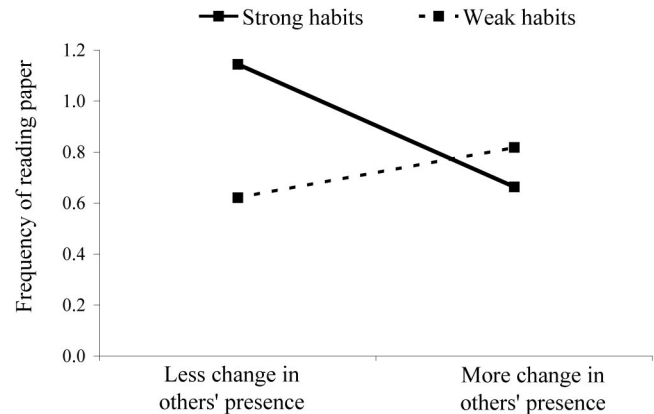


Figure 6. Decomposition of two-way interaction: Frequency of reading the newspaper as a function of strength of reading habits at old university, intentions at the new university, and change in presence of others.

yielded two-way interactions between habit and changed context. Across these interactions, it appears that changes in circumstances had no systematic effects on performance for participants with weak or no habits. For these participants, two of the context changes were associated with slight increases in performance frequency—represented in positive slopes (for reading the newspaper/perceived change, reading the newspaper/change in others' presence)—and two were associated with slight decreases—represented in negative slopes (for exercising/change in location, watching TV/perceived change). However, for participants with strong habits at their old school, greater changes in context were consistently associated with decreases in frequency of performance. This decrease reflects the reduced performance frequency that emerged with the disruption of habits. This pattern is understandable given that some participants with habits held favorable intentions and others held relatively unfavorable ones. When contexts changed and habits were disrupted, students with neutral or unfavorable intentions may have decided not to engage in the behavior. The aggregated effect across favorable, neutral, and unfavorable inten-

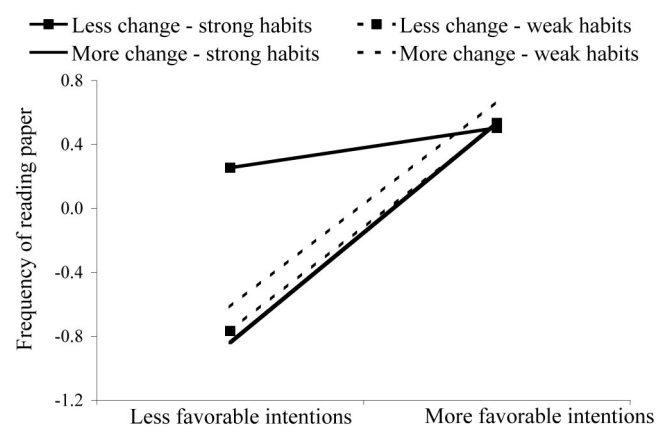


Figure 7. Decomposition of three-way interaction: Frequency of reading the newspaper as a function of strength of reading habits at old university, intentions at the new university, and change in roommates' reading behavior.

tions would be an overall decrease in frequency of performance for this group.

We conducted exploratory analyses to evaluate the plausibility of our account for the decrease in performance frequency with disruption of habits. That is, we calculated the simple regression slopes between intention and behavior at varying levels of habit at the old university and at varying levels of context change. Because the three-way interactions including intentions were not significant in any of the models for which we reported two-way interactions between habit strength and context change, we do not report the intention results in detail. However, the simple effects patterns are interesting because they all indicated that disrupting habits placed behavior under greater intentional control. Specifically, the simple slope of the relation between intention and behavior was relatively flat for participants with strong habits whose context did not change across the transfer. For the other three combinations of habit strength and context change, intention was somewhat more strongly related to behavior. That is, for participants who had weak or no habits and for participants who had strong habits and who experienced changes in context, intentions guided action so that more favorable intentions were associated with more frequent performance. Thus, this more extensive exploration of the results for the two-way interactions essentially mirrored the pattern obtained in the three-way interactions and suggested that changes in context not only disrupted habits but also (on a nonsignificant basis) tended to place behavior under intentional control. Thus, the reduced performance with disruption of habits plausibly reflects the power of neutral or unfavorable intentions.⁹

Explaining the Effects of Context Changes on Habit Performance

The above regression models support our prediction that changes in context disrupt habit performance and furthermore indicate that such changes sometimes bring behavior under intentional control. We have argued that the disruption in habit performance emerges relatively directly from the removal of automatic cues for well-practiced responses. Alternatively, the disruption in habits could emerge in alliance with various other psychological processes, and we were able to evaluate two such possibilities. As we explain below, we considered whether the changes in contexts yielded shifts in intentions between universities, and we also considered whether the context changes themselves reflected intentions or habits at the old university.

Effects of context changes on changes in intentions. In addition to disrupting the smooth repetition of past actions, changing contexts could provide new information about outcomes of behavior and thus lead people to change their intentions. That is, people might fail to act on their habits when contexts change because the new contexts invite a reevaluation of intentions, and people are acting on their new intentions. Suggesting the importance of intention stability, research on intention strength has found that intentions are a better predictor of action when they remain stable than when they change (Conner et al., 2000; Sheeran & Abraham, 2003).

Two aspects of our findings discussed so far indicate that participants did in fact change their intentions with the transfer. In part, this change is evident in the mean values of intention reported in Table 1. As we noted already in our discussion of these findings, participants' intentions to read the newspaper shifted with the

transfer to become more favorable and their intentions to watch TV became less favorable, whereas their mean level intentions to exercise did not shift appreciably. Additional evidence of change emerged in the bivariate correlations reported in Table 2. That is, participants' intentions to exercise were only weakly correlated between the two universities—suggesting that individuals shifted exercise intentions, but not in any uniform direction that would appear as a shift in mean values. In contrast, in the correlational analyses, intentions to read the paper and to watch TV revealed stronger temporal stability across the transfer. Thus, intentions changed with the transfer, although in somewhat different ways across behavioral domains.

For intention change to be responsible for the shifts in habit performance that we reported in the regression models above, intention change would need to be related systematically to context change and habit strength. To evaluate this possibility, we calculated regression equations predicting stability in intentions across the transfer from (a) habits at the old university, (b) the extent to which the circumstances changed between the old and new university, and (c) the interaction between habits at the old university and changes in circumstances. Because we are interested in these analyses primarily as an alternative explanation for the effects on context change on habit performance, we report the intention stability results only for those aspects of context that disrupted habits.

The results of the analyses on intention stability can be seen in Table 10. The most consistent finding across the analyses is a main effect for context change, which indicates that intentions shifted with the changes in context. It also is interesting to note that for exercising but not for reading the newspaper or watching TV, habits were consistently related to temporal stability of intentions. That is, participants with stronger exercise habits at their old university were less likely to experience changes in intentions between universities.

The important finding from our perspective is the lack of interactions between habit and perceived change in circumstances. If intention change mediated the shifts in behavior with the transfer, then change in intentions should parallel the habit change results. That is, greater change in intentions should be evident when contexts shifted for strong habits than when they shifted for weak habits. Specifically, students with strong habits who experienced context changes would have had to change their intentions more than (a) students with weak or no habits or (b) students with strong

⁹ We also evaluated whether the decrease in performance with changed contexts was due to participants with strong habits entering contexts that inhibited performance. Given that we obtained specific ratings of different types of contexts associated with the social cues to performance (i.e., presence of others, roommates' behavior), we focused these analyses on social contexts. We constructed regression models predicting performance of each behavior at the new university from each social context at the new university, habit strength, and the interaction between these. No interactions emerged between context and habit strength, suggesting that decreases in performance at the new university were not due to participants with strong habits selecting into specific contexts that inhibited performance. It is especially important to note that these interactions were not obtained for reading the paper, despite that changes in social contexts moderated performance of newspaper reading habits. Instead, main effects were obtained for contexts at the new university, indicating that participants were in general more likely to read the paper when they did so with others present and when their roommates read the paper.

Table 10
Regression Analyses Predicting Temporal Stability of Intentions From Habit Strength at the Old University and Change in Performance Context From the Old to New University

Predictor	B	SE	β
Exercising			
Predicting intention stability, $R^2(N = 109) = .09$			
Habit strength	0.06	0.03	.20*
Perceived change in circumstances	-0.16	0.08	-.20*
Habit \times Perceived Change	0.01	0.02	.03
Predicting intention stability, $R^2(N = 114) = .07$			
Habit strength	0.07	0.04	.23*
Change in location	-0.07	0.14	-.06
Habit \times Change in Location	-0.05	0.04	-.01
Watching TV			
Predicting intention stability, $R^2(N = 115) = .08$			
Habit strength	0.08	0.04	.19 \diamond
Perceived change in circumstances	-0.17	0.07	-.21*
Habit \times Perceived Change	-0.02	0.03	-.06
Predicting intention stability, $R^2(N = 115) = .09$			
Habit strength	0.02	0.05	.04
Change in location	-0.03	0.16	-.21 \diamond
Habit \times Change in Location	0.04	0.05	.10
Reading the newspaper			
Predicting intention stability, $R^2(N = 98) = .08$			
Habit strength	0.03	0.03	.11
Perceived change in circumstances	-0.18	0.09	-.22*
Habit \times Perceived Change	0.02	0.03	.06
Predicting intention stability, $R^2(N = 115) = .07$			
Habit strength	0.07	0.03	.20*
Change in roommates' behavior	-0.22	0.10	-.19*
Habit \times Change in Roommates' Behavior	0.04	0.04	.08
Predicting intention stability, $R^2(N = 115) = .09$			
Habit strength	0.05	0.04	.13
Change in others' presence	-0.30	0.11	-.25**
Habit \times Change in Others' Presence	0.05	0.05	.09

Note. Regression models were estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered. $\diamond p < .10$. * $p < .05$. ** $p < .01$.

habits who experienced little change in context. This proved not to be the case.

In sum, it appears that the changes in context were associated with changes in intentions. However, the pattern of these shifts was relatively constant across strong and weak habits, indicating that intention by itself cannot explain the disruption of habits. Instead, the analyses on intention change suggest that, when critical aspects of supporting contexts change, intentions sometimes shift in alliance with habits.

Effects of intentions and other dispositions on change of circumstances. We were able to address yet another account of the psychological mechanisms underlying our finding that habits are

disrupted by changes in context. That is, this pattern could be due to students' selection of performance settings with the transfer. In this explanation, the disruption of habits occurred because of participants' desire to maintain or change their habits and their selection of contexts accordingly. For example, participants with strong TV watching habits who wanted to discontinue this behavior might have decided to spend their time in places without TV at the new university. In this account, changed contexts did not directly disrupt habits, but instead the wish to change habits was responsible for both the changed context and the changed behavior.

To evaluate the effects of a desire to change habits, we calculated regression equations in which shifts in context were predicted from students' intentions at the old university, their habits, and the interaction between intentions and habits. If the desire to change was the catalyst behind disruption of habits, then the greatest change in contexts would necessarily emerge when participants had the greatest wish to change their habits—when they possessed strong habits and unfavorable intentions. This pattern would emerge in an interaction between intentions and habits in predicting change in context. However, as can be seen in Table 11, the only interaction that approached significance emerged in the analysis on exercising with change in location as a predictor. The lack of consistent interactions challenges the idea that students who had established habits but wished to change their behavior did so in part by selecting contexts that would disrupt habit performance.

It is interesting to note that three of the regressions on context change indicated that stronger habits at the old university were associated with less change in contexts across the transfer. For exercising, people with stronger habits at their old university were more likely to exercise in similar locations. For watching TV, people with stronger habits were more likely to watch TV in the same location. For reading the newspaper, people with stronger habits at their old university were more likely to perceive the context had remained stable. These relations plausibly reflect participants' conscious or nonconscious selection into contexts at the new university that would allow them to maintain their past habits. However, because the pattern of context change did not parallel the pattern of habit disruption, it does not appear that decisions to change or maintain performance contexts could explain habit disruption in the present research.

Discussion

The present study demonstrated the dependence of everyday habits on supporting stimulus cues. Changes in the contexts in which students typically exercised, watched TV, and read the newspaper disrupted the performance of these habits. We had reasoned that, when repeated in stable circumstances, behavior comes to be linked in memory with recurring aspects of the performance context. Changes in important aspects of the context then decrease the likelihood of automatically activating the practiced behavioral response. According to connectionist networks, the changes interrupt reconstruction of learned patterns of activation in memory (e.g., Botvinick & Plaut, 2004), whereas in schema models the changes remove environmental trigger conditions for the guiding behavioral schema (e.g., Cooper & Shallice, 2000). Furthermore, for participants in our study, the absence of relatively automatic guides to action in some cases prompted them to make

Table 11
*Regression Analyses Predicting Changes in Performance
 Context From the Old to New University From Habits and
 Intentions at the Old University*

Predictor	<i>B</i>	<i>SE</i>	β
Exercising			
Predicting perceived change in circumstances, $R^2(N = 109) = .04$			
Habit strength	-0.02	0.04	-.07
Intention at old university	-0.12	0.07	-.18 \diamond
Habit \times Intention	-0.02	0.02	-.09
Predicting change in location, $R^2(N = 114) = .04$			
Habit strength	-0.17	0.02	-.65**
Intention at old university	0.07	0.04	.14 \diamond
Habit \times Intention	0.03	0.01	.16*
Watching TV			
Predicting perceived change in circumstances, $R^2(N = 115) = .03$			
Habit strength	0.05	0.05	.10
Intention at old university	0.05	0.05	.10
Habit \times Intention	-0.01	0.03	-.02
Predicting change in location, $R^2(N = 115) = .02$			
Habit strength	-0.13	0.03	-.45**
Intention at old university	-0.03	0.03	-.08
Habit \times Intention	0.01	0.01	.05
Reading the newspaper			
Predicting perceived change in circumstances, $R^2(N = 98) = .08$			
Habit strength	-0.09	0.04	-.24*
Intention at old university	-0.03	0.06	-.06
Habit \times Intention	-0.01	0.02	-.05
Predicting change in roommates' behavior, $R^2(N = 115) = .04$			
Habit strength	0.04	0.03	.11
Intention at old university	0.04	0.04	.13
Habit \times Intention	-0.03	0.01	-.02
Predicting change in the presence of others, $R^2(N = 115) = .03$			
Habit strength	0.02	0.03	.06
Intention at old university	-0.06	0.04	-.19 \diamond
Habit \times Intention	-0.00	0.01	-.01

Note. The regression models were estimated with all predictors entered simultaneously. Following Cohen et al. (2003), all predictors were centered.

\diamond $p < .10$. * $p < .05$. ** $p < .01$.

decisions about behavior, so that they formed or retrieved intentions and guided their actions accordingly.

The two aspects of context that most consistently modified habit performance across behavioral domains were students' perceived changes in performance circumstances and our estimates of location change calculated from students' reports at each school of their usual performance location (if any). Although these measures assessed context change in different ways, both revealed that context change disrupted habits. The success of these relatively global assessments of context is understandable given that each plausibly reflects a variety of specific factors for each of the behaviors we studied. For example, participants might have perceived changes in the circumstances in which they read the newspaper when they picked it up from a newsstand instead of having it delivered, whereas they might have perceived changes in the circumstances in which they exercised when they went running on

a track at noon instead of running out-of-doors in the morning. Thus, the global measures of context were especially successful presumably because they were sufficiently broad to encompass the specific, idiosyncratic features of circumstances that triggered habits in each domain.

Social cues of others' presence and behavior proved to be important aspects of the performance context for one behavior, reading the newspaper. Newspaper reading habits could be disrupted by changes in the presence of others or by changes in roommates' newspaper reading. These effects indicate that, for many of the students in our study, reading the paper was a solitary activity they performed alone or was a social activity that depended on others. We wondered whether the findings for presence of others reflected a specific direction of change, so that, for example, the disruption in habit performance occurred primarily when the social context changed so that participants no longer read with others. However, follow-up analyses to test the direction of change revealed that any changes at all in others' presence disrupted habit performance. Thus, reading habits were interrupted both when others joined in the activity at the new university and when others no longer took part. We conducted similar follow-up tests to evaluate possible effects of the direction of change in roommates' newspaper reading. We tested whether the disruption occurred primarily when roommates quit reading the paper at the new university rather than when they initiated reading. Again, the analyses revealed that any changes in roommates' reading behavior disrupted habit performance. The vulnerability of habits to interference from others is consistent with Quinn and Wood's (2004) finding that people who lived with others reported a lower proportion of daily habits than people who lived alone. The present findings suggest that close others not only disrupt habits but also provide stimulus cues that trigger habit performance. In short, habits can be socially shared.

The aspects of circumstances that we investigated concerned primarily external cues for performance. Mood and other internal states along with time of day also have the potential to be important cues for performance (Ji Song & Wood, 2005). We anticipate that when these states or time of day become chronically associated with a particular action, they can come to trigger that action, much like external circumstances of location and presence of others. However, retrospective self-reports might not be ideal to assess subtle cues such as mood, and these might better be captured with diary methods and other ongoing assessments of the psychological states that precede action.

It is important to note that the present research used a quasi-experimental design in which the changes in context emerged naturally as part of the experience of transferring to a new university. Because the transfer yielded changes in some features of performance contexts but not others, we could examine the effects of a number of aspects of context. That is, it was not the case that some participants experienced cataclysmic changes with the transfer that were apparent on most of the dimensions of context that we examined whereas others experienced only minor adjustments. However, the design did not represent a true experiment, and it was necessary to rule out alternative accounts of the results, especially the possibility that participants self-selected into study conditions. In this regard, we were able to demonstrate that participants who wished to change their habits (i.e., those with strong habits yet unfavorable intentions) were not especially likely to select new performance contexts with the transfer. Thus, we could

rule out the possibility that a desire to change habits was responsible for the disruption of habits with context change. However, given the essentially correlational nature of our design, future investigations might well use an experimental approach to establish more definitively the causal connection between change in cues and disruption of habits.

The Interplay Between Habits and Intentions

A striking aspect of the present findings is the reciprocal relation that sometimes emerged between habits and intentions in guiding action. With reduced habitual control, behavior came under intentional control. This relation was apparent in the three-way interactions that involved perceived change in circumstances for exercising, change in roommates' behavior for reading the newspaper, and change in location for watching TV (see Figures 2, 4, and 7). A weaker, nonsignificant version of this pattern also was apparent when we explored the simple three-way slopes in the analyses that yielded only two-way interactions between habits and context change. Thus, a relatively consistent—although not always significant—tendency emerged across all of the analyses for context change to disrupt habits and also to prompt action congruent with intentions.

We speculate that habits and intentions often have a compensatory relation in guiding action, and this pattern did not emerge in all analyses because students' actions were still in flux from the shift in contextual cues. When changes in circumstances disrupted habits but did not implicate intentions, behavior presumably was guided by transitory influences such as mood states and the actions of others. Students were not repeating past habits but also were not systematically carrying out their intentions. It might be that with greater experience in the new context, students' actions would come to be guided more systematically by new contextual cues or by intentions.

The reciprocal relation between habits and intentions that we identified in the present research was first noted by Triandis (1977). He argued that “when a behavior is new, untried, and unlearned, the behavioral-intention component will be solely responsible for the behavior” (p. 205). However, “as behavior repeatedly takes place, habit increases and becomes a better predictor of behavior than behavioral intentions” (Triandis, 1977, p. 205). In short, actions that were initially goal-directed become triggered by associated stimuli when they are repeated into habits. Our findings suggest further that when habits are undermined by changes in context, behavior largely reverts to intentional control.

The relatively separate influence of intentions and habits on action was evident in the differential effects of change in performance circumstances on habits and intentions. The regression models predicting intention stability suggested that changed circumstances disrupted habits directly, separately from their effects on intentions. That is, participants tended to change their intentions when the context varied across the transfer, but the pattern of intention change did not parallel habit change. Thus, change in intentions does not appear to be the catalyst for the disruption of habits when contexts changed.

Even though habits and intentions functioned as alternative predictors of action, they proved to be moderately correlated with each other both before and after the transfer. This positive association makes sense given our assumption that habits often emerge from intended responses, as people initially repeat actions that they

believe will yield desired outcomes. The positive association also could reflect an inference process. People who are uncertain about their intentions might infer them from their past behavior, reasoning via a self-perception-like process (Bem, 1972) that, “I did it in the past, I will probably do it in the future.” In general, then, the bivariate correlations suggest that habits typically correspond in a general way to people's intentions and life goals or to their inferences of these goals.

The moderate correlations between habits and intentions also suggest that people are not especially sensitive to small deviations between well-practiced behavior and goals in daily life. In fact, it may be functional to overlook small deviations between behaviors and goals, given the apparent limits on everyday self-regulatory capacity needed to bring actions in line with intentions (Baumeister, Muraven, & Tice, 2000). Thus, students with a habit to read the paper or to exercise at their old university might continue to perform these actions as part of their daily routine even if they had only moderately favorable intentions to do so. When everyday habits deviate more markedly from important goals, people will likely experience dissatisfaction with their behavioral outcomes and attempt to exert regulatory control by overriding habits with more goal-congruent action (Baumeister & Heatherton, 1996).

Implications for Habit Change

The present findings highlight stimulus control as a powerful method of self-regulation. We speculate that stimulus change was successful in the present study in part because it interrupted the unwanted response sequence from being initiated. In addition, when stimuli changed, our students did not need to engage in vigilant monitoring for automatically cued relapses to the unwanted but well-practiced behavior. The context shifts in the present research occurred as part of a larger lifestyle change of transferring to a new school, and they may differ from strategic decisions to change aspects of everyday contexts in order to change action.

Some evidence concerning the success of strategically shifting contexts to bring about behavior change can be found in the extensive body of research on the transtheoretical model of behavior change (Prochaska, DiClemente, & Norcross, 1992). In this paradigm, modifying behavior (e.g., quitting smoking, beginning exercise) involves several stages ranging from precontemplation to contemplation to preparation to action and to maintenance. Movement through these stages is facilitated by a number of psychosocial processes, including two that are related to changing circumstances. In particular, *stimulus control* involves altering the environment to provide positive cues for the desired behavior (and presumably removing cues for undesired behaviors), and *reinforcement management* involves changing the contingencies that control the problem behavior. It is interesting that meta-analytic syntheses of health promotion research have not suggested that these processes are especially advantaged in moving people between stages (Marshall & Biddle, 2001; Rosen, 2000). However, these reviews did not differentiate between strategies to alter established habits (e.g., to stop smoking) and strategies to initiate a new behavior (e.g., to begin a medical regimen). We anticipate that habits are uniquely vulnerable to change through stimulus control and other strategies (e.g., response substitution) that disrupt learned associations between cues and responses. In contrast, adopting a new behavior is likely to be accomplished effectively

through other strategies, such as making a commitment to change or accepting support from others. In general, we anticipate that behavior change strategies will be most successful when they are tailored to the mechanisms guiding action (see Rothman, Baldwin, & Hertel, 2004).

Conclusion

In sum, the present research provides insight into the unique mechanisms that regulate habit performance. When people practice action, they develop associations in memory between the action and aspects of the context in which it typically occurs. With sufficient repetition in stable contexts, behavior comes to be triggered relatively automatically by these features of the performance context. The present research capitalized on a naturally occurring event, transferring to a new university, to demonstrate the impact of stimulus cues on habits. Specifically, when the transfer involved a change in the circumstances in which students typically exercised, watched TV, or read the newspaper, habit performance was disrupted, and behavior tended to come under intentional control. In addition, in a seemingly separate process, changes in context sometimes influenced the favorability of intentions. Thus, changes in context separately influenced intentions and derailed habits.

The importance of supporting circumstances for habit performance is consistent with the claim that habits reflect more than just the frequency with which a behavior has been performed in the past (e.g., Ajzen, 2002; Verplanken & Rudi, 2004). This insight builds on Shiffrin and Schneider's (1977) classic finding that automaticity of performance is facilitated when actions are repeated often in stable contexts (i.e., the "consistent mapping" condition in their experiment) rather than unstable ones (i.e., the "varied mapping" condition). However, in everyday life, behaviors and contexts may be linked so that actions that are performed frequently also may be performed in certain contexts (e.g., weightlifting in a gym). To the extent that behaviors and contexts are linked, simple frequency measures may be sufficient to assess habit strength.

In general, the present research suggests that change interventions need to be tailored to the mechanisms guiding action. Actions that are triggered by stimulus cues are vulnerable to changes in those cues, whereas actions that are oriented to attain certain outcomes and avoid others are vulnerable to changes in the beliefs about those outcomes or about performance efficacy. Thus, effective habit change interventions are likely to involve stimulus control, such as limiting exposure to stimulus cues, and response substitution, such as linking a competing response with the cues. Effective interventions to change more intentional action are likely to provide new information that decreases the value of behavioral outcomes and the likelihood they will occur or decreases the apparent control over performance. The present research provides partial support for this strategy of matching intervention to action by demonstrating the effectiveness of context change with everyday actions.

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Received March 2, 2004

Revision received February 18, 2005

Accepted February 18, 2005 ■

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