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British Journal of Psychology (2021)

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# What we repeatedly do: Evaluating the determinants and consequences of habit enactment during daily goal-pursuit

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Many theorists have stressed the benefits of goal-conducive habits. However, past research has not yet demonstrated that habits benefit goal-pursuit in daily life independently of more effortful forms of goal-pursuit. Additionally, it is unclear if habits are triggered independently of conscious self-regulatory processes. To address these issues, we conducted three intensive experience sampling studies. We found that habitual behaviours facilitated goal-progress independently of effortful goal-directed behaviours. Additionally, we evaluated three sets of predictions regarding the relationship between habits and other effortful self-regulatory processes. The *goal-independent* account suggests that habits function independently of planning and testing processes. The *goal-dependent* account suggests that habits are influenced by these processes, and the *hybrid* account suggests that these processes indirectly influence habits through their association with contextual cue exposure. The results were consistent with the hybrid account, in that planning and testing were associated with habit enactment, but this association was mediated by contextual cue exposure. Collectively, our results suggest that one must consider both conscious self-regulatory processes and automatic cue-response associations to understand how the benefits of goal-conducive habits are realized in daily life.

From a student aspiring to succeed in school to an academic toiling away at a grant proposal, many of our goals cannot be achieved in a single bound. Instead, it can take months and even years to achieve our goals. For this reason, theorists from a broad range of psychological disciplines are interested in habits because they are thought to support persistent goal-striving (Wood, 2017). In this way, basic theorizing from social psychology (Wood, 2017), cognitive psychology (De Houwer, Tanaka, Moors, & Tibboel, 2018), and animal behaviour research (Dickinson, 1985) has implications for applied fields such as educational (Fiorella, 2020) and health psychology (Galla & Duckworth, 2015; Gardner, 2015). Habits are action tendencies that can be performed with little awareness or deliberation in response to a set of associated conditions or contextual cues (Hagger, 2019).

Yet, despite growing interest, two issues remain. First, few empirical studies have *directly* examined if habits support goal-pursuit in daily life and if they do so above and beyond more effortful forms of goal-pursuit. Second, it is unclear if habits interact with other self-regulatory processes that direct other effortful behaviours. Drawing largely off

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DOI:10.1111/bjop.12524

animal behaviour research (Dickinson, 1985) and neurocomputational models (Wood, 2017; Wood & Rünger, 2016), some theorists suggest that habitual behaviours are enacted independently of goals and effortful self-regulatory processes (Wood & Rünger, 2016). Yet, other theorists suggest that habitual behaviours might be goal-dependent and rely on effortful self-regulatory processes (Aarts & Dijksterhuis, 2000; De Houwer et al., 2018; Marien, Custers, & Aarts, 2018).

To address these issues, we conducted three intensive experience sampling studies. In these studies, we assessed the performance of habitual behaviours as people pursued goals in daily life. This allowed us to assess the contribution of habitual behaviours to goal-progress as people pursued academic, health, career, and social goals while evaluating three separate sets of predictions regarding the relationship between habits and other self-regulatory processes.

### Understanding habits within a dual processing framework

Studies that track behaviour in daily life consistently find that past behaviour frequency predicts the probability of repeating the same behaviour in the future (Quellette & Wood, 1998; Wood, Quinn, & Kashy, 2002). Some theorists explain this *residual behaviour* effect via habit formation (Triandis, 1977; Wood & Rünger, 2016). Accordingly, behaviours performed in the same context eventually become associated with contextual cues (e.g., studying after class). Upon forming this association, mere exposure to the cue (e.g., finishing class) provides sufficient cause for the associated behaviour (e.g., studying).

However, others have challenged this interpretation arguing that 'No matter how often we may have climbed the same mountain, it is difficult to believe that this behaviour has become routine in the sense of constituting an automatic response sequence' (Ajzen, 2002; p. 109). In other words, even though we might perform many behaviours in the same context, it is not clear if these behaviours ever become automatic cue-dependent behaviours. To establish this, Ajzen (2002) argued that theorists needed an independent assessment of habit that measured habits in a way that was 'psychologically meaningful'. Accordingly, if habitual behaviours are performed automatically and independently of conscious intentions (Quellette & Wood, 1998; Triandis, 1977), then it is necessary to establish that frequently repeated behaviours acquire some degree of automaticity (Ajzen, 2002; Verplanken, 2006).

Relying on dual processing theory, Verplanken and Orbell (2003) addressed this by developing an independent assessment of habit. Broadly, dual processing theory distinguishes between two modes of cognition. One is *automatic*, rigid, efficient, and effortless. The other is *controlled*, flexible, and effortful (Fiske & Taylor, 2017). Using this distinction, Verplanken and Orbell developed the Self-Report Habit Index (*SRHI*), which measures the perceived automaticity of a behaviour (Gardner, Abraham, Lally, & de Bruijn, 2012).

Since then, researchers have used the SRHI to determine if the residual behaviour effect can be explained in terms of habit formation. For example, Lally, Van Jaarsveld, Potts, and Wardle (2010) found that repeating once novel behaviours led to an increase in perceived behavioural automaticity over time (see also Lally, Wardle, & Gardner, 2011). Critically, this provides support for the claim that the residual behaviour effect reflects habit formation (Wood & Rünger, 2016).

### *Do habits really help us achieve our goals?*

Wood and Neal (2007) suggest that habits likely develop as we repeat goal-supportive behaviours in a consistent context (e.g., following an exercising routine; Tappe, Tarves, Oltarzewski, & Frum, 2013). As a result, these behaviours likely become associated with contextual cues and become habitual in the sense that they become less effortful and can be performed somewhat automatically (Lally et al., 2010).

Critically, prior studies suggest that habitual behaviours likely support goal-attainment. For example, habits have been shown to facilitate weight loss and academic success (Galla & Duckworth, 2015; Rebar et al., 2016). However, these studies did not assess or control for the influence of the other soon-to-be-discussed self-regulatory processes depicted in Figure 1 (see Gardner, Lally, & Rebar, 2020 for related points). This means that the true relationship between habitual behaviours and goal-attainment is unknown. For this reason, we sought to determine if effortful goal-supportive behaviours, which we call *effortful operations* (see Figure 1; Path 1a) and habit enactment (see Figure 2; Path 2a) independently predict goal-progress (see Table 1 for an overview of hypotheses).

### *Determinants of effortful operations: a cybernetic account*

We relied on cybernetic theory to describe the determinants of effortful operations (Austin & Vancouver, 1996). Cybernetic theory suggests that goal-pursuit is realized through a system that consists of a *testing* and *operating process* (see Figure 1). The testing process compares one's current state to their desired state. Deviations from one's desired state initiate *goal-operations* that bring one's current state in line with their desired state. For example, if a student takes a practice exam (i.e., testing), she might realize that she does not fully understand a concept. This could prompt her to study (i.e., operating), which is depicted in Figure 1 (i.e., Path 1b).

Beyond basic testing and operating processes, we know that other self-regulatory processes support goal-pursuit. Specifically, individuals often form plans that specify when and where they are going to enact goal-operations (Gollwitzer, 2012). Planning can facilitate effortful operations through several mechanisms (Wilkowski & Ferguson, 2016). However, in this study, we focused on the direct influence that well-specified plans can have on effortful operations (Path 1c; Gollwitzer, 2012).

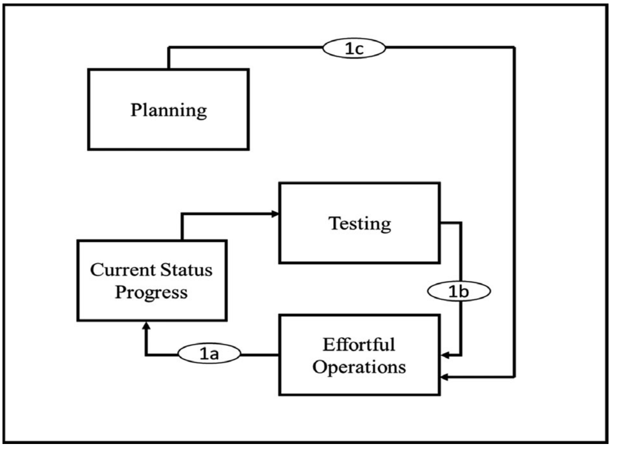


**Figure 1.** Controlled self-regulatory processes.

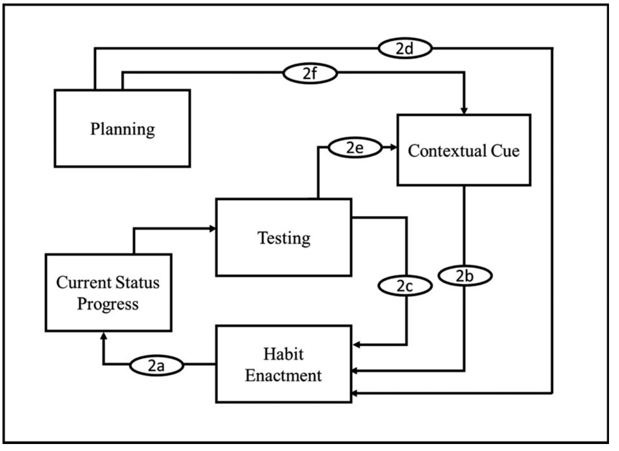


**Figure 2.** Habit enactment within a cybernetic framework.

***Determinants of habit enactment: the goal-independent account***

Originating in classic behaviourism (Skinner, 1953), many modern theorists suggest that habitual behaviours are goal-independent (Dickinson, 1985; Hagger, 2019; Wood & Rünger, 2016). This implies that habitual behaviours are *not* performed to attain a specific outcome. Instead, they are enacted in response to contextual cues. When extrapolated to human behaviour, this might suggest that goals have little influence on habitual behaviour (de Wit, Niry, Wariyar, Aitken, & Dickison, 2007; Wood & Rünger, 2016). That is, once a student develops a strong habit to study after class, merely encountering associated contextual cues (e.g., finishing class) can elicit studying independently of a higher-order goal to succeed in school. According to this account, the selection, preparation, and execution of a habitual behaviour are entirely dependent upon contextual cues (Marien et al., 2018). In support of this, research has demonstrated that (1) the initiation of strong habits is more dependent upon contextual cues than goals (Neal, Wood, Labrecque, & Lally, 2012), (2) habits predict behaviour-enactment above and beyond conscious intentions (Rebar et al., 2016), and (3) habitual behaviours are sometimes enacted despite conscious intentions not to perform the behaviour (Neal, Wood, Wu, & Kurlander, 2011; but see Gardner et al., 2020). For this reason, we expected that exposure to specific contextual cues might directly lead to the enactment of habitual behaviours (see Figure 2; Path 2b).

Crucially, the goal-independent account suggests that habits function independently of the controlled self-regulatory processes that direct effortful-operations (Wood & Rünger, 2016). This is precisely because the selection, preparation, and execution of habitual behaviours are thought to be entirely automatic (Marien et al., 2018). Additionally, such feedback-driven processes are directed by goals. That is, people form plans to carry out behaviours aimed at moving them closer to their goal (Locke & Latham, 1990), and testing processes depend on goals to the extent that one must compare their current state to a desirable state that is specified by a goal (Carver & Scheier, 1982). Critically, goal-independent theorists argue that habitual behaviours should not be influenced by these goal-dependent processes (Marien et al., 2018; Wood & Rünger, 2016).

**Table 1.** Summary of hypothesized direct effects

| Theoretical subdivision | Predictor | Outcome | Path | Prediction |
|---|---|---|---|---|
| Do habits enable goal-progress? | Effortful operations | Goal-Progress | 1a | + |
| | Habit enactment | Goal-progress | 2a | + |
| Determinants of effortful operations | Testing | Effortful operations | 1b | + |
| | Planning | Effortful operations | 1c | + |
| Determinants of habit enactment | | | | |
| Goal-independence | Context cue-exposure | Habit enactment | 2b | + |
| | Testing | Habit enactment | 2c | ∅ |
| | Planning | Habit enactment | 2d | ∅ |
| Goal-dependence | Testing | Habit enactment | 2c | + |
| | Planning | Habit enactment | 2d | + |
| | Testing → Context cue-exposure | Habit enactment | 2e → 2b | + |
| Hybrid | Planning → Context cue-exposure | Habit enactment | 2f → 2b | + |

*Note.* + indicates that the predicted association between two variables will be positive; ∅ indicates a hypothesized null relationship between two variables.

### ***Determinants of habit enactment: the goal-dependent account***
In contrast to the above account, some theorists conceptualize habits as learned associations between super-ordinate goals and sub-ordinate instrumental behaviours (Danner, Aarts, & de Vries, 2007). According to this theory, habits are enacted when contextual cues activate super-ordinate goals which automatically initiate sub-ordinate behaviours (Aarts & Dijksterhuis, 2000). If the student described earlier had learned an association between her goal to do well in school and studying, then simply activating her goal might lead her to study. Critically, the goal-dependent account suggests that goals are a necessary part of the causal chain that links contextual cues to habitual behaviours (Sheeran et al., 2005).

If habitual behaviours are goal-dependent, then they might be influenced by many of the same self-regulatory processes that direct effortful operations. Speaking to this, research on habitual skills suggests that such behaviours can be performed somewhat automatically, but still depend on goals (Marien et al., 2018), and that goal-inconsistent habits are less likely to be enacted under some conditions (Gardner et al., 2020). This would suggest that such behaviours are likely influenced by feedback that is processed via testing processes. We sought to test this by determining if testing was positively associated with habit enactment (i.e., Path 2c). It might follow from the prior line of reasoning that planning facilitates habit enactment as well. If habits are goal-dependent, then they might be *directly* influenced by planning processes (Aarts, Gollwitzer, & Hassin, 2004; Marien et al., 2018). We sought to evaluate this possibility as well (i.e., Path 2d).

### ***The Hybrid* account: strategic exposure to contextual cues**
Finally, controlled self-regulatory processes might *indirectly* facilitate habit enactment by directing people towards contexts that facilitate habitual behaviours (Wood, 2017). For example, a student might plan to go to the library if she recognizes that she is able to study efficiently as a natural consequence of developing a studying habit (i.e., Path 2f → 2b; Wood, 2017). Relatedly, this student might determine that she needs to go to the library after engaging in testing (e.g., taking a practice quiz) and determining that she needs to study for an upcoming exam (i.e., Path 2e → 2b). Accordingly, exposure to specific contextual cues might mediate the association between testing, planning, and habit enactment.

### ***Current investigation***
We conducted three experience sampling studies to test the hypotheses in Table 1. Studies 1 and 2 were designed to test hypotheses regarding the independent contribution of habit-enactment and effortful operations to goal-progress. Additionally, several analyses were carried out to contrast hypotheses from the goal-independent and goal-dependent account of the determinants of habit enactment. In both studies, participants specified three goals and then completed short surveys over the course of several days, which assessed the relevant self-regulatory processes and goal-progress. Study 3 was designed to test hypotheses concerning contextual cue exposure as a determinant of habit enactment and the hybrid account. It should be acknowledged that this methodology is correlational and thus does not lend itself to causal claims. Nonetheless, it is high in ecological-validity and directly studies real-life goal pursuit. Thus, it does have advantages relative to laboratory experiments. Since Studies 1 and 2 used a similar methodology, we present them together. All data files and supplementary material can be accessed through the

Open Science Framework: https://osf.io/xw3g7/?view_only=b5ac1dee2d5b4d9fb36850201d8b5f1b.

# STUDIES 1–2

## Method

### *Participants*

#### *Study 1*

One hundred and seven undergraduate students (80 females, $M_{age}$ = 19.4) participated in exchange for partial course credit. Compliance rates were quite high with participants completing an average more than the 13 requested surveys ($M$ = 13.7 or 68.5% of the 20 total distributed surveys). Participants submitted 1,463 reports on three separate goals, which left us with an effective sample of 4,389 observations.

#### *Study 2*

Eighty-six undergraduate students (55 females; $M_{age}$ = 19.2) participated in exchange for partial course credit. Compliance rates were quite high with participants again completing more than the 20 requested surveys ($M$ = 20.65 or 67.73% of the 30 possible surveys). In total, participants submitted 1,776 reports resulting in an effective sample of 5,328 observations.

### *Procedure*

#### *Identifying long-term goals*

After providing informed consent, participants were asked to complete a computer-administered survey. In it, participants were asked to come up with goals that (1) they were going to pursue through the end of the semester or further, (2) work towards on most days of their life, and (3) were truly distinct from one another. After thinking of each goal, participants typed a brief description of their goal.[1]

#### *Experience sampling protocol*

Participants in both studies began the experience sampling protocol the following morning. Upon receiving a signal, participants were asked to provide a short description of their first long-term goal and then answer the following items using a scale of 0 = Not at all to 4 = Extremely.

To assess *Testing*, participants responded to the following statements, *I evaluated how well I was progressing on this goal* and *I evaluated how well my current plan for reaching this goal was working*. To assess *Planning*, participants responded to the following questions, *Did you think of specific actions for how to achieve your goal?* and *Did you plan when and where you should perform specific actions to achieve your goal?*. To assess *Effortful Operations*, participants responded to the following items, *I*

[1] *To address separate hypotheses not relevant to the current study, Study 1 included additional instructions to help participants specify various types of goals. A full description of this procedure can be found in Supporting Information Section 1.*

*worked hard to move toward this goal* and *I did something to move toward this goal that required a great deal of effort*.

Participants then responded to six items assessing *Habit Enactment*. These items were adapted from the SRHI (Verplanken & Orbell, 2003) but were re-worded to fit the purposes of these two studies. To assess unconscious behavioural initiation, participants responded to the following, *I started to do something to move toward this goal without even realizing it* and *Without even thinking about it, I did something to move toward this goal*. To assess effortlessness, participants responded to the following items, *I did something to move toward this goal that would have been hard not to do* and *I did something to move toward this goal that would have required effort not to do*. To assess context-stability, participants responded to the following items, *I did something that is part of my normal routine that moved me towards this goal* and *I did something that moved me towards this goal which I have been doing for a long time*.

As an index of *Concurrently Assessed Goal-Progress*, participants responded to the following item, *I made a great deal of progress toward this goal*. These questions were repeated for the remaining two goals. All items were presented in random order.

#### *Prospectively identified goal-progress*

Study 2 included a prospective measure of goal-progress (Kiresuk, Smith, & Cardillo, 1994; Sheldon & Elliot, 1998; Williamson & Wilkowski, 2020). We included this additional measure because prior research suggests that people sometimes conflate the amount of effort they exert on a task with progress (i.e., the effort heuristic; Kruger, Wirtz, Van Boven, & Altermatt, 2004). We were concerned that this might distort the relationship between habit enactment, effortful operations, and concurrently assessed goal progress.

After identifying their goals, participants were asked to identify five outcomes that represented varying amounts of progress – namely, *no progress* (such as ‘getting an F on my upcoming exam’), *a little progress* (such as ‘getting a D on my upcoming exam’), *moderate progress* (such as ‘getting a C on my upcoming exam’), *quite a bit of progress* (such as ‘getting a B on my upcoming exam’), and *exceptional progress* (such as ‘getting an A on my upcoming exam’). Participants were told to come up with outcomes that were Concrete (i.e., another person could determine if the outcomes were attained) and Equally Spaced (i.e., the differences between each outcome were approximately equal). During the final session, participants were asked to report what outcome they achieved during the week.

#### *Changes in study protocols*

In Study 1, participants received five signals per day. These signals were distributed throughout the day in 2.5-hr intervals and continued for 4 days. In Study 2, participants received five signals per day over 6 days, and they were distributed throughout the day in 2-hr intervals.

### ***Analysis strategy***

We used Multilevel Modelling (MLM) to address the nested structure of our data. All models were estimated using the lme4 package in R (Bates, Machler, Bolker, & Walker, 2015). For hypothesis tests, we report 95% confidence intervals. Any interval that does not contain zero provides evidence for statistical significance at a 95% confidence level.

Our data exhibited a complex nested structure. Specifically, each observation (e.g., Alex's pursuit of her academic goal at 4:00 pm, Tuesday) was simultaneously nested within a goal (e.g., Alex's academic goal), a time-point (e.g., Alex's experiences at 4:00 pm, Tuesday), which were also nested within a participant (e.g., Alex). To address this, we estimated 3-level cross-classified models. In these models, observations were modelled at level 1; goals were modelled at level 2; timepoints were also modelled at level 2 via a cross-classification; and participants were modelled at level 3. Section 2 in Supporting Information describes our model building process in more detail.

### *Zero-order and unique effects*

We used a two-step analytical approach to test our hypotheses. At step 1, we calculated the *zero-order* effect of a hypothesized predictor on an outcome (e.g., Effortful Operations = Testing). At step 2, we calculated the *unique effect* of a predictor on an outcome while controlling for all other self-regulatory processes (e.g., Effortful Operations = Testing + Planning + Habit Enactment). Critically, we only considered a result significant if *both* its zero-order and unique effect were significant.

### *Centring*

Although centring around cluster-means is often recommended (Enders & Tofighi, 2007), we were unable to do this because of our cross-classified data structure. For this reason, we centred variables around the sample's grand mean. We then entered covariates for each predictor variable at different levels of each model to separate effects at different levels of analysis (Kreft, de Leeuw, & Aiken, 1995).

When predicting Prospectively Identified Goal-Progress, we were able to conduct these analyses using a two-level model by nesting goals within participants. It is important to point out that this led to a large reduction in statistical power since it decreased our effective sample from 5,328 observations to 258 goals in Study 2 and 5,292 observations to 291 goals in Study 3.

### *Bayesian analyses*

We planned to test the hypothesized null effects derived from the goal-independent account using Bayesian analyses (Wagenmakers, 2007). As noted below, these analyses were conducted, but yielded information that was largely redundant with frequentist analyses. As such, they are reported in Supporting Information Section 3.

### *Effect sizes*

We used procedures from Rights and Sterba (2018) to calculate the within-cluster variance explained by a predictor variable (i.e., ${R^{2(f1)}}_W$). We also calculated the change in the total amount of within-cluster variance accounted for by a model with and without the relevant predictor (i.e., $\Delta {R^{2(f1)}}_W$). This provides an index of the unique within-cluster variance in y accounted for by x. These procedures are relatively new, so we were unable to estimate effect sizes in the full 3-level cross-classified models. For this reason, we used 2-level models where each predictor variable was nested within participants.

We interpreted these effects considering Funder and Ozer's (2019) recommendations. Accordingly, an effect can be considered very small but potentially consequential overtime if it reaches, $r$ = .05 ($r^2$ = .003); small and more consequential overtime if it reaches, $r$ = .10 ($r^2$ = .01); medium and potentially consequential immediately if it reaches, $r$ = .20 ($r^2$ = .04); large and likely consequential immediately if it reaches, $r$ = .30 ($r^2$ = .09); or exceptionally large and perhaps an over-estimate of the true effect if it reaches, $r$ = .40 ($r^2$ = .16).

*Statistical power*

For analytical reasons, we followed Arend and Schäfer's (2019) recommendations for determining statistical power in 2-level multilevel models. We are not currently aware of a method to determine statistical power in 3-level cross-classified models. All three studies were designed to detect a small effect, $r$ = .10, at a false-negative error rate of .20, at the observation-level of analysis. Analyses at the goal-level had less power overall but were still sufficiently powered to detect a medium sized effect, $r$ = .20, at a .20 false-negative error rate.

## Results

### *Descriptive statistics*

As shown in the upper panel of Table 2, the most common goals specified in Studies 1–2 were academic goals (e.g., Maintain at least a 3.5 GPA), followed by health goals (e.g., Go to the Gym five times per week), career goals (e.g., Work 20 hr per week), and social goals (e.g., Call my family each week). Measures of central tendency and dispersion are shown in Table 2's bottom panel.

### *Examining the theorized consequences of habit enactment*

First, we hypothesized that Effortful Operations and Habit Enactment would independently predict Concurrently Assessed Goal-Progress. As shown in Table 3 and consistent with our hypotheses, we found consistent evidence that Effortful Operations uniquely predicted an increase in Concurrently Assessed Goal-Progress, Study 1: $b'$ = 0.29, 95% CI

**Table 2.** Descriptive statistics

| | Academic | Health | Career | Social | | |
|---|---|---|---|---|---|---|
| Study 1 | 39% | 25% | 14% | 21% | | |
| Study 2 | 48% | 29% | 15.50% | 7.30% | | |
| Study 3 | 35% | 42% | 8.50% | 13.20% | | |
| Variable | Study 1 | | Study 2 | | Study 3 | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Habit enactment | 1.95 | 1.1 | 1.64 | 1.18 | 0.76 | 1.38 |
| Effortful operations | 1.98 | 1.23 | 1.65 | 1.26 | 1.38 | 1.38 |
| Testing | 2.03 | 1.22 | 1.84 | 1.25 | 1.36 | 1.3 |
| Planning | 2.04 | 1.21 | 1.89 | 1.27 | 1.47 | 1.3 |
| C.A. goal-progress | 2.01 | 1.31 | 1.71 | 1.33 | 1.32 | 1.38 |
| P.I. goal-progress | – | – | 2.46 | 1.05 | 2.51 | 1.08 |
| Cue exposure | – | – | – | – | 0.78 | 1.39 |

*Note.* All items were scored on a 0 to 4 response scale.

**Table 3.** Tests of hypothesized direct effects

| Theoretical subdivision | Predictor | Outcome | Study | $b$ | $R^{2(f1)}_W$ | $b'$ | $\Delta R^{2(f1)}_W$ |
|---|---|---|---|---|---|---|---|
| Do habits enable goal-progress? | Effortful operations | Concurrently assessed goal-progress | 1 | 0.56 [0.53, 0.60]* | .37 | 0.29 [0.25, 0.34]* | .03 |
| | | | 2 | 0.68 [0.65, 0.71]* | .53 | 0.38 [0.34, 0.42]* | .05 |
| | | Prospectively identified-goal-progress | 2 | 0.95 [0.59, 1.31]* | .10 | −0.04 [−0.70, 0.63] | <.0001 |
| | Habit enactment | Concurrently assessed goal-progress | 1 | 0.76 [0.71, 0.81]* | .48 | 0.47 [0.41, 0.52]* | .10 |
| | | | 2 | 0.82 [0.78, 0.86]* | .51 | 0.33 [0.28, 0.38]* | .04 |
| | | Prospectively identified-goal-progress | 2 | 0.84 [0.51, 1.17]* | .09 | 0.33 [−0.16, 0.82] | .005 |
| Determinants of effortful operations | Testing | Effortful operations | 1 | 0.44 [0.41, 0.48]* | .35 | 0.15 [0.11, 0.19]* | .01 |
| | | | 2 | 0.63 [0.59, 0.66]* | .48 | 0.20 [0.17, 0.24]* | .01 |
| | Planning | Effortful operations | 1 | 0.46 [0.43, 0.49]* | .37 | 0.24 [0.20, 0.27]* | .03 |
| | | | 2 | 0.61 [0.58, 0.64]* | .49 | 0.24 [0.20, 0.27]* | .02 |
| Determinants of habit enactment | Testing | Habit enactment | 1 | 0.41 [0.38, 0.44]* | .4 | 0.22 [0.19, 0.25]* | .04 |
| | | | 2 | 0.50 [0.47, 0.52]* | .51 | 0.19 [0.16, 0.22]* | .04 |
| | Planning | Habit enactment | 1 | 0.37 [0.34, 0.40]* | .37 | 0.16 [0.13, 0.19]* | .02 |
| | | | 2 | 0.47 [0.45, 0.50]* | .47 | 0.17 [0.14, 0.20]* | .01 |

*Note.* $b$ represents the zero-order effect. $b'$ represents the unique-effect. $R^{2(f1)}_W$ is the within-cluster variance accounted for by each zero-order effect. $\Delta R^{2(f1)}_W$ is the change in within-cluster variance accounted for by adding a variable.
$^*p < .05$.

[0.25, 0.34], $\Delta R^{2(f1)}{}_W = .03$; Study 2: $b' = 0.38$, 95% CI [0.34, 0.42], and $\Delta R^{2(f1)}{}_W = .05$. Additionally, Habit Enactment predicted a medium to large increase in Concurrently Assessed Goal-Progress, Study 1: $b' = 0.47$, 95% CI [0.41, 0.52], and $\Delta R^{2(f1)}{}_W = .10$; Study 2: $b' = 0.33$, 95% CI [0.28, 0.38], and $\Delta R^{2(f1)}{}_W = .04$.

We conducted a similar analysis on Prospectively Identified Goal-Progress. Results indicated that Effortful Operations predicted a large increase in Prospectively Identified Goal-Progress at the zero-order level, $b = 0.95$, 95 CI [0.59, 1.31], and $\Delta R^{2(f1)}{}_W = .10$. However, the unique effect of Effortful Operations did not reach statistical significance or the threshold for a very small effect, $b = -0.04$, 95% CI [−0.70, 0.63], and $\Delta R^{2(f1)}{}_W < .0001$.

A similar pattern emerged when we entered Habit Enactment as a predictor of Prospectively Identified Goal-Progress. The zero-order effect of Habit Enactment was significant and met the threshold for a large effect, $b = 0.84$, 95% CI [0.51, 1.17], and $\Delta R^{2(f1)}{}_W = .09$. Yet, the unique effect did not reach statistical significance, $b' = 0.33$, 95% [−0.16, 0.82], and $\Delta R^{2(f1)}{}_W = .005$. However, it did meet the threshold for a very small effect.

### *Examining the theorized determinants of effortful operations*

Next, we examined hypotheses concerning the theorized determinants of Effortful Operations. As shown in Table 3, we found that Testing uniquely predicted a small increase in Effortful Operations, Study 1: $b' = .15$, 95% CI [0.11, 0.19], and $\Delta R^{2(f1)}{}_W = .01$; Study 2: $b' = .20$, 95% CI [0.17, 0.24], and $\Delta R^{2(f1)}{}_W = .01$. Additionally, Planning consistently predicted a small increase in Effortful Operations, Study 1: $b' = 0.24$, 95% CI [0.20, 0.27], and $\Delta R^{2(f1)}{}_W = .03$; Study 2: $b' = 0.24$, 95% CI [0.20, 0.27], and $\Delta R^{2(f1)}{}_W = .02$.

### *Examining the theorized determinants of habit enactment*

We then tested both the goal-independent and goal-dependent account of habit enactment. Across both studies, Testing predicted a medium-sized increase in Habit Enactment, Study 1: $b' = 0.22$, 95% CI [0.19, 0.25], and $\Delta R^{2(f1)}{}_W = .04$; Study 2: $b' = 0.19$, 95% CI [0.16, 0.22], and $\Delta R^{2(f1)}{}_W = .04$. Additionally, Planning predicted a small increase in Habit Enactment across both studies: Study 1: $b' = 0.16$, 95% CI [0.13, 0.19], and $\Delta R^{2(f1)}{}_W = .02$; Study 2: $b' = .17$, 95% CI [0.14, 0.20], and $\Delta R^{2(f1)}{}_W = .01$. Crucially, these results are more consistent with the goal-dependent account of the determinants of habit enactment. Results from additional Bayesian analyses (originally planned to evaluate the goal-independent account) further support this point and can be found in Supporting Information Section 3.

## Discussion

In both studies, we found that habit enactment and effortful operations independently facilitated goal-progress. This was especially true when we assessed goal-progress as participants were actively pursuing goals (i.e., concurrently assessed goal-progress). The results from the analysis of prospectively identified goal-progress were less clear, but still provided some evidence that habits and effortful operations facilitate goal-progress.

In terms of the theorized determinants of habit enactment, we found support for the goal-dependent account. Both planning and testing facilitated habit enactment, and this was true even after we controlled for overlap between habit enactment and effortful operations (Marien et al., 2018). These findings were quite surprising since previous studies suggest that habits are likely goal-independent (Wood & Rünger, 2016).

These studies did have some important limitations. First, our assessment of prospectively identified goal-progress may not have been properly calibrated to test our hypotheses. Upon inspecting the participant's progress outcomes, we found that many outcomes could not be attained in a week (e.g., lose 12% body fat) or were not realistic given the time of the semester (e.g., Graduate from college). Additionally, some outcomes referred to things that could be attained by performing a single action (e.g., apply for a job). Beyond this, it is possible that our methods may have over-estimated the extent to which testing, and planning processes influenced habit enactment. We asked participants to respond to items that explicitly referenced their goals, which may have led participants to make goal-based inferences to explain their behaviours (Wood & Rünger, 2016). Last, we were not able to test predictions from the hybrid account because we did not evaluate context cue exposure.

## STUDY 3

In Study 3, we sought to replicate and extend our earlier findings. We also sought to evaluate the hybrid account of the determinants of habit enactment (Wood & Rünger, 2016). Though Study 3 again used an experience sampling protocol, it differed from Studies 1–2 in important ways. During the orientation session, we asked participants to identify 'good habits' that they could report on throughout the study, and participants then identified goals that were related to their habits. We assessed habit enactment and effortful operations separately during the experience sampling protocol, which allowed us to distinguish between habitual behaviours and effortful operations more effectively. We also took several steps to correct the issues with our assessment of prospectively identified goal-progress.

### Methods

#### *Participants*

Ninety-seven students participated in exchange for partial course credit.[2] Compliance rates were acceptable with participants completing 18.2 out of 20 requested surveys (or 60.6% of the 30 possible surveys). In total, participants submitted 1,764 reports on three habits/goals, resulting in an effective sample size of 5,292 observations for most analyses.

#### *Procedure*

*Habit identification*

After providing informed consent, participants completed an orientation survey. In it, the participants were asked to think of a 'good' habit. They were specifically instructed to think of a behaviour they had been performing in the same context for a long period of

[2] *Due to a programming error, we were unable to collect descriptive statistics concerning participants age and gender. However, the sample in Study 3 was drawn from a population that closely resembles Studies 1 and 2.*

time. Participants were then asked to type a brief description of the behaviour they identified. They were then asked to type a brief description of the context in which they typically performed their behaviour and then to combine the information into a coherent description (i.e., I do [my behaviour] in [the context I normally perform it].

Of the 291 habits identified, 35% were broadly related to academics (e.g., 'I study after dinner in a study room Monday through Friday'), 53% were broadly related to health and hygiene (e.g., 'I do my workout everyday at 12:30pm'), 4% were social (e.g., 'I get coffee with my best friend every Saturday morning'), and 6% were generally related to leisure (e.g., 'I play video games at home on the weekends').

Afterwards, participants responded to 10 items from the SRHI using a 1 = Disagree to 7 = Agree scale (Verplanken & Orbell, 2003; $M = 4.48$, $SD = 1.36$). Lally et al. (2010) suggested that a score below the mid-point of the response scale (i.e., 4) indicates a non-habitual behaviour. To determine if our procedure effectively elicited habits, we subtracted 4 from each habit strength score and then entered this variable into an unconditional, 2-level MLM where habits were nested within participants. The results indicated that the average habit-strength was significantly greater than 4, $b_0 = 0.48$, $t = 4.83$, and $p < .0001$; thus, our procedure appears to effectively lead participants to identify habits.

### *Goal identification*

Participants then responded to several questions about goals related to their habits. Specifically, participants were asked to respond to the following questions: 'We asked you think of a "good" habit. In your opinion, what makes this a good habit?'. Participants then typed an open-ended response. Afterwards, participants were asked, 'Does this habit help with the pursuit of a goal in your life?'. Participants responded to this question using a 0 = Not at all to 4 = Definitely, scale. Overall, 99% of participants indicated that their 'good habit' supported a goal at least to some extent ($M = 3.35$, $SD = 0.94$). Finally, participants were asked to type a brief description of their goal.

### *Prospectively identified goal-progress*

Participants followed procedures similar to Study 2 to identify progress outcomes. However, we included additional instructions to address the previously discussed issues. First, we asked participants to ensure that their outcomes could be achieved within a week and to identify outcomes that could only be attained by performing a series of actions (rather than a single action). As in Study 2, participants completed this assessment of goal-progress at the end of the study. Participants repeated these procedures three times to identify three habits and their associated goals and outcomes.

A research assistant then told participants that they would receive five surveys per day, over the next 6 days (i.e., 30 surveys total). Survey reminders were sent out in random intervals between 10 am and 8 pm. Surveys were sent out in approximate 2-hr intervals with the stipulation that no survey could be sent out within 30 min of another survey.

### *Experience sampling protocol*

Participants began the experience sampling protocol the next morning. Upon accessing the daily surveys, participants were first asked to provide their name along with a short description of their first habit and goal.

Next, participants were asked several questions about their habit. They were specifically asked: 'To what extent did you engage in this behaviour in the last 30 minutes?'. We used this item to assess *Habit Enactment*. In total, participants indicated that they enacted 1,421 habits (i.e., $x > 0$). We then asked participants to type a description of the context in which they normally enact their habit. After typing this description, participants were asked ('Did you encounter this situation in your life?'). This item was included to assess *Contextual Cue Exposure*. In total, participants encountered the context in which they normally enacted their habit 1,463 times. Participants then completed the same questions used in Studies 1 and 2 to measure *Testing, Planning, Effortful Operations* and *Concurrently Assessed Goal-Progress*.

### *General analytic procedures*

We relied on the same analysis strategy with one minor exception. When determining the appropriate nested structure of our data, we found that our 3-level cross-classified model did not converge when we were attempting to predict Habit Enactment. However, our model would converge when the timepoint-level was dropped, and we simply estimated a 3-level model where observations (i.e., level 1) were nested within goals (i.e., level 2) and participants (i.e., level 3). This indicates that Habit Enactment varied randomly across participants and specific habits, but that it did not vary randomly across timepoints (Nezlek, 2008). This seems to suggest that some individuals enact habits more often than others and that some habits are enacted more frequently than others; but there is no evidence of a tendency for individuals to enact multiple habits at a given time. For this reason, we estimated 3-level models without a cross-classification whenever Habit Enactment was considered as an outcome variable (see Supporting Information Section 2 for more information).

Additionally, we conducted two mediational analyses to assess the *Hybrid Account* of the determinants of Habit Enactment. To do so, we used the Sobel test to estimate the indirect effect of a predictor (x) on an outcome (y) through a candidate mediator ($m$). Although the Sobel test has sometimes been criticized, it is valid with large sample sizes (see MacKinnon, Fairchild, & Fitz, 2007). Since the current analyses are based on 5,292 level-one observations, it can be considered valid in the current context. Furthermore, we are not aware of any program that can provide other measures of indirect effects (e.g., bootstrapping) within three-level cross-classified models.

## Results

### *Examining the consequences of habit enactment*

First, we evaluated the hypothesis that Effortful Operations would predict Concurrently Assessed Goal-Progress. As shown in Table 4, Effortful Operations uniquely predicted a large increase in Concurrently Assessed Goal-Progress, $b' = 0.51$, 95% CI [0.48, 0.54], and $\Delta R^{2(f1)}{}_W = .10$. Additionally, Effortful Operations' unique relationship with Prospectively Identified Goal-Progress was small in size, and it approached but did not reach statistical significance, $b' = 0.46$, 95% CI [−0.005, 0.92], and $\Delta R^{2(f1)}{}_W = .01$.

We conducted a similar analysis to assess the impact of Habit Enactment on goal-progress. Consistent with Studies 1 and 2, we found evidence that Habit Enactment uniquely predicted a small increase in Concurrently Assessed Goal-Progress, $b' = 0.10$, 95% CI [0.08, 0.12], and $\Delta R^{2(f1)}{}_W = .01$. We also found that Habit Enactment's unique

**Table 4.** Tests of hypothesized direct effects

| Theoretical subdivision | Predictor | Outcome | $b$ | $R^{2(f1)}_W$ | $b'$ | $\Delta R^{2(f1)}_W$ |
|---|---|---|---|---|---|---|
| Do habits enable goal-progress? | Effortful operations | Concurrently assessed goal-progress | 0.79 [0.76, 0.81]* | .64 | 0.51 [0.48, 0.54]* | .10 |
| | Effortful operations | Prospectively identified goal-progress | 0.50 [0.24, 0.76]* | .05 | 0.46 [−0.005, 0.92]$^{+}$ | .01 |
| | Habit enactment | Concurrently assessed goal-progress | 0.36 [0.34, 0.38]* | .23 | 0.10 [0.08, 0.12]* | .01 |
| | Habit enactment | Prospectively identified goal-progress | 0.35 [0.16, 0.53]* | .05 | 0.23 [−0.003, 0.46]$^{+}$ | .01 |
| Determinants of effortful operations | Testing | Effortful operations | 0.80 [0.77, 0.83]* | .53 | 0.45 [0.42, 0.49]* | .06 |
| | Planning | Effortful operations | 0.74 [0.71, 0.74]* | .5 | 0.33 [0.29, 0.36]* | .05 |
| Determinants of habit-enactment | Testing | Habit enactment | 0.70 [0.65, 0.76]* | .15 | 0.01 [−0.04, 0.06] | <.001 |
| | Planning | Habit enactment | 0.65 [0.60, 0.70]* | .13 | 0.04 [−0.004, 0.08] | <.001 |
| | Contextual cue exposure | Habit enactment | 0.83 [0.81, 0.84]* | .72 | 0.77 [0.75, 0.78]* | .50 |

*Note.* $b$ represents the zero-order effect. $b'$ represents the unique-effect. $R^{2(f1)}_W$ is the within-cluster variance accounted for by each zero-order effect. $\Delta R^{2(f1)}_W$ is the change in within-cluster variance accounted for by adding a variable.
$^{*}p < .05$. $^{+}p < .055$.

relationship with Prospectively Identified Goal-Progress was small in size, and it approached but did not reach statistical significance, $b' = 0.23$, 95% CI [−0.003, 0.46], and $\Delta R^{2(f1)}{}_{W} = .01$.

### *Examining the theorized determinants of effortful operations*

We then tested the hypotheses that both Testing and Planning would predict Effortful Operations. As shown in Table 4, we found support for both hypotheses. Specifically, Testing uniquely predicted a medium-sized increase in Effortful Operations, $b' = 0.45$, 95% CI [0.42, 0.49], and $\Delta R^{2(f1)}{}_{W} = .06$ as did Planning, $b' = 0.33$, 95% CI [0.29, 0.36], and $\Delta R^{2(f1)}{}_{W} = .05$.

### *Examining the theorized determinants of habit enactment*

We then assessed the influence of Testing, Planning, and Contextual Cue Exposure on Habit Enactment. These analyses were slightly different from the analyses conducted in Studies 1 and 2 because we were able to control for the influence of Contextual Cue Exposure. Although we found that the zero-order effects of both Testing, $b = 0.70$, 95% CI [0.65, 0.76] and Planning, $b = 0.65$, 95% CI [0.60, 0.70] on Habit Enactment were significant, neither Testing $b = 0.01$, 95% CI [−0.04, 0.06], nor Planning, $b = 0.04$, 95% CI [−0.004, 0.08] produced a significant unique effect on Habit Enactment.

Last, we assessed the influence of Contextual Cue Exposure on Habit Enactment. Consistent with prior theory (Wood & Rünger, 2016), we found clear evidence that Contextual Cue Exposure produced a large unique effect on Habit Enactment, $b' = 0.77$, 95% CI [0.75, 0.78], and $\Delta R^{2(f1)}{}_{W} = .50$. We then performed the same analysis to determine the influence of Contextual Cue Exposure on Effortful Operations. Interestingly, we found that Contextual Cue Exposure might facilitate the enactment of Effortful Operations, $b = 0.044$, 95% CI [0.021, 0.07]. However, the effect was considerably smaller (i.e., $R^{2(f1)}{}_{W}{}' < .001$) than the effect of Contextual Cue Exposure on Habit Enactment. This could suggest that Contextual Cue Exposure likely plays a more central role in facilitating Habit Enactment.

### *Evaluating the hybrid account of the determinants of habit enactment*

We next conducted mediational analyses to determine if Contextual Cue Exposure mediated the association between Testing and Habit Enactment. As noted above, the zero-order effect of Testing on Habit Enactment was significant, $b' = 0.14$, 95% CI [0.07, 0.22]. More importantly, the indirect effect of Testing on Habit Enactment through Contextual Cue Exposure was also significant, $Z = 13.84$, $p < .0001$, and the unique effect of Testing on Habit Enactment after controlling for Contextual Cue Exposure was no longer significant, $b = 0.011$, 95% CI [−0.04, 0.06]. This provides evidence that Contextual Cue Exposure fully mediates the association between Testing and Habit Enactment.

We then conducted a similar mediational analysis to determine if Contextual Cue Exposure mediated the association between Planning and Habit Enactment. As noted above, the zero-order effect of Planning on Habit-Enactment was significant, $b = 0.11$, 95% CI [0.04, 0.18]. More importantly, the indirect effect of Planning on Habit Enactment through Contextual Cue Exposure was significant, $Z = 7.89$, $p < .0001$, and the unique effect of Planning on Habit Enactment after controlling for Contextual Cue Exposure was no longer significant, $b = 0.041$, 95% CI [−0.003, 0.08]. Thus, this provides evidence that

Contextual Cue Exposure fully mediates the association between Planning and Habit Enactment.

## GENERAL DISCUSSION

We conducted three experience-sampling studies to examine the theorized determinants and consequences of goal-supportive habits. Our results suggest that habits and effortful operations independently predict goal-progress. Perhaps, more interestingly, though, the results supported a 'hybrid' of the accounts stressing the goal-independent (Wood & Rünger, 2016) and the goal-dependent (Marien et al., 2018) nature of habits. Consistent with the goal-dependent account, self-regulatory processes such as planning and testing were strongly and significantly related to habit-enactment (Studies 1 and 2). Consistent with the goal-independent account, however, such effects are fully mediated by the exposure to relevant contextual cues (Study 3). In other words, self-regulatory processes such as planning and testing might lead individuals to intentionally expose themselves to contexts in which they habitually engage in goal-supportive behaviours, but perhaps, it is the exposure to these contexts which most directly triggers habit-enactment.

Theorists have suggested that it is important to develop habits during goal-pursuit because habits automatize goal-supportive behaviours that facilitate goal-attainment (Fiorella, 2020; Wood, 2019). Consistent with this, we were able to demonstrate that habitual and non-habitual behaviours independently predicted an increase in goal-progress. To our knowledge, this is the first study to demonstrate that both types of behaviour independently support goal-pursuit in daily life. Critically, this provides foundational support for emerging theory on the importance of habits in goal-pursuit (Wood, 2017).

Admittedly, the contributions of both habits and effortful goal-supportive behaviours were less clear when we assessed their role in helping participants attain pre-specified outcomes (i.e., prospectively identified goal-progress). Methodologically, we identified and rectified several issues with our prospective outcome selection procedure, and this appeared to address many of these issues. In Study 3, both effortful operations and habit enactment produced a small effect on prospectively identified goal-progress that would likely become more consequential over time (Funder & Ozer, 2019).

Regarding the theorized determinants of effortful operations, the results from our studies were quite consistent with prior research on cybernetic theory (Austin & Vancouver, 1996; Carver & Scheier, 1982). Specifically, our results indicated that planning and testing led to the enactment of effortful goal-supportive behaviours. Importantly, these results replicate prior studies of goal-pursuit in daily life (Wilkowski & Ferguson, 2016) and suggest that our measures had predictive validity insofar as they were able to demonstrate established phenomena.

Another goal of our research was to test several claims regarding the determinants of habitual behaviours. Theorists debate whether habits should be conceptualized as *goal-independent* behavioural responses (Wood & Rünger, 2016) or *goal-dependent* behavioural routines (Marien et al., 2018). In our studies, we set out to test predictions derived from each perspective about how habits might interface with other goal-dependent self-regulatory processes.

Some theorists suggest that habits are enacted independently of goals (Wood & Rünger, 2016). If so, habit enactment may happen independently of the self-regulatory processes needed to initiate effortful goal-pursuit. We did not find support for this perspective. In all three studies, we found significant zero-order effects of testing and planning on habit enactment. These results are at odds with a simple application of the goal-independent account (Wood & Rünger, 2016). However, it is important to point out that goal-independent theorists sometimes acknowledge that goals could play a more indirect role in facilitating habit enactment (see Wood, 2017).

To test the goal-dependent account, we examined if testing and planning were positively associated with habit enactment (Marien et al., 2018). Consistent with this account, both testing and planning were positively associated with habit enactment, and this was true even after we controlled for overlap between habit enactment and effortful operations. This could indicate that self-regulatory processes such as planning and testing are necessary and directly involved in triggering habit-enactment. However, as we will soon discuss, this interpretation might be too simplistic.

We evaluated the hybrid account in Study 3. According to this account, self-regulatory processes like planning and testing might be associated with habit enactment, but this association is mediated by contextual cue exposure. In less opaque terms, self-regulatory processes might lead people to intentionally put themselves in situations where they habitually engage in goal-supportive behaviours (Wood, 2017; Wood & Rünger, 2016). Prima facie, this proposal seems reasonable given that individuals committed to living a healthy lifestyle control their contexts to facilitate exercising (Eid, Overman, Puga, & Turner, 2008). We found clear support for the hybrid account in Study 3. Specifically, we found that contextual cue exposure fully mediated the association between self-regulatory processes (i.e., planning and testing) and habit enactment.

What does this say about the issue of goal-dependency versus goal-independency? We believe that our results suggest that there is truth to both goal-dependent and goal-independent accounts. In line with the goal-independent account, our results suggest that contextual cue exposure is the proximate cause of habit enactment (Wood & Rünger, 2016). The context itself does seem to play an important role in guiding and triggering the enactment of goal-supportive habits.

Nonetheless, people do not passively drift into contexts where they habitually engage in goal-supportive behaviours. Instead, the current data indicate that they intentionally plan to enter such contexts because of their goals and that conscious monitoring of goal-progress also leads them to enter such contexts.

Speaking to this, Marien, Custers, and Aarts (2019) recently suggested that the conceptualization of habit as a strict goal-independent behavioural response starts to become untenable as the behaviour becomes more complex and involves more constituent actions. To give an example, a student might develop a habit to study when she is at the library. Studying, however, is a complex task that consists of multiple actions. Thus, she might need to develop a plan to initiate the sequence of actions that underlies studying (e.g., planning to go to the library after work), but once she arrives at the library, she might be able to rely on her studying habit which effectively automates studying once she encounters relevant contextual cues. Ultimately, the issue of goal-dependency or independency depends on behavioural complexity and how broadly one construes the behaviour. When a behaviour is construed broadly, our results could suggest that the behaviour is goal-dependent. The selection of a goal-conducive context seems to rely on conscious self-regulation. Under a narrower construal, our results might be consistent with the goal-independent account. Once in a specific context, contextual cues may be sufficient to trigger the enactment of a habitual behaviour in some fashion.

### *Limitations and directions for future research*

The current studies provide ecologically valid evidence that goal-conducive habits uniquely contribute to goal-pursuit in daily life and that both conscious self-regulatory processes and more automatic stimulus-response connections are involved in triggering habit enactment in this context. Nonetheless, these studies are not without their limitations, and thus, it will be important for future research to use other methodologies to overcome these limitations. Although experience-sampling studies are intensive and ecologically valid, they are ultimately correlational and do not allow one to draw causal conclusions. Thus, future research involving experimental protocols is needed to provide evidence of causality. Because of their intensive nature, we also conducted these studies with undergraduate populations. It will thus be important for future research to assess whether these patterns are apparent in other populations. Perhaps, conscious self-regulation plays less of a role in facilitating habits among older adults in more stable life circumstances.

Additionally, several steps could be taken to improve our measures. For example, in Studies 1 and 2, we distinguished between effortful operations and habit enactment by asking participants about perceived effort. These measures could have been improved by asking specifically about *cognitive effort*, since it is possible to enact a habit (e.g., exercising) but still exert *physical effort*. We tried to address this issue analytically by calculating unique effects. However, subsequent researchers should be aware of the difference between cognitive effort and physical effort.

The current studies were also not well-suited to make an important distinction between *Habitual Instigation* and *Habitual Execution* (Gardner et al., 2016). In this case, habitual instigation refers to the automatic triggering and selection of a behaviour; while habitual execution refers to the automation of the sub-actions that need to be performed to complete a task. It is possible that distinguishing between these constructs might complicate and qualify the conclusions emphasized here. For example, a goal might instigate a behaviour, but the execution of the behaviour might be goal-independent. In the example mentioned earlier, the student's goal to do well in school might lead her to engage in studying, but the act of studying might unfold in a way that is automatic and goal-independent. Conversely, she might automatically decide to study after encountering a contextual cue that is associated with studying (e.g., finishing class) and the activation of this studying behaviour might not depend on a goal. However, she might monitor her behaviour to ensure she is moving towards her goal (Marien et al., 2018). This distinction could be important given that habitually instigated behaviours might play a more central role in promoting behavioural engagement (Gardner et al., 2016) and might provide further clarification on the determinants of habit enactment (Gardner et al., 2020). Subsequent research should take this distinction into account to determine the extent to which the benefits of habit-enactment depend on whether the behaviour is habitually instigated or habitually executed.

Following Wood and Neal's (2007) theorizing on the *habit-goal interface*, the current studies were focused on 'good' or goal-congruent habits. Thus, we do not know if these results will generalize to other types of habits – such as 'bad' (i.e., goal-incongruent) or 'neutral' (i.e., goal-independent) habits (Wood, 2019). Recent analyses suggest that this may be critical to take into account (Gardner et al., 2020). For example, the goal-independent account may receive greater support for 'neutral' habits (e.g., habits that supported a previously valued but now-abandoned goal and have no adverse consequences). Future research should thus examine these issues for different types of habits.

### *Conclusion*

We conducted three intensive experience-sampling studies to examine the theorized determinants and consequences of goal-conducive habits in daily life. Our studies provide preliminary evidence that habitual behaviours facilitate goal-progress and might do so independently of more effortful forms of goal-pursuit. Thus, these studies suggest that goal-conducive habits might be useful and help people achieve their goals. Given this, it becomes important to consider the *determinants* of goal-conducive habits. Our results were consistent with a *hybrid* account that emphasizes the importance of both conscious self-regulatory processes and automatic cue-response associations. Consistent with the goal-dependent account (Marien et al., 2018), self-regulatory processes such as planning and testing were consistently related to habit enactment. Consistent with the goal-independent account (Wood & Rünger, 2016), however, such effects were fully mediated by contextual-cue exposure. Such results provide preliminary evidence that self-regulatory processes might lead individuals to intentionally expose themselves to contexts in which they routinely engage in goal-supportive habits, and these contexts might trigger the enactment of goal-conducive habits more directly. Thus, to fully understand the enactment of goal-conducive behaviours in daily life, one must consider both conscious self-regulatory processes and automatic cue-response associations.

## Conflicts of interest

All authors declare no conflict of interest.

## Author contribution

**Laverl Z. Williamson:** Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Software (equal); Supervision (equal); Validation (equal); Visualization (equal); Writing – original draft (equal); Writing – review & editing (equal). **Benjamin M. Wilkowski:** Conceptualization (equal); Data curation (equal); Investigation (equal); Methodology (equal); Project administration (equal); Resources (equal); Supervision (equal); Validation (equal); Visualization (equal); Writing – review & editing (equal).

## Data availability statement

Data for these studies and additional materials are available at https://osf.io/xw3g7/?view_only=c5f96dbd16984c9883daf4bd1bd971ae

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*Received 24 March 2021*

## Supporting Information

The following supporting information may be found in the online edition of the article:

**Appendix S1**. Habits in daily goal-pursuit.