The Making of a Habit:

The Moderating Role of Construal Level on the Development of Automaticity

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Abstract of the Dissertation

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Through practice, erratic behaviors become consistent. Numerous daily actions, including health-related behaviors such as exercise, are guided by habits that function automatically. However, considerable variability exists in the time it takes for a new behavior to become consistent and automatic. To date, little research has examined why the speed of habit formation varies across individuals and situations. I tested whether focusing on the concrete procedures of action (concrete thinking) facilitates the development of behavioral consistency and automaticity more so than focusing on the abstract purpose of action (abstract thinking). In Experiment 1, I examined whether concrete vs. abstract thinking influences consistency of exercise behavior across a two-week period, and whether goal-related affect explains why differences in exercise consistency emerge. In Experiment 2, I aimed to replicate the findings from Experiment 1 and to test whether concrete vs. abstract thinking leads people to develop a greater increase in subjective experiences of exercise automaticity across a two-week period. Experiment 3 examined whether concrete relative to abstract thinking promotes consistency and automaticity in repeated judgments that are executed increasingly rapidly across time. Although Experiment 1 provided initial support for the hypotheses, Experiments 2 and 3 did not. The present experiments suggest that concrete vs. abstract thinking does not moderate the speed at which repeated behaviors become automatic. Although numerous studies suggest that abstract and concrete thinking impact immediate acts of self-regulation, the present experiments suggest that changes in automaticity do not appear to be the mechanism through which mental construal promotes effective self-regulation.

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Chapter 1

In recent decades, considerable effort has been made to understand how people make decisions about their physical health. Several health belief theories, including the protection-motivation theory (Rogers, 1983), the health-belief model (Janz & Becker, 1984), and the theory of planned behavior (Ajzen, 1991), have focused on identifying decisional determinants of health behavior, such as behavioral intentions, risk perceptions, and subjective norms. Such models view health behaviors as reasoned, deliberate, and conscious acts that require attention and willpower to be successful. Correlational evidence validates decisional theories' predictive utility with respects to health behavior-determinants such as behavioral intentions (Hagger, Chatzisarantis, & Biddle, 2002); however, efforts to change health behaviors with interventions that target these variables have been less successful (Michie, Abraham, Whittington, & McAteer, 2009). Furthermore, meta-analytic reviews show that behavioral intentions account for approximately 28% of the variance in behavior (Sheeran, 2002) and that a medium-to-large change in behavioral intentions generates a small-to-medium effect on behavior (Webb & Sheeran, 2006). The gap between intentions and behavior suggests that behaviors may be shaped by factors that extend outside of conscious, reasoned, and deliberate efforts.

Habits and Health Behaviors

In light of the limitations of such decisional models, recent models of health behavior change emphasize a dual-systems framework (Friese, Hofmann & Wiers, 2011; Hofmann, Friese, & Wiers, 2008; Rothman, Sheeran, & Wood, 2009). This approach draws upon information processing models such as the Reflective-Impulsive Model (RIM; Strack & Deutsch, 2004), which proposes two distinct pathways for information processing: a *reflective* system that draws upon people's knowledge and explicit intentions, and an *automatic* system that operates through learned associations between environmental cues and behavioral tendencies and that functions without conscious awareness or effort. One way in which the automatic system influences behavior is through habits. Habits are automatic behavioral responses that are linked to specific situational cues (Lally, Van Jaarsveld, Potts, & Wardle, 2010; Ouellette & Wood, 1998; Wood & Neal, 2007). The first time a behavior is carried out, it often requires effort and attention. However, as the behavior is repeated consistently (e.g., at the same time or in the same physical location), the action is likely to proceed in a more efficient and effortless manner.

A defining feature of habits is the tendency for behavior to become automatic, that is, efficient or without conscious awareness, control, or intent (Gardner, Abraham, Lally, & de Bruijn, 2012; Orbell & Verplanken, 2010). By transferring control of a behavior from the conscious will of an individual to cues in the environment, beneficial habits, such as engaging in regular physical activity, do not require the same self-regulatory resources as effortful goal-pursuit. Whereas effortful self-control is constrained by a number of situational variables, including cognitive load (Boon, Stroebe, Shut, & Ijntema, 2002; Ward & Mann, 2000) and emotional distress (Herman, Polivy, Lank, & Heatherton, 1987), strong habits persist even when willpower is low (Neal, Wood, & Drolet, 2013) and when attention is diverted elsewhere (Botvinick & Bylsma, 2005; Wood, Quinn, & Kashy, 2002). Through studies using experience sampling, it is estimated that one third to one half of our daily actions are guided by habits (Wood et al., 2002), including numerous health-related behaviors, such as fruit and vegetable intake, smoking, alcohol consumption, and physical activity (Brug, de Vet, de Nooijer, & Verplanken, 2006; Gardner, de Bruijn, & Lally, 2012; Orbell & Verplanken, 2010; Verplanken, & Melkevik, 2008). Furthermore, interventions focused on increasing health-promoting behaviors through habit formation have found behavior-change effects lasting over 6 months

(Lally, Chipperfield, & Wardle, 2008).

To explain how habits become automatic, past research has focused primarily on the role of behavioral repetition and consistency (e.g., Lally et al., 2010; Neal, Wood, Wu, & Kurlander, 2011). Habit formation follows an asymptotic curve, such that the first few repetitions of a behavior lead to large increases in automaticity, but with additional repetitions, changes in automaticity increase gradually until a limit is reached (Lally et al., 2010). In a study on habit formation, Lally and colleagues (2010) found that it took between 18 to 254 days for participants to reach 95% of their asymptote of automaticity. This finding suggests that considerable variability exists in the time it takes for a repeated behavior to become automatic. To date, little is known about why the speed of habit formation varies across individuals and situations. Having established that habits have a robust influence on behavior, including behaviors with important health implications, research is needed that identifies the conditions that affect the speed at which automaticity develops.

As reviewed previously, automatic habits develop from associations between environmental cues and behavioral tendencies. In experimental studies of habit formation, participants are instructed to link behaviors to a salient daily event (i.e., a cue), such as time of day (e.g., eat fruit with lunch; Lally et al., 2010). In a related vein, research by Gollwitzer and colleagues has found that pre-deciding how to act in response to specific, situational cues, a strategy known as implementation intentions, promotes goal attainment (Gollwitzer, 1999; for a review see Gollwitzer & Sheeran, 2006). Implementation intentions involve planning when, where and how one will execute a goal in an if-then format (e.g., “If I encounter X situation, then I will respond by Y”; Gollwitzer, 1999). By increasing the accessibility of anticipated situational cues, implementation intentions help people to detect good opportunities in their environment to act (Aarts, Dijksterhuis, & Midden, 1999; Webb & Sheeran, 2004). Once a cue is detected, like habits, implementation intentions proceed in an effortless manner because control of the behavior has been transferred from the conscious will of the individual to cues in the environment (Gollwitzer, 1999; Gollwitzer & Schaal, 1998). Taken together, research on habits and implementation intentions suggests that thinking in a localized (rather than global) manner that promotes attention towards environmental cues plays an important role in the development of behavioral automaticity.

Levels of Construal and Habits

Examining people's general orientation towards thinking in a localized, specific manner may help to clarify the conditions under which automaticity develops. As people make efforts to establish good habits, such as engaging in regular exercise, they may think about exercise in terms of the specific, concrete procedures (e.g., "How do I exercise?") or in terms of the general, abstract purpose (e.g., "Why do I want to exercise?"). Conceptualizing a behavior in terms of its concrete vs. abstract features is referred to as a difference in construal level (Trope & Liberman, 2003; 2010). When people construe information abstractly, they are more likely to attend to the superordinate, defining features of an event, such as the general purpose of carrying out a behavior (Liberman, Sagistano, & Trope, 2002; Liberman & Trope, 1998). Conversely, when people construe information concretely they are more likely to focus on subordinate, idiosyncratic features, such as the specific procedures of carrying out a behavior.

People can be led to think in an abstract or concrete manner through experimental manipulations of psychological distance (e.g., time, physical space), such that psychologically distant events promote abstract thinking, whereas proximal events promote concrete thinking (Liberman & Trope, 1998; Fujita, Henderson, Eng, Trope, & Liberman, 2006a). Additionally, abstract vs. concrete thinking can be manipulated by thinking about actions in terms of how or why are performed (Freitas, Gollwitzer, & Trope, 2004) or in terms of broad or narrow object categories (Fujita, Trope, Liberman, Levin-Sagi, 2006b). Abstract and concrete thinking can be activated as a mindset, such that leading people to think in an abstract or concrete manner in one domain impacts subsequent judgments or behaviors in other, unrelated domains (Freitas et al., 2004; Fujita et al., 2006b).

Concrete and abstract thinking promote effective self-regulation in distinct ways. For example, several studies have found that, relative to thinking concretely, abstract thinking helps people to exert self-control (Fujita, 2008; Fujita et al., 2006b; Mischel, Shoda, & Rodriguez, 1989). When people construe information in an abstract (vs. concrete) manner they withstand physical discomfort in service of goal-pursuit for longer durations (Fujita et al., 2006b), prefer healthy foods over unhealthy ones (Fujita & Han, 2009), make better judgments about future temptations (Fujita & Roberts, 2010), and spend more minutes exercising (Sweeney & Freitas, 2014). Furthermore, abstract thinking leads people to perceive less conflict across their various life goals (Clark & Freitas, 2013), and improves decision-making under situations of information overload (Fukukura, Ferguson, & Fujita, 2013).

Although abstract thinking appears to be useful when people need to choose between competing goals and information, concrete thinking appears to be more effective when people need to focus on when and how to execute a behavior. One recent study found that, among people who formed implementation intentions for an upcoming hand gripping task, those in an abstract mindset performed worse on that task than those in a concrete mindset (Wieber, Sezer, & Gollwitzer, 2014). Conversely, people who formed general intentions (i.e., they did not specify plans of when and how to act) for the upcoming task performed better on the task if they were in an abstract (vs. concrete) mindset. These authors conclude that abstract thinking facilitates motivation to act through effortful top-down control, but it has a detrimental effect on the automatic bottom-up control that is needed to recognize situational cues of when and how to act. Thus, in situations where it is important to be able to detect situational cues that guide one's behavior, concrete thinking appears to be more effective than abstract thinking.

Previous research has examined the effect of concrete vs. abstract thinking on behavioral execution within the context of cross-sectional, lab-based studies. However, we still do not know how concrete vs. abstract thinking impacts the execution of behaviors that require repetition across time. Given that habit formation is considered a gradual process (Lally et al., 2010), an investigation of the impact of concrete vs. abstract thinking on behaviors that extend beyond a single lab session is warranted. Furthermore, whereas Wieber and colleagues (2014) experimentally manipulated intention formation before manipulating construal level, no research has been conducted to directly assess whether concrete vs. abstract thinking impacts how people plan and execute repeated goal-directed behaviors.

Substitutability and Feedback Sensitivity

In addition to impacting people's ability to detect important situational cues, another way in which concrete thinking may impact behavior execution is by increasing the motivational significance of planned actions. When people think abstractly (relative to concretely), they perceive greater correspondence across their various life goals (Clark & Freitas, 2013; Freitas, Clark, Kim, & Levy, 2009). As a result, when people think abstractly they are more likely to see their life goals as substitutable for one another (Clark & Freitas, 2013). For an individual in an abstract mindset, then, there may be a number of ways in which to achieve an overarching goal (e.g., life happiness can be achieved through exercise or academic success). Conversely, for an individual in a concrete mindset, any missed opportunity to execute a planned behavior will be more motivationally significant because the relations between one's actions and one's broader aims are less accessible.

Accordingly, another consequence of thinking in a specific, concrete manner is an increased sensitivity to feedback. A number of studies have indicated that when people adopt a relatively narrow view of the self, relative to a broader, more complex self-view, they respond to failure with more extreme affective responses (Linville, 1985; Niedenthal, Setterlund, & Wherry, 1992) and greater defensiveness (Dixon & Baumeister, 1991). Relatedly, relative to concrete thinking, past research has found that abstract thinking increases receptivity towards receiving evaluative feedback (Freitas et al., 2004; Freitas, Salovey, & Liberman, 2001), presumably because abstract thinking buffers against the negative impact of critical feedback. Indeed, negative feedback has a stronger impact on people's state self-esteem when they are led to think in a concrete (vs. abstract) manner (Vess, Arndt, & Schlegel, 2011). Thus, concrete thinking may facilitate behavior execution because people have more extreme affective responses when they succeed or fail in their goal-pursuit than they do when thinking abstractly.

Overview of the Present Research

As described above, concrete thinking helps people to detect situational cues of when to act and increases the motivational significance of behavior execution by decreasing perceptions of substitutability of goals and by increasing sensitivity towards evaluative feedback. Drawing on this research, I hypothesized that concrete (relative to abstract) thinking facilitates the development of consistency in repeated behaviors across time, leading to greater increases in automaticity. Furthermore, I hypothesized that the effect of concrete vs. abstract thinking on behavioral consistency relates to differences in feedback sensitivity.

I conducted three experiments to test these predictions. In Experiments 1 and 2, consistency and automaticity were assessed in the context of exercise behavior. Exercise was chosen as the target behavior, in part, because past research has found that exercise habits exert a moderate influence on exercise behavior (for a meta-analytic review, see Gardner, de Bruijn, & Lally, 2011). In Experiments 1 and 2, participants were asked to commit to the goal of exercising four times per week for two weeks. Across these two weeks, participants were led to think about their physical health in a concrete or abstract manner. Participants completed daily reports of their exercise behavior, of their positive and negative affect in regards to the exercise goal, and of their plans to exercise the next day.

In Experiment 1, I examined whether thinking about one's health in a concrete vs. abstract manner impacted the consistency of exercise behavior, and the relationship between planned and actual minutes of exercise across the two-week period. By leading people to actively reflect each day on their progress towards meeting the exercise goal, participants' daily reports of their minutes of exercise acted as a form of evaluative feedback. Participants' affective responses to this feedback (i.e., how positive or negative they felt about their effort to exercise that day) were used as an index of feedback sensitivity.

Whereas Experiment 1 provided an initial test of the influence of construal level on behavioral consistency, Experiment 2 builds on Experiment 1 by including a direct measure of automaticity. In Experiment 2, automaticity was assessed using the automaticity subscale from the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI is the most widely used measure of habits among studies of health behavior (Gardner et al., 2011); it consists of three subscales: repetition, automaticity, and relevance to self-identity. I included only the automaticity subscale because automaticity is considered the defining feature of habits (Gardner et al., 2012; see Galla & Duckworth, 2015 for a similar approach). The four-item subscale has acceptable internal reliability and shows similar convergent and predictive validity with the full 12-item scale (Gardner et al., 2012). In Experiment 2, subjective automaticity was assessed in regards to exercise behavior at the beginning, middle, and end of the two-week period.

Experiment 3 examined whether concrete vs. abstract thinking impacts automaticity at the level of information categorization. Although research has begun only recently to examine the role of automaticity within the context of health-related behaviors, automaticity long has been used as a framework for understanding practice effects across a number of domains. Specifically, research on practice effects has found that repetition leads to large improvements in performance early on, but as practice continues there is a pattern of diminishing returns. As a task is repeated, the time it takes to perform that task decreases as a power function (Logan, 1992; Newell & Rosenbloom, 1981). Having found that this pattern characterizes learning across a wide variety of tasks, including cigar rolling (Crossman, 1959), retrieving facts from memory (Pirolli & Andreson, 1985), and making lexical decisions (Logan, 1988), this pattern is referred to as a power *law* (Newell & Rosenbloom, 1981). A number of theories have been proposed to explain how practice leads to automatic processing (for a review, see Moors & de Houwer, 2006). For example, Logan (1988) proposed that the power curve reflects a transition from using multi-step algorithmic processing to single-step memory retrieval.

To gain further insight into the extent to which concrete (vs. abstract) thinking facilitates automaticity and consistency, Experiment 3 examined whether concrete vs. abstract thinking impacts the rate at which repeated responses speed up across time and become consistent. That is, I tested whether abstract (relative to concrete) thinking impacts the speed at which repeated judgments become automatic. Whereas Experiments 1 and 2 were field-based studies, as a lab-based study, Experiment 3 allowed for greater experimental control than was possible in Experiments 1 and 2. Furthermore, by examining whether construal level impacts automaticity at the level of information categorization, Experiment 3 allowed for a broader perspective of the ways in which concrete vs. abstract thinking facilitates automaticity.

In Experiment 3, participants completed a speeded response-time task in which they were given a target word (e.g., “area”) and were asked to quickly decide which of two possible choices best describes this word (e.g., “range” or “field”). This task is designed so that there is no wrong answer. Instead, participants must decide based on personal preference. Consistent with the methods of Logan (1988), participants were shown numerous repetitions of the same stimuli. I hypothesized that participants in the concrete (relative to abstract) condition would show a more rapid speed up of response times across trials and would be quicker to settle on a consistent preference.

Aims and Hypotheses

Experiment 1 Aim: This experiment examined how thinking in a concrete vs. abstract manner impacted goal-related affect, exercise plans, and exercise behavior across a two-week period. Whereas Experiment 1 was exploratory, Experiment 2 was a confirmatory study in which I sought to replicate and extend findings from Experiment 1. Within the last few years, replicability in research has received increased attention as a critical component of cumulative science (Asendorpf et al., 2013; Nosek et al., 2012).

Experiment 2 Aims: This experiment aimed: 1) to replicate and confirm the findings from Experiment 1 on goal-related affect, planning, and behavioral consistency; and 2) to test whether people in the concrete (relative to abstract) condition develop a greater increase in exercise automaticity across the two weeks of the study.

Hypothesis 1: Participants in the concrete (relative to abstract) condition will show greater consistency in their exercise behavior across the two weeks of the study, as assessed by examining the relationships between daily minutes of exercise, planned minutes of exercise, and future minutes of exercise.

Hypothesis 2: Participants in the concrete (relative to abstract) condition will demonstrate a greater increase in subjective exercise automaticity across the two weeks of the study.

Hypothesis 3: Participants in the concrete (relative to abstract) group will demonstrate greater feedback sensitivity, such that goal-related affect will impact behavioral consistency in the concrete group, but not the abstract group.

Experiment 3 Aims: This experiment aimed to examine whether concrete vs. abstract thinking impacts automaticity and consistency at the level of information categorization. Experiment 3 used a speeded response time task to examine consistency in preferred responses and the speed up of responses across time.

Hypothesis 1: Participants' mean response times will speed up across blocks and this speed up will be more extreme in the concrete group, such that the average change in response times across blocks will be greater in the concrete group than the abstract group.

Hypothesis 2: Participants in the concrete group will be quicker to settle on a consistent preference, such that the average change in the number of switches across blocks would be greater in the concrete group than the abstract group.

Chapter 2

Experiment 1

Experiment 1 investigated how focusing on the concrete procedures vs. the abstract purpose of action influences adherence to intentions to exercise. Participants were assigned randomly to the concrete or abstract condition, and they were asked to commit to exercising four times per week for two weeks. For the following two weeks, they completed daily measures of their exercise-related plans, positive and negative affect, and behavior.

Participants

210 undergraduate students participated in exchange for course credit and for the opportunity to win $25 in a lottery. Prior to conducting any data analyses, 14 participants were excluded because of a technological or experimenter error (n = 12), or because their baseline exercise data and their total minutes of exercise across the two weeks of the study were more than 3 standard deviations from the mean (n = 2). Additionally, 16 participants completed less than half of the follow-up surveys, yielding insufficient data for analysis. Thus, the final sample consisted of 180 participants, (42 male), aged 17 - 32, (M = 19.63, SD = 2.287). Regarding race and ethnicity, 36.7% (N =77) described themselves as other or mixed, 23.8% (N = 50) as Black, 15.7% (N = 33) as White, 9.5% (N = 20) as East Asian, 7.6% (N = 16) as South East Asian, and 6.7% (N =14) as Latino/a.

To determine the appropriate sample size, I conducted a power analysis, which indicated that in each condition, 80 participants were required, to achieve statistical power (1- β) of .80 with α = .05 with an estimated effect size of Cohen's d = 0.45.

Procedures

Screening Protocol

The aim of the screening procedure was to identify individuals who are already engaging in at least some physical activity and intend to continue to do so. To be eligible, participants could not indicate that they exercise 0 days/week. Additionally, using 5-point scales, participants responded to the following items: “Overall how important is getting more physical activity/exercise to you?” and “How strongly committed are you to getting more physical activity/exercise in the next 4–6 months?” To be eligible, participants had to indicate a score of at least 3 on both items (“*Moderately Important*” and “*Moderately Committed*”). Finally, to be eligible participants had to indicate that they were not pregnant, and that they did not participate in any sports teams at Stony Brook University.

Data Collection

The experiment consisted of one lab session and two weeks of daily online follow-up surveys. Upon entering the lab, participants were assigned randomly to the concrete or abstract condition. The lab session proceeded in four stages. After providing informed consent, participants read some brief educational materials from the United States Center for Disease Control (CDC), which were included to provide some context for the upcoming exercise goal commitment. Next, participants completed a measure of their baseline physical activity within the last week. Second, following a standardized script, a research assistant held a brief interview with the participant. As a cover story, participants were informed that “we are interested in understanding how people vary in their goals, behavior and memory. To be consistent across everyone who participates in this study, we are asking all of our participants to commit to carrying out the same goal”. All participants were asked, “For the purposes of this study, we are asking participants to try to exercise during the next two weeks. Specifically, during the next two weeks, would you be willing to commit to the goal of exercising moderately to vigorously for at least 30 minutes, 4 times each week?" Participants agreed verbally to commit to this goal. Additionally, to document their commitment, participants read and signed an "Exercise Goal Document" that provided specific instructions about the exercise goal and the daily online surveys.

Third, participants completed a 2-part construal level manipulation. First, they completed Freitas et al.'s (2004) mindset manipulation in which they considered how (concrete conditions) or why (abstract condition) to improve and maintain their physical health. After completing a hard copy of this task, participants were asked to type their responses into an electronically-administered survey (emailed to participants via qualtrics.com), so that they could view their responses to the how/why diagram during the daily follow-up surveys. In the second part of the construal level manipulation, participants viewed a series of behaviors from Vallacher and Wegner's (1989) Behavioral Identification Form (BIF) and reframed these behaviors in terms of how (concrete condition) or why (abstract condition) they are performed (Critcher & Ferguson, 2011). Fourth, participants completed measures of exercise importance, perceived goal conflict, goal commitment, anticipatory and current emotions about the exercise goal, implicit beliefs about the nature of people, regulatory focus, trait self-control, and demographic items.

Starting the day after the lab session, participants completed daily online surveys for the next 14 days to track their progress towards the exercise. Each day they reported the amount of minutes they spent exercising and the type of exercise they did. Next, to remind participants of the abstract purpose or concrete procedures of action, participants completed an unfinished diagram that resembled the how or why diagram they completed in the lab. Finally, they reported their positive and negative affect about their effort towards meeting their exercise goal and their plans to exercise the next day.

Measures and Materials

Educational fliers. The first flier, "Be Active Your Way: A Fact Sheet for Adults," described what kind and how much physical exercise is needed for a healthy adult, and it included definitions and examples of moderate and vigorous activities. The second flier, "There are a lot of ways to get the physical activity you need," provided examples of exercise schedules.

Exercise Behavior. Baseline and follow-up exercise were measured with the short version of the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003). At baseline, participants reported their exercise over the last 7 days, including days of vigorous and moderate activity, and the average number of minutes spent daily on each of these types of activity. To compute baseline physical activity scores (i.e., total minutes of physical activity at baseline), I used the following equation: (days spent on vigorous exercise * average minutes spent on vigorous exercise) + (days spent on moderate exercise * average minutes spent on moderate exercise). In the follow-up questionnaires, these items were adapted to ask about minutes spent on vigorous and moderate exercise.

Construal Level Manipulation. In Freitas et al.'s (2004) mindset manipulation participants completed a diagram in which they considered how or why they, "Improve and Maintain Health." In the concrete condition, the goal is listed at the top of the page with four blank boxes positioned below it. Conversely, in the abstract condition, the goal is listed at the bottom of the page, with four blank boxes positioned above it. These diagrams are structured so that those in the concrete condition give increasingly specific responses, whereas those in the abstract condition give increasingly broad responses.

Next, participants viewed a list of 25 behaviors from Vallacher and Wegner's Behavior Identification Form (1989; BIF). Following the procedures of Critcher and Ferguson (2011), participants reframed each behavior (e.g., “Making a list”) in terms of how (concrete condition) or why (abstract condition) the behavior is performed. After providing their own reframing of the 25 behaviors, participants rated from 1 (*Not at All Well*) to 5 (*Perfectly*), how well a provided description (i.e., the abstract or concrete response from the original form) captured how or why one would perform each behavior. Thus, participants repeatedly reconstrued behaviors in terms of their abstract purpose or concrete process and were exposed to the concrete and abstract choices from the original BIF.

Exercise importance. Participants responded to the item, “How important is exercising to you?” using a 5-point scale.

Perceived goal conflict. Participants responded to the item, “To what extent does succeeding in your exercise goal have a helpful or harmful effect on other goals you may have” using a 5-point scale (adapted from Emmons & King, 1988).

Goal commitment. Participants completed Klein, Wesson, Hollenbeck, Wright, and Deshon’s (2001) five-item scale in reference to the exercise goal.

Affect. *Anticipatory affect* about the exercise goal was assessed in the lab with positive and negative affect items adapted from Bagozzi, Baumgartner, and Pieters (1998). Additionally, in lab participants rated their *current affect* about the exercise goal using the valence and arousal scales of the Self-Assessment Manikin (Bradley & Lang, 1994). These same items were used also for the daily follow-up questionnaires to assess participants’ daily affect.

Implicit Person Theories. Participants completed Chiu, Hong and Dweck’s (1997) three-item scale, which assesses the extent to which people’s general tendencies are fixed or malleable.[1]

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[1] The Implicit Person Theories, Regulatory Focus and Self-Control scales were included to rule out potential alternative explanations.

Regulatory Focus. Participants completed Higgins et al. (2001) eleven-item regulatory focus questionnaire, which assesses the extent to which people's subjective history of promotion vs. prevention success.

Self-control. Participants completed Tangney, Baumeister & Boone (2004) 13-item scale, which assesses trait self-control.

Exercise Plans. In the daily surveys participants reported whether they planned to exercise the next day, the type of exercise they planned to do (moderate vs. vigorous), the specific activities they planned to do (e.g., cardio), and the number of minutes they planned to spend on vigorous and moderate exercise (using a 5-point scale, such that 1 = *0-15 minutes*, 5 = *More than 60 minutes*). Participants' total number of planned minutes of exercise (i.e., moderate + vigorous) was used as a measure of their planned exercise for the next day.

On the final day of the study, participants rated how challenging they found the exercise goal to be, and how satisfied they were with their effort to pursue the goal using 5-point scales ranging from 1 (*Not at All)* to 5 (*Extremely*).

Results

Overview of data analyses

Data analyses proceeded in four steps. First, I checked for outliers in the baseline and follow-up exercise scores using the guidelines for the short version of the IPAQ (Sjöström et al., 2005). Consistent with these guidelines, participants who reported more than 180 min of activity per day both at baseline or on any of the follow-up days were considered outliers. Values exceeding 180 were recoded to be equal to 180 min. Second, I checked that the randomization of participants to conditions was successful. Third, I examined whether there was a difference in the total number of minutes of exercise between the two groups. Fourth, I tested whether construal level moderated behavioral consistency by examining whether construal level impacted: 1) the relationship between today's minutes of exercise and plans to exercise tomorrow, 2) consistency in exercise behavior across subsequent days, and 3) consistency in executing exercise plans into actual behavior across the two weeks of the study. Fifth, I tested whether construal level moderated goal-related affect by examining whether: 1) construal level moderated the degree of positive or negative affect people felt when they met or did not meet their exercise goal, and 2) whether differences in goal-related affect arising from construal level explained when people translated exercise plans into behavior.

For these analyses, I conducted hierarchical linear modeling. All hierarchical linear models were conducted using the SAS Proc Mixed procedure. The Intraclass correlation (ICC) for the outcome variables included: .303 (SAM Valence), .361 (Sam Arousal), .343 (Positive Affect), .340 (Negative Affect), .261 (Total Minutes) and .590 (Total Planned Minutes), indicating that between 26.1 to 59% of the variance in the outcome variables was associated with difference between individuals. In daily diary studies, an ICC between .2 - .4 is considered typical for multilevel modeling (Bolger & Laurenceau, 2013).

To account for the passage of time and for potential autocorrelation effects (that is, that measures taken close together in time may be more similar than measures taken further apart in time), an autoregressive model was used, and day of the study was included as a continuous predictor in all models and rescaled such that day 1 = 0, day 7 = .50, and day 14 = 1 (Bolger & Laurenceau, 2013). Degrees of freedom were calculated based on the number of participants rather than the number of observations (Bolger & Laurenceau, 2013).

Randomization Check

Body mass index, age, and baseline exercise were submitted to a multivariate analysis of variance (MANOVA), which was nonsignificant, $F(3, 176) = 1.13$, $p = .338$, $\eta^2_p = .02$. The univariate tests were not significant (Fs(1, 179) = .038-2.43, ps = .846 - .121, η^2_p = .00-.01). Furthermore, there was no difference in the number of men and women in each condition, ($\chi^2(1, 180) = 1.12$, $p = .290$). Thus, the randomization of participants to conditions was successful.

Impact of Construal Level on Total Exercise Behavior

The abstract group ($M = 515.11$, $SD = 254.01$) spent numerically more minutes exercising than the concrete group ($M = 496.21$, $SD = 244.79$), but the difference was not significant, $t(178) = .51$, $p = .612$. Furthermore, there was no difference in the number of days spent exercising between the concrete ($M = 9.60$, $SD = 2.62$) and the abstract group ($M = 9.71$, $SD = 2.73$), nor a difference in the average number of minutes spent exercising each day (Concrete: $M = 42.87$, $SD = 20.71$, Abstract: $M = 43.25$, $SD = 19.78$).

Impact of Construal Level on Exercise Plans and Exercise Consistency

To examine whether construal level impacts the relationship between daily minutes of exercise and plans to exercise the next day, hierarchical linear modeling was used to predict minutes of planned exercise for tomorrow from: day of the study, minutes of exercise on a given day, assignment to the concrete or abstract condition (coded as "0" and "1", respectively), and the interaction between condition and total minutes of exercise. As shown in Figure 1, there was a significant interaction, *Coefficient* = -.005, $SE = .01$, $t(177)$, = -2.80, $p = .006$, such that minutes of exercise was associated with minutes of planned exercise for tomorrow in the concrete condition, *Coefficient* = .007, $SE = .01$, $t(88) = 5.16$, $p < .001$, but not the abstract condition, *Coefficient* = .002, $SE = .01$, $t(88) = 1.29$, $p = .201$.

Next, I examined whether construal level impacts how consistent people are in the amount of time they spent exercising on a subsequent day. I used hierarchical linear modeling to predict minutes of exercise on a given day from: day of the study, minutes of exercise on the previous day, assignment to the concrete or abstract condition, and the interaction between minutes of exercise on the previous day and condition. There was a significant interaction, *Coefficient* = -.102, *SE* = .05, $t(177)$, = -2.08, $p = .040$. Although the slopes are different, the simple effect of minutes of exercise yesterday on minutes of exercise today failed to reach significance in both the concrete, *Coefficient* = .061, *SE* = .04, $t(88) = 1.74$, $p = .085$, and abstract conditions, *Coefficient* = -.028, *SE* = .03, $t(88) = -.83$, $p = .409$.

Impact of Construal Level on Planning Consistency across Time

To examine whether construal level impacted how consistent people were at translating exercise plans into exercise behavior across the two weeks of the study, I used hierarchical linear modeling to predict minutes of exercise from: day of the study, yesterday's exercise plans, assignment to the concrete or abstract condition, and the product of the three predictor variables. The three-way interaction failed to reach significance, *Coefficient* = -7.410, *SE* = 3.81, $t(177)$, = -1.94, $p = .053$.[2]

Impact of Construal Level on Goal-Related Affect

To examine whether there were differences in goal-related affect between the two conditions, I used hierarchical linear modeling to predict affect scores from: day of the study, participants' minutes of exercise on a given day, their assignment to the concrete or abstract condition, and the interaction between condition and total minutes of exercise. Using valence scores from the self-assessment manikin (SAM), there was a significant interaction between

[2] In my proposal, I originally found this effect to be larger ($p < .05$); however, I identified an organizational error in the data file. Once this was corrected for, the effect was found to be marginal.

minutes of exercise and construal level condition, *Coefficient* = .007, *SE* = .01, t(177), = 3.21, p = .002. On days when participants spent relatively more minutes exercising, those in the concrete group (*Coefficient* = -.038, *SE* = .01, t(88) = -24.58, $p < .001$) expressed greater positive affect than did those in the abstract group (*Coefficient* = -.031, *SE* = .01, t(88) = -22.74, $p < .001$). Using arousal scores from the SAM, there was a significant interaction between minutes of exercise and construal level condition, *Coefficient* = .009, *SE* = .01, t(177), = 3.89, $p < .001$. On days where participants spent relatively more minutes exercising, those in the concrete group (*Coefficient* = -.038, *SE* = .01, t(88) = -23.18, $p < .001$) expressed greater arousal than did those in the abstract group (*Coefficient* = -.030, *SE* = .01, t(88) = -19.73, $p < .001$).

Similarly, using positive affect scores, there was a significant interaction between minutes of exercise and construal level condition, *Coefficient* = -.005, *SE* = .01, t(177) = -3.06, p = .003. On days where participants spent more minutes exercising, those in the concrete group (*Coefficient* = .031, *SE* = .01, t(88) = 24.89, $p < .001$) expressed greater positive affect than those in the abstract group (*Coefficient* = .026, *SE* = .01, t(88) = 22.46, $p < .001$). However, using negative affect scores, there was not a significant interaction between minutes of exercise and construal level condition, *Coefficient* = .001, *SE* = .01, t(177) = .25, p = . 803.

Impact of Construal Level on Goal-Related Affect and Exercise Plans

To examine whether differences in goal-related affect arising from construal level explain when exercise plans lead to action, hierarchical linear modeling was used to predict minutes of exercise on a given day from yesterday's exercise plans, yesterday's affect score, assignment to the concrete or abstract condition, and the interaction between the three predictors. For SAM Valence and SAM Arousal scores there was no significant three-way interaction. However, there was a significant three-way interaction for positive affect scores (*Coefficient* = -1.320, *SE* = .63,

$t(172) = -2.10$, $p = .036$, and for negative affect scores (*Coefficient* = 1.880, $SE = .85$, $t(172) = 2.23$, $p = .026$).

To clarify the nature of this interaction, I examined the interaction between yesterday's exercise plans and affect for each construal level condition for positive and negative affect scores. For positive affect scores, there was a significant interaction between yesterday's affect and yesterday's exercise plans in the concrete condition, *Coefficient* = 1.020, $SE = .47$, $t(88) = 2.17$, $p = .033$, but not in the abstract condition, *Coefficient* = -.310, $SE = .41$, $t(88) = -.75$, $p = .454$ (See Figure 2). For negative affect scores, there was a significant interaction between yesterday's affect and yesterday's exercise plans in the concrete condition, *Coefficient* = -2.163, $SE = .689$, $t(88) = -3.15$, $p = .002$, but not in the abstract condition, *Coefficient* = -.27, $SE = .45$, $t(88) = -.61$, $p = .546$. In the concrete group, plans to exercise a relatively high number of minutes were associated with more minutes of exercise when people experienced relatively high positive affect and relatively low negative affect on the previous day.

Discussion

Consistent with the possibility that concrete (vs. abstract) thinking facilitates consistency, Experiment 1 found that people in the concrete group were more consistent in their exercise behavior across subsequent days of the study, and on days when they exercised a relatively high amount they made plans to exercise a relatively high amount again the next day. Furthermore, consistent with previous research indicating that a concrete (relative to an abstract) focus increases sensitivity to evaluative feedback, Experiment 1 provides initial evidence that goal-related affect has a stronger effect on behavior when people think concretely. Specifically, I found that people in the concrete group felt especially positive on days when they exercised more, and that differences in affect explained when people in the concrete condition were successful at translating yesterday's exercise plans into future exercise behavior. As noted above, these findings resulted from exploratory analyses; thus, they should be interpreted provisionally until they are replicated in a confirmatory experiment.

Chapter 3

Experiment 2

In Experiment 2, I sought to replicate and extend the findings from Experiment 1. The goals of Experiment 2 were 1) to replicate the findings from Experiment 1 on goal-related affect, planning and consistency and 2) to test whether people in the concrete condition develop a greater increase in subjective experiences of exercise automaticity across the two weeks of the study relative to people in the abstract condition.[3]

Participants

241 undergraduate students participated in exchange for course credit and the opportunity to win $25 in a lottery. Prior to conducting any data analyses, 2 participants were excluded because of a technological or experimenter error. 1 participant was excluded because he or she spent 0 minutes exercising across the two week period. Additionally, 16 participants completed fewer than 8 of the follow-up surveys, yielding insufficient data for analysis. Thus, the final sample consisted of 222 participants, (86 male), aged 17 - 47, (M = 20.01, SD = 3.13). Regarding race and ethnicity, 33.8% (N = 75) described themselves as White, 26.1 % (N = 58) as East Asian, 14.4% (N = 32) as South East Asian, 12.2% (N = 27) as other or mixed, 6.8% (N = 15) as Black, and 6.8% (N = 15) as Latino/a.

To determine the appropriate sample size, I conducted a power analysis which indicated that in each condition, 80 participants were required to achieve statistical power level (1- β) of

[3] As detailed below, a measure of integrated exercise motivation also was included in this experiment to examine differences in exercise motivation between the 2 groups. It was hypothesized that people in the abstract condition would express greater integrated motivation to exercise than the concrete condition at the onset of the study.

.80 with α = .05 with an estimated effect size of Cohen's d = 0.45. Based on Experiment 1, I anticipated that there will be an attrition rate of approximately 15%. Thus, I planned to oversample by approximately 15% (N = 210).

Procedures

Experiment 2 followed nearly identical procedures as were followed in Experiment 1, with the following changes:

1) After reporting their baseline exercise behavior in lab, participants completed the automaticity subscale from the Self-Report Habit Index (Verplanken & Orbell, 2003). Exercise automaticity was measured also at the end of first and second week of the study via the online questionnaires for those days.

2) Perceived behavioral control will be assessed in lab with the item “For me, exercising four times per week for the next two weeks will be: *Very Difficult*, *Difficult*, *Somewhat Difficult*, *Somewhat Easy*, *Very Easy*. Additionally, participants rated how difficult it was to exercise four days per week at the end of the first and second week of the study via the online questionnaires for those days.

3) In place of the regulatory focus questionnaire during the lab session, participants completed the integrated and external regulation subscales from the Exercise Regulation Questionnaire (Markland & Tobin, 2004; Wilson et al., 2006) as a measure of exercise motivation. Participants completed this measure again on the last day of the study via the online questionnaire for day 14.

Before data collection began, all methods, hypotheses, and planned analyses for Experiment 2 were pre-registered on Open Science Framework on 2/13/2015. The registration can be viewed at: https://osf.io/tjsev/?view_only=c150d31b6b9d4c9aa014450176e048ae.

Again, hierarchical linear modeling was used to test the hypotheses. The Intraclass correlation (ICC) for the outcome variables included: .325 (SAM Valence), .371 (Sam Arousal), .364 (Positive Affect), .383 (Negative Affect), .305 (Total Minutes) and .589 (Total Planned Minutes), indicating that between 30.5 to 58.9% of the variance in the outcome variables was associated with difference between individuals.

Results

Randomization Check

As with Experiment 1, body mass index, age, and baseline minutes of weekly exercise were submitted to a multivariate analysis of variance, which was nonsignificant, $F(3, 218) = 1.27$, $p = .285$, $\eta^2_p = .02$. The univariate tests were not significant (Fs(1, 220) = .00 – 2.10, ps = .148-.982, η^2_p = .00-.01). Furthermore, there was no difference in the number of men and women in each condition, ($\chi^2(1, 221) = .60$, $p = .439$). Thus, the randomization of participants to conditions appears to have been successful.

Impact of Construal Level on Total Exercise Behavior

Again, the abstract group (M = 488.49, SD = 271.27) spent numerically more minutes exercising than the concrete group (M = 465.03, SD = 238.43), but the difference was not significant, $t(220) = -.68$, $p = .501$. Furthermore, there was no difference in the number of days spent exercising between the concrete (M = 8.82, SD = 2.94) and the abstract group (M = 9.32, SD = 2.87), nor a difference in the average number of minutes spent exercising each day (Concrete: M = 38.95, SD = 35.70, Abstract: M = 40.13, SD = 34.34).

Impact of Construal Level on Automaticity

A repeated measures ANOVA was used to test whether people in the concrete (relative to abstract) condition developed a greater increase in exercise automaticity across the two weeks of the study. 77 participants in the concrete group and 81 in the abstract group completed the measure of automaticity at all three time points. Mauchley's test indicated that the assumption of sphercity was violated for the main effect of time, Mauchly's $W = .93$, $p = .003$. Therefore, degrees of freedom were calculated using's Huynh-Feldt's estimate of sphercity. The results indicated that there was there was a main effect of time, $F(1.90, 296.63) = 3.80$, $p = .025$, $\eta^2_p = .02$, but this effect was not moderated by condition, $F(1.90, 296.63) = .23$, $p = .783$, $\eta^2_p < .01$. At baseline automaticity scores were near the midpoint of the scale ($M = 4.00$, $SD = 1.35$), decreased slightly at the end of week 1 ($M = 3.72$, $SD = 1.61$) and increased slightly at the end of the week 2 ($M = 3.94$, $SD = 1.69$).

Impact of Construal Level on Integrated Motivation, External Motivation and Perceived Behavioral Control

A repeated measures ANOVA was used to test whether construal level impacted external and integrated motivation to exercise. Ninety four participants in the concrete group and 91 in the abstract group completed the measures of motivation during both the lab session and at the end of week 2. There was no effect of time for integrated motivation, ($F(1,183) = 3.15$, $p = .078$, $\eta^2_p = .02$), nor for external motivation ($F(1,183) = .01$, $p = .949$, $\eta^2_p < .01$. Furthermore, there was no interaction between time and condition for either integrated or external motivation.

A repeated measures ANOVA was used to test whether construal level impacted perceived behavioral control. Seventy seven participants in the concrete group and 81 in the abstract group completed the measures of perceived behavioral control during the lab session, at the end of week 1, and at the end of week 2. Mauchley's test indicated that the assumption of sphercity was violated for the main effect of time, Mauchly's $W = .926$, $p = .003$. Therefore, degrees of freedom were calculated using's Huynh-Feldt's estimate of sphercity. There was an effect of time for perceived behavioral control, $F(1.90, 295.90) = 20.66$, $p < .001$, $\eta^2_p = .12$, such that participants perceived the exercise goal as somewhat more difficult at the end of week 1 ($M = 3.56$, $SD = 1.20$) than at baseline ($M = 3.00$, $SD = 1.11$), and somewhat less difficult at the end of week 2 ($M = 3.52$, $SD = 1.32$). However, there was no interaction between time and condition, $F(1.90, 295.90) = .706$, $p = .487$, $\eta^2_p = .01$.

Impact of Construal Level on Exercise Plans and Exercise Consistency

To examine whether construal level impacts the relationship between daily minutes of exercise and plans to exercise the next day, hierarchical linear modeling was used to predict minutes of planned exercise for tomorrow from day, total minutes of exercise on a given day, assignment to the concrete or abstract condition, and the interaction between condition and total minutes of exercise. Unlike in Experiment 1, there was no significant interaction, *Coefficient* = .002, $SE = .01$, $t(218)$, = 1.00, $p = .317$. However, there was a main effect of total minutes of exercise, *Coefficient* = -.016, $SE = .01$, $t(218) = -3.33$, $p < .001$.

Next, I examined whether construal level impacts how consistent people are in the amount of time they spent exercising on a subsequent days. I used hierarchical linear modeling to predict minutes of exercise on a given day from day, minutes of exercise on the previous day, assignment to the concrete or abstract condition, and the interaction between, minutes of exercise on the previous day and condition. Unlike Experiment 1, there was no significant interaction, *Coefficient* = -.006, $SE = .04$, $t(218)$, = -.14, $p = .890$. There was a main effect of day of the study, *Coefficient* = -6.897, $SE = 2.30$, $t(218) = -3.01$, $p = .003$, but no other main effects.

Impact of Construal Level on Planning Consistency across Time

To examine whether construal level impacted how consistent people were at translating exercise plans into exercise behavior across the two weeks of the study, I used hierarchical linear modeling to predict minutes of exercise from day of the study, yesterday's exercise plans, assignment to the concrete or abstract condition, and the product of the three predictor variables. Unlike in Experiment 1, this time there was a significant three-way interaction, *Coefficient* = 7.800, *SE* = 3.36, $t(218)$, = 2.33, $p = .021$. To clarify the nature of this interaction, I examined the interaction between yesterday's exercise plans and day of the study for each construal level condition. In the concrete condition, there was a negative association between day of the study and yesterday's exercise plans, *Coefficient* = -6.700, *SE* = 2.54, $t(107) = -2.63$, $p = .010$, suggesting that between week 1 and 2, participants became less effective at translating their exercise plans into behavior. In the abstract condition, there was no significant association between day of the study and yesterday's exercise plans, *Coefficient* = 1.050, *SE* = 2.22, $t(107)$ = .48, $p = .634$, suggesting that people remained equivalently accurate in their planning across the two weeks of the study.

Impact of Construal Level on Goal-Related Affect

To examine whether there were differences in goal-related affect between the two conditions, I used hierarchical linear modeling to predict affect scores from day, participants' minutes of exercise on a given day, their assignment to the concrete or abstract condition, and the interaction between condition and total minutes of exercise. Across all four affect measures there was no significant interaction between minutes of exercise and construal level condition, SAM Valence: *Coefficient* = -.003, *SE* = .01, $t(218)$, = -1.65, $p = .101$; SAM Arousal: *Coefficient* = .001, *SE* = .01, $t(218)$, = 0.61, p =.539; Positive Affect Score: *Coefficient* = .001, *SE* = .01, $t(218)$ = .28, $p = .783$; Negative Affect Score: *Coefficient* = -.001, *SE* = .01, $t(218) = -1.01$, $p = .312$. However, all four models revealed a significant main effect of day and minutes of exercise.

Impact of Construal Level on Goal-Related Affect and Exercise Plans

To examine whether differences in goal-related affect arising from construal level explain when exercise plans lead to action, hierarchical linear modeling was used to predict minutes of exercise on a given day from yesterday's exercise plans, yesterday's affect score, assignment to the concrete or abstract condition, and the interaction between the three predictors. Across all four affect measures, there were no significant three-way interactions (SAM Valence: *Coefficient* = .625, *SE* = .44, $t(212)$= 1.43, p = .156; SAM Arousal: *Coefficient* = .295, *SE* = .41, $t(212)$= .720, p = .472; Positive Affect Score: *Coefficient* = -.860, *SE* = .52, $t(212)$= -1.66, p = .098 ; Negative Affect Score: *Coefficient* = .848, *SE* = .71, $t(212)$= 1.20, p = .233).

Comparing the Results from Experiment 1 and Experiment 2

Commonalities

Because Experiment 2 failed to replicate the findings from Experiment 1, I examined whether there were basic commonalities across the two experiments. In both studies, plans to exercise significantly predicted the next day's minutes of exercise, Experiment 1: *Coefficient* = 9.776, *SE* = .66, $t(178)$ = 14.88, p <.001; Experiment 2: *Coefficient* = 7.623, *SE* = .59, $t(220)$ = 12.87, p <.001. Furthermore, across both studies minutes of exercise was positively associated with participants' plans to exercise the next day, Experiment 1: *Coefficient* = .004, *SE* = .01, $t(178)$ = 4.09, p <.001; Experiment 2: *Coefficient* = .003, *SE* = .01, $t(220)$ = 3.96, p <.001.

Additionally, in both studies participants reported higher levels of goal-related positive affect on days when they spent more (relative to fewer) minutes exercising, as indicated in their SAM Valence scores (Experiment 1: *Coefficient* = -.034, *SE* = .01, $t(178)$ = -33.17, p <.001; Experiment 2: *Coefficient* = -.038, *SE* = .01, $t(220)$ = -39.34, p <.001) and in their Positive Affect Scores (Experiment 1: *Coefficient* = .028, *SE* = .01, $t(178)$ = 33.14, p <.001; Experiment 2:

Coefficient = .031, *SE* = .01, $t(220) = 38.35$, $p < .001$). Similarly, across both studies participants reported higher levels of goal-related arousal on days when they spent more (relative to fewer) minutes exercising, as indicated in their SAM Arousal scores (Experiment 1: *Coefficient* = -.033, *SE* = .01, $t(178) = -29.88$, $p < .001$; Experiment 2: *Coefficient* = -.038, *SE* = .01, $t(220) = -35.84$, $p < .001$). Participants also reported lower levels of goal-related negative affect on days when they spent more (relative to fewer) minutes exercising, as indicated in their Negative Affect scores (Experiment 1: *Coefficient* = -.014, *SE* = .01, $t(178) = -18.17$, $p < .001$; Experiment 2: *Coefficient* = -.016, *SE* = .01, $t(220) = -23.40$, $p < .001$).

Differences

Next, I proceeded by pooling the data from both experiments together to conduct a series of exploratory analyses to examine potential differences between these two experiments. For a comparison of variables in Experiment 1 and 2, see Table 1. Participants in Experiment 1 spent a greater total number of minutes exercising across the two-week period than did participants in Experiment 2, $t(332.58) = 4.58$, $p < .001$, $d = .466$. Participants in Experiment 1 exercised on more days than did participants in Experiment 2, $t(400) = 2.09$, $p = .037$, $d = .211$. Additionally, more participants met the exercise goal during both weeks of the study in Experiment 1 than in Experiment 2, $\chi^2(1) = 4.53$, $p = .033$. Although plans to exercise were predictive of next-day exercise behavior in both experiments (as discussed above), this effect was moderated by Experiment, *Coefficient* = -1.978, *SE* = .88, $t(396) = -2.24$, $p = .026$, such that the effect of planning was more robust in Experiment 1, *Coefficient* = 9.78, *SE* = .66, $t(178) = 14.92$, $p < .001$, than in Experiment 2, *Coefficient* = 7.64, *SE* = .59, $t(218) = 12.91$, $p < .001$.

Second, a MANOVA revealed that among the variables measured during the initial lab session (baseline minutes of exercise, exercise importance, trait self-control, perceived goal conflict, commitment, anticipatory and current affect, age, and BMI), the only outcome on which participants varied between experiments was exercise importance. Participants in Experiment 2 indicated that exercise was more important to them than did participants in Experiment 1, $t(400) = -9.55$, $p < .001$, $d = .948$. The mean score for exercise importance in Experiment 1 and 2 differ by more than 1 standard deviation, exceeding Cohen's (1988) criterion for a large effect. Finally, Experiment 2 included more male participants than did Experiment 1, $\chi^2(1) = 12.58$, $p < .001$.

Third, I tested whether any of the hypothesized effects remained significant when data from both studies were pooled together. The effect of construal level on exercise plans and exercise consistency was not significant, nor was the effect of construal level on planning consistency across time. However, in regards to the impact of construal level on goal-related affect, consistent with the findings from Experiment 1, there was an interaction between total minutes of exercise and experimental condition when predicting SAM Arousal scores, *Coefficient* = .005, *SE* = .01, $t(399) = 3.42$, $p < .001$, such that minutes of exercise was associated with greater arousal in the concrete group, *Coefficient* = -.038, *SE* = .01, $t(200) = -35.80$, $p < .001$, than the abstract group, *Coefficient* = -.033, *SE* = .01, $t(198) = -30.32$, $p < .001$. Similarly, when predicting positive affect scores, there was an interaction between total minutes of exercise and condition, *Coefficient* = -.002, *SE* = .01, $t(399) = -2.10$, $p = .036$, such that minutes of exercise was associated with greater positive affect in the concrete group, *Coefficient* = .031, *SE* = .01, $t(200) = 37.85$, $p < .001$, than the abstract group, *Coefficient* = .028, *SE* = .01, $t(198) = 33.85$, $p < .001$. However, these interactions failed to reach significance when using SAM valence scores and negative affect scores.

Furthermore, in regards to the effect of construal level on goal-related affect and exercise plans, when predicting total minutes of exercise there remained a significant three-way interaction between construal level condition, affect, and planning when predicting SAM Valence, Positive Affect and Negative Affect scores (Sam Valence: *Coefficient* = .681, *SE* = .33, $t(392) = 2.06$, $p = .039$; Positive Affect: *Coefficient* = -1.114, *SE* = .40, $t(392) = -2.79$, $p = .005$; Negative Affect: *Coefficient* = 1.274, *SE* = .53, $t(392) = 2.41$, $p = .016$); however, there was not a significant three-way interaction when predicting SAM Arousal scores (Sam Arousal: *Coefficient* = .556, *SE* = .31, $t(392) = 1.79$, $p = .074$). Consistent with Experiment 1, the interaction between affect and planning was significant for the concrete group (Sam Valence: *Coefficient* = -.559, *SE* = .25, $t(196) = -2.25$, $p = .025$; Sam Arousal: *Coefficient* = -.479, *SE* = .23, $t(196) = -2.08$, $p = .038$; Positive Affect: *Coefficient* = .820, *SE* = .30, $t(196) = 2.74$, $p = .006$; Negative Affect: *Coefficient* = -1.462, *SE* = .42, $t(196) = -3.48$, $p < .001$), but not the abstract group (Sam Valence: *Coefficient* = .133, *SE* = .22, $t(196) = .610$, $p = .539$; Sam Arousal: *Coefficient* = .091, *SE* = .21, $t(196) = .420$, $p = .665$; Positive Affect: *Coefficient* = -.312, *SE* = .26, $t(196) = -1.19$, $p = .237$; Negative Affect: *Coefficient* = -.159 2, *SE* = .32, $t(196) = -.490$, $p = .623$).

Discussion

Unlike Experiment 1, Experiment 2 did not provide support for the prediction that concrete (vs. abstract) thinking facilitates consistency and increases sensitivity to evaluative feedback. Furthermore, Experiment 2 did not provide support for the additional hypothesis that concrete thinking would lead to a greater increase in subjective experiences of exercise automaticity across the two weeks of the study relative to abstract thinking. A comparison of the two experiments revealed that while there are several basic commonalities across the two studies, participants generally were less effective at translating their plans into action in Experiment 2 and spent fewer minutes exercising across the two-week period. Such findings may help to shed some light on the differing results in Experiments 1 and 2. Experiment 2 was high-powered and used nearly identical methods as Experiment 1; however, the inconsistencies between the two experiments suggests that the hypothesized effects are much smaller than originally anticipated.

Given that Experiments 1 and 2 were field-based studies, there are a number of external variables that may have impacted the results. By incorporating a lab-based study, Experiment 3 allowed for greater experimental control than was possible in Experiments 1 and 2. Thus, in Experiment 3 I aimed to clarify whether construal level impacted the speed at which choices become consistent and automatic in the context of information categorization.

Chapter 4

Experiment 3

In Experiment 3, participants completed a speeded response-time task in which they decided which of two possible descriptions best describes a target word or phrase. I hypothesized that participants' mean response times would speed up across blocks and that this speed up would be more extreme in the concrete group, such that the average change in response times across blocks will be greater in the concrete group than the abstract group. Second, I hypothesized that participants in the concrete group would be quicker to settle on a consistent preference, such that the average change in the number of switches across blocks would be greater in the concrete group than the abstract group.

Participants

270 undergraduate students participated in exchange for course credit. Prior to conducting any data analyses, 6 participants were excluded because they were not native English speakers. Additionally, 6 participants were removed because their average switch rates were 4 SDs or more from the overall sample's mean. Thus, the final sample consisted of 258 participants, (77 male), aged 17 - 27, (M = 19.89, SD = 1.72). Regarding race and ethnicity,

46.9% of participants identified as White ($N = 121$), 13.95% as Black or African American ($N = 36$), 11.63% as Latino/a ($N = 30$), 10.47% as East Asian ($N = 27$), 8.14% as more than one ethnicity or other ($N = 21$), and .004% as Indian American or Alaskan Native ($N = 1$).

To determine the appropriate sample size, I conducted a power analysis, which indicated that a total of 260 participants were required to achieve statistical power ($1- \beta$) of .80 with $\alpha = .05$ and an estimated effect size of Cohen's $d = 0.35$.

Procedure

After providing informed consent, participants completed Freitas et al.'s (2004) construal level manipulation in regards to the goal of, "Improving and maintaining your academic standing." This task is identical to the task used in Experiments 1 and 2, except the content of the goal.

Participants were instructed that the task involved making quick decisions about different types of words. To maintain a strong construal level manipulation, each block began with five trials in which participants saw a type of behavior (adapted from the Behavior Identification Form; BIF). A behavior was presented in the center of the screen (e.g, "making a list"). Below this item, on the left and right sides, participants saw two possible reframings of the behavior that described how (concrete condition) or why (abstract condition) it is performed. Participants were asked to, "Quickly select the phrase that best describes the behavior."

Next, participants completed 60 trials in which they made similar judgments about single words. A target word was presented in the center of the screen (e.g., "company"). Below this item, on the left and right sides, participants saw two possible descriptions for the target word ("visitors" or "business"). Participants were instructed to quickly decide which of the two words best described the target word by pressing the left or right shift keys. Participants completed a total of 520 trials (8 blocks with 65 trials per block). Each of the behavior items were presented twice, and each of the target words were presented eight times (once per block). Within each block, the stimuli were presented in a randomly selected order.

Third, to confirm that the concrete and abstract trials induced differences in construal level, participants completed a manipulation check. The manipulation check consisted of a series of 10 items (adapted from Libby, Shaeffer, & Eibach, 2009) in which participants were presented with a behavior (e.g., “Donating blood”) and asked to choose between a concrete (e.g., “ getting stuck with a needle”) or an abstract (“helping someone in need”) description of that behavior. If the manipulation was successful, people in the abstract group should have selected more why-focused (abstract) answers, whereas people in the concrete group should have selected more how-focused (concrete) answers.

Fourth, participants completed a few questions about the response time task, including: “How difficult was the response time task?”, “How boring was the response time task?”, “How well do you think you performed on the response time task?”. Participants were asked to report on their current mood using the valence and arousal scales using the Self-Assessment Manikin.

Stimuli

As part of the experimental manipulation of construal level, 25 items from the Behavior Identification Form (BIF; Vallacher & Wegner, 1989) served as the concrete or abstract items. For each item, participants viewed the target behavior (e.g., “making a list”), along with two descriptions of how (e.g., “writing things down” or “getting a paper and pencil”) or why (“getting organized” or “reaching a goal”) that behavior is performed. These items were derived from two sources: 1) the how and why responses from the original version of the BIF and 2) the reframings provided by participants in Experiment 1 as part of the 2-part construal level manipulation.

A list of 60 nouns were selected from the English Lexicon Project (Balota et al., 2007), a web-based database that generates lexical stimuli based on lexical characteristics. Descriptors were generated using a standard thesaurus. Target words range from 3 to 8 letters in length (M = 5.13), and the descriptors range from 3 to 13 letters (M = 6.68). See Appendix A.

Piloting

Two separate piloting samples were recruited (N = 30 and N = 32, respectively). Participants in the pilot studies completed the response-time task without the construal-level manipulation (8 blocks with 75 trials each for a total of 600 trials). The goals of piloting the response time task were: 1) to identify at least 50 items with sufficient variability, 2) to assess people's tendency to develop consistent preferences, and 3) to assess whether people's response times across blocks follows a linear or nonlinear pattern. First, to confirm whether there was sufficient variability between participants' preferences for particular descriptors (i.e., that people vary in their initial preference for particular descriptors) I reviewed the average response for the first presentation of each stimuli (coded as 0/1). I selected items in which participants displayed at least a 75/25 split for the first presentation of an item, which yielded a total of 60 items. Second, I examined the total number of instances in which participants' preference for a particular descriptor changed across blocks. The mean switch rate was 21.37% (SD = 10.35%) in Pilot 1 and 21.86% (SD = 13.44%) in Pilot 2. Third, I examined the pattern of participants' response times across blocks. In both Pilot 1 and 2, mean response times sped up across blocks, and followed a linear pattern (Pilot 1: B = -126.250, SE = 2.69, t = -46.98, p < .001; Pilot 2: B = -149.630, SE = 3.26, t = -45.92, p < .001). Furthermore, in both Pilot 1 and 2, I found that the mean change in reaction time across blocks was significantly different from zero, (e.g., Pilot 2: $t(31) = -10.93$, $p < .001$).

Statistical Analysis Plan

Prior to data collection for Experiment 3, the hypotheses, methods, and data analysis plan were pre-registered on Open Science Framework (see: https://osf.io/5u2gn/). Data analysis proceeded in five stages. First, I checked the response time (RT) data for outliers. Trials with values that were more than 3 standard deviations above the grand mean or less than 200 msec were excluded from data analysis. This criterion led to the exclusion of 2.7% of trials. Additionally, I excluded the RTs for trials in which participants expressed a change in preference from their previous presentation of a particular item. My aim was to assess the speed-up of responses as decisions become automatic; a change in preference suggests that a decision was not yet automatic. This criterion led to the exclusion of an additional 13.22 % of trials.

Second, I checked participants' switch rates (total number of times a participant's response changed from a previous presentation of a given stimulus) for outliers. The average switch rate (18.66%) was similar to that of the two pilot samples. I had planned to remove participants with a switch rate that was 3 SDs or more from the overall sample's mean. However, this criterion resulted in losing too many participants ($n = 32$) which would have yielded a sample size lower than that specified by the power analysis. Instead, participants with a switch rate that was 4 SDs or more from the overall sample's mean were excluded from analysis ($n = 6$).

Third, I checked that the randomization of participants to conditions was successful. Participants in the abstract and concrete conditions were compared on all variables that should be unaffected by the experimental manipulation to ensure the randomization was successful, including: age, gender, handedness and ethnicity. Fourth, I checked that the manipulation was successful by assessing responses on the manipulation check. Higher scores indicate more abstract thinking, so I expected that scores on the manipulation check should be higher in the abstract group.

Fifth, I tested the hypotheses. To test whether there was a significant RT difference between groups, I computed a linear contrast for each condition to examine the mean change in RT across blocks, using the following equation:

MEAN(mean RT Block 2 - mean RT Block 1, mean RT Block 3 - mean RT Block 2,
mean RT Block4 - mean RT Block3, mean RT Block5 - mean RT Block4,
mean RT Block6 - mean RT Block5, mean RT Block7 - mean RT Block6,
mean RT Block8 - mean RT Block7).

As stated in the pre-registered data analysis plan, I used an independent samples t-test (1-tailed, alpha = .05) to test whether the concrete group displayed a greater mean change in RT across blocks relative to the abstract group. Next, to test whether the concrete group was quicker to settle on a consistent preference, I computed a linear contrast using the same equation, but with mean switches per block instead of mean RT. Again, I used an independent samples t-test (1-tailed, alpha = .05) to test whether the concrete group displayed a greater mean change in the number of switches across blocks relative to the abstract group.

Results

Randomization Check and Manipulation Checks

There was no significant difference between groups by age ($t(255) = -.655$, $p = .513$), handedness ($\chi^2(2) = 4.12$, $p = .127$), ethnicity ($\chi^2(6) = 4.15$, $p = .657$), or sex ($\chi^2(2) = 1.99$, $p = .369$). Thus, the randomization of participants to conditions appears to have been successful.

Participants in the abstract group (M = 11.62, SD = 2.36) selected significantly more why-focused (abstract) answers than did the concrete group (M = 9.25, SD = 2.68), $t(256) = -7.605$, $p < .001$, $d = -.473$. Thus, the experimental manipulation appears to have been successful.

Furthermore, as expected, participants' average response time decreased across blocks (see Table 2). The mean change in reaction time across blocks (M = -177.17, SD = 111.83) was significantly different from zero, ($t(257) = -25.45$, $p < .001$). Consistent with the pilot studies, then, these findings suggest that the experimental task was successful at creating the intended categorization effect.

Response Times across Blocks

The concrete group displayed a numerically greater speed-up in response times across blocks (M = -185.94, SD = 121.05) than did the abstract group (M = -169.39, SD = 101.48), but this difference failed to reach significance, $t(256) = -1.26$, $p = .104$, $d = -.078$. In an exploratory analysis, I computed an ANCOVA with participants' manipulation check scores as a covariate, condition as an independent variable and the linear contrast score as the dependent variable. Although accounting for manipulation check scores strengthened the effect somewhat, the main effect of condition failed to reach significance, $F(1,255) = 3.40$, $p = .066$, $\eta_p^2 = .01$.

Switches across Blocks

The concrete group (M = .127, SD = 1.60) showed a numerically greater change in the number of switches across blocks than the abstract group (M = .034, SD = 1.41), but this difference did not reach significance, $t(256) = .50$, $p = .311$, $d = .031$. In parallel to the exploratory analysis described above, I conducted an ANCOVA with manipulation scores as a covariate and experimental condition as a between-subjects factor. Accounting for manipulation check scores did not yield a significant main effect of condition, $F(1,255) = .30$, $p = .583$.

Responses to the Task

A MANOVA revealed that there was no difference between experimental groups in terms of task difficulty or engagement, no difference in terms of how well they thought they performed, and no difference in affect (univariate tests: *F*s(1, 255) = .06 - 2.70, *p*s = .172 -.777).

Discussion

Although participants in the concrete group displayed a numerically faster speed up of responses that abstract group, the difference between groups did not reach significance. Furthermore, contrary to expectations, the concrete group was not quicker to settle on a consistent preference than the abstract group. The results of the manipulation check suggest that the present results cannot be accounted for by an unsuccessful experimental manipulation. Furthermore, given that the experiment had a large sample size, these findings suggest that if construal level impacts the speed at which repeated judgments become automatic, it is likely a very small effect.

Chapter 5

General Discussion

The present research examined whether concrete (relative to abstract) thinking facilitates the development of consistency in repeated behaviors across time. Results from Experiment 1 showed that people in the concrete group were more consistent in their exercise behavior across subsequent days of the study relative to the abstract group. Furthermore, consistent with previous research indicating that a concrete (relative to an abstract) focus increases sensitivity to evaluative feedback, Experiment 1 provided initial evidence that goal-related affect has a stronger effect on behavior when people think concretely. However, as previously stated, Experiment 1 did not include a direct measure of automaticity.

To examine whether changes in automaticity helped to explain why the concrete group was more consistent than the abstract group, Experiment 2 included a measure of people's subjective experience of exercise automaticity. However, contrary to expectations, in Experiment 2 the abstract and concrete groups did not show a significant difference in behavioral consistency or a significant difference in automaticity. Although Experiment 2 used nearly identical methods as Experiment 1, a comparison of the two experiments revealed some notable differences between the two studies. Participants were less effective at translating their plans into exercise in Experiment 2 than Experiment 1 and engaged in less exercise across the two-week period than did participants in Experiment 1.

The experimental manipulation of concrete and abstract thinking was designed to be as strong as possible. However, when conducting field-based studies, there is an inherent tradeoff between internal and external validity. Furthermore, exercise is a relatively complex behavior, requiring planning and sustained effort across time. By studying a relatively simple behavior (i.e., information categorization) within a well-controlled laboratory environment, Experiment 3 provided a stronger test of whether construal level impacts behavioral consistency. Contrary to expectations, the concrete group did not display a significantly faster speed up of responses than the abstract group, nor were they quicker to settle on a consistent preference. Taken together, these three experiments suggest that if construal level impacts the speed at which repeated behaviors become automatic, it is likely a very small effect.

Although null results may be difficult to interpret, I propose that these mixed findings are not a result of poor methodological design or poor data collection practices. All three experiments were well-powered and included a screening procedure (screening for interest in exercise in Experiments 1 and 2 and for English proficiency in Experiment 3). Furthermore, the presence of several basic, consistent and robust commonalities across Experiments 1 and 2 suggest that the experiments were conducted in a careful and consistent manner. In Experiments 1 and 2, I reasoned that leading participants to reflect upon the concrete procedures or abstract purpose of their actions prior to making their daily exercise plans would yield a strong construal level manipulation. However, it remains possible that the repetitive nature of this manipulation may have limited the long-term effectiveness of this approach. In Experiment 3, however, the inclusion of a manipulation check confirmed that the experimental manipulation did induce differences in concrete and abstract thinking.

Contributions of the Present Research

The present findings add to the existing literature in a number of ways. Past studies have used correlational designs to examine whether people's self-reported tendency to focus on the process or purpose of dieting relates to weight loss (Freund & Hennecke, 2012). More specifically, recent research suggests that people's dispositional tendency to think in a concrete or abstract manner relates to their tendency to engage in health-promoting behaviors, including physical activity and fruit and vegetable consumption (Sweeney & Freitas, 2016). By incorporating an experimental design, the present results provide more conclusive evidence that focusing on the concrete procedures or abstract purpose of action does not *cause* a change in the speed at which repeated behaviors, such as exercise behavior, become consistent and automatic.

Furthermore, whereas the majority of past research has examined the effect of construal level on self-regulation within the context of cross-sectional laboratory-based studies (e.g., Fujita et al., 2006b; Fujita & Roberts, 2010), experiments 1 and 2 are the first studies, to date, to examine the effect of concrete and abstract thinking across several weeks. By examining repeated behaviors in different domains and across different temporal periods (a one hour lab session in Experiment 3 vs. two-week period in Experiments 1 and 2), the present research provides more conclusive evidence that changes in automaticity do not appear to be the mechanism by which mental construal impacts ongoing acts of self-regulation.

Past studies of construal level have incorporated experimental designs in which there is overlap between the content of the construal level manipulation (e.g, focusing on how or why to improve and maintain one's physical health) and the outcome variables (e.g., motivation to seek out health information; Belding, Naufel, & Fuijita, 2015, Study 2; see also: Davis, Kelley, Kim, Tang, & Hicks, 2016). Alternatively, other studies have used experimental designs in which the content of the construal level manipulation and the outcome variable do not overlap (e.g., Fujita & Han, 2009; Freitas et al., 2004). In such studies it has been presumed that abstract and concrete thinking increases the accessibility of a set of cognitive operations that should carry over from one task to another. That is, it has been presumed that changes in concrete vs. abstract thinking engender domain-general effects. In light of the present findings, it may be that variability in the match between the content of the construal level manipulation and the outcome variable is more impactful than previously thought. In Experiment 3, there was no overlap between the content of the experimental manipulation and the outcome variable. In Experiments 1 and 2, the content of the experimental manipulation overlapped with the outcome variable; however, these were field-based longitudinal studies in which other variables may have affected the mental accessibility of the concrete vs. abstract aspects of one's physical health. Future research may consider revisiting assumptions about the importance of the overlap between the content of the construal level manipulations and the outcome variables.

The present findings add also to the literature on habit formation. Past studies have indicated that forming strong intentions to exercise and planning when, where, and with whom to exercise positively predict the development of exercise automaticity (de Bruijn, Gardner, van Osch & Sniehotta, 2014). However, once a strong exercise habit is formed, some studies have suggested that intentions to exercise are less predictive of exercise behavior (de Bruijn & Rhodes, 2011; Gardner et al., 2011). Alternatively, other studies have found the opposite pattern, such that intentions to exercise are a better predictor of exercise behavior among people with strong exercise habits than among people with weak exercise habits (de Bruijn, Rhodes, van Osch, 2012; Rhodes et al., 2010). Taken together, it remains unclear under what conditions action planning promotes habit formation and when it may interfere with perceptions of automaticity. In Experiment 2, I found that in both experimental groups there was a decrease in perceived exercise automaticity from baseline to the end of week 1. However, at the end of week 2, participants' automaticity scores increased slightly, returning on average to the level observed at baseline. Such findings may suggest that leading people to form deliberate daily action plans can interfere with perceptions that one's actions are automatic, but, with time, such interference effects may start to dissipate.

Within the last few years, the reproducibility of science has become a central issue across numerous disciplines including, but not limited to, psychology, economics, biomedical science, and political science (Camerer et al., 2016; Dafoe, 2014; Iqbal, Wallach, Khoury, Schully, & Ioannidis, 2016; Open Science Collaboration, 2015). Increasingly researchers are being encouraged to engage in scientific practices that are more transparent, including pre-registering hypotheses and analysis plans prior to data collection, making experimental materials and data open-access, and conducting close replication studies (Asendorpf et al., 2013; Finkel, Eastwick, & Reis, 2015). Large-scale replication efforts have revealed that many findings in psychology are not as robust as was once believed (Klein et al., 2014; Open Science Collaboration, 2015).

By conducting high-powered experiments and by pre-registering the predictions for Experiments 2 and 3, the present research was conducted in a manner consistent with recent guidelines for reproducible and open science. Although the results of Experiment 1 were promising, the present research highlights the value of conducting an internal replication prior to dissemination.

Future Directions

The present research suggests that concrete and abstract thinking does not appear to impact the speed at which ongoing health behaviors become automatic habits; however, future research may consider whether abstract and concrete thinking has an additive effect when paired with other self-regulatory strategies, such as implementation intentions (as suggested by Wieber and colleagues, 2014). Furthermore, future research may consider using less intrusive, more objective measures of exercise behavior, such as card swipe ins at a gym. Requiring participants to record their daily exercise behavior may have acted inadvertently as a self-observation intervention. That is, leading participants to observe and reflect upon their daily actions can be thought of as a type of intervention strategy (Johnson & White, 1971). Self-monitoring is considered one of the most robust behavioral change techniques among studies of physical activity (Michie et al., 2009). Although unverifiable in the present research, it is possible that a self-observation effect may have overwhelmed any possible level-of-construal effect in Experiment 2.

Furthermore, future research may consider the importance of the specific content brought to mind by construal level manipulations. In the present research, participants were free to generate their own how or why responses; however, the specific how- or why-related aspects brought to mind by such manipulations may be more impactful than previously thought. Past research has found, for example, that people who report exercising for health-related reasons (e.g., weight loss) exercise less than those who report exercising for affective reasons (e.g., improved mood; Gellert, Ziegelmann, Schwarzer, 2012). Such findings suggest the type of goals or values brought to mind my abstract thinking may impact the effectiveness of mental construal on self-regulation. Similarly, the procedures brought to mind by concrete thinking may vary on a number of important dimensions, such as self-efficacy, feasibility and immediacy.

Focusing on how- or why-related aspects may lead people to form new associations between a discrete action (e.g., "improving and maintaining health") and action plans, or between a discrete action and one's long-term goals or values. However, given that Experiments 1 and 2 involved participants who were already engaged in at least some exercise, they likely already valued exercise to some extent and had pre-existing action plans. The null findings, then, may be explained in part by a tendency to default to pre-existing associations. Future research may endeavor to disentangle whether there is a basic construal level effect, or whether the effect of construal level on self-regulation depends upon the content and novelty of the associations generated by how- or why-focused thinking. Rather than allowing people to generate their own set of *hows* or *whys*, future research may consider whether concrete vs. abstract thinking is more effective when paired with certain types of action plans, values, or goals.

Conclusion

Although the present studies did not support the hypothesis that concrete thinking impacts the speed at which repeated choices become automatic, these studies have several important implications. Automaticity has been studied in a variety of domains (e.g., Bargh, 1984; Lally et al., 2010; Logan, 1998); however, little effort has been made to integrate methodologies across these different perspectives. By incorporating multiple measures of automaticity, I hope the present research will encourage future researchers 1) to bridge models of automaticity in social, cognitive and health psychology; and 2) to further investigate the conditions under which repeated behaviors become automatic. Furthermore, by 1) providing evidence that abstract vs. concrete thinking does not appear to moderate the speed at which repeated behaviors become automatic; and 2) by drawing attention to questions and empirical gaps that can be addressed in future research, the present research may help to generate a more comprehensive framework for understanding the conditions under which abstract vs. concrete thinking facilitates effective self-regulation and the conditions under which repeated behaviors become habits.

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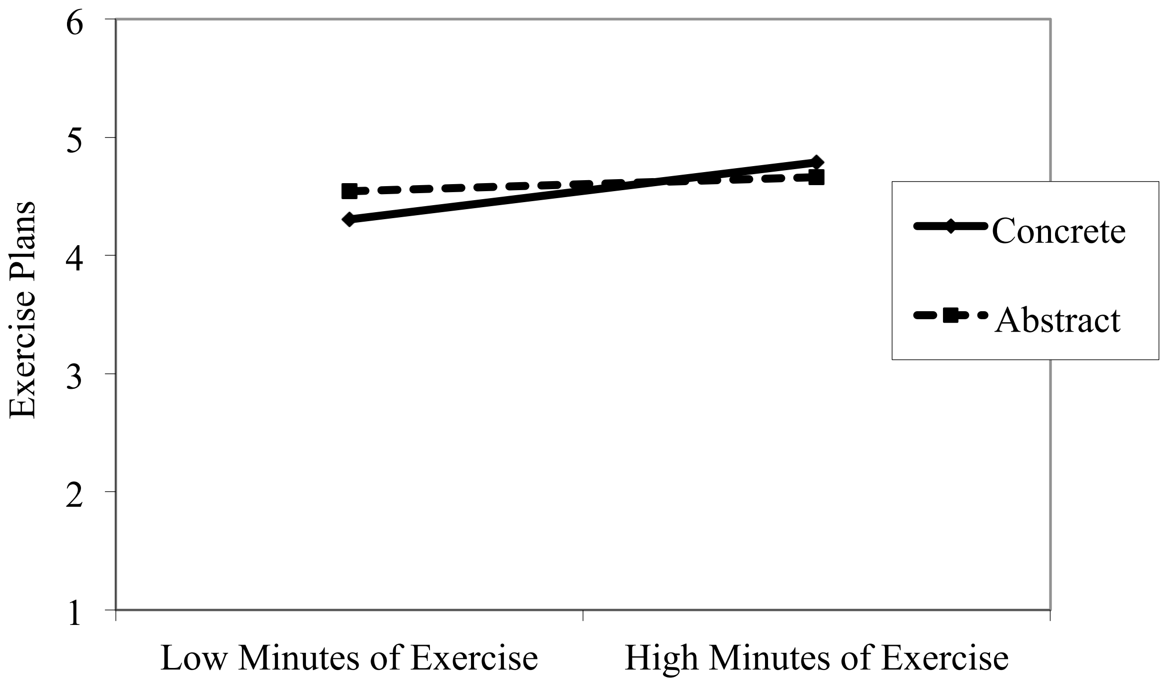

Figure 1. Interaction between minutes of exercise and experimental condition when predicting plans to exercise the next day (Experiment 1).

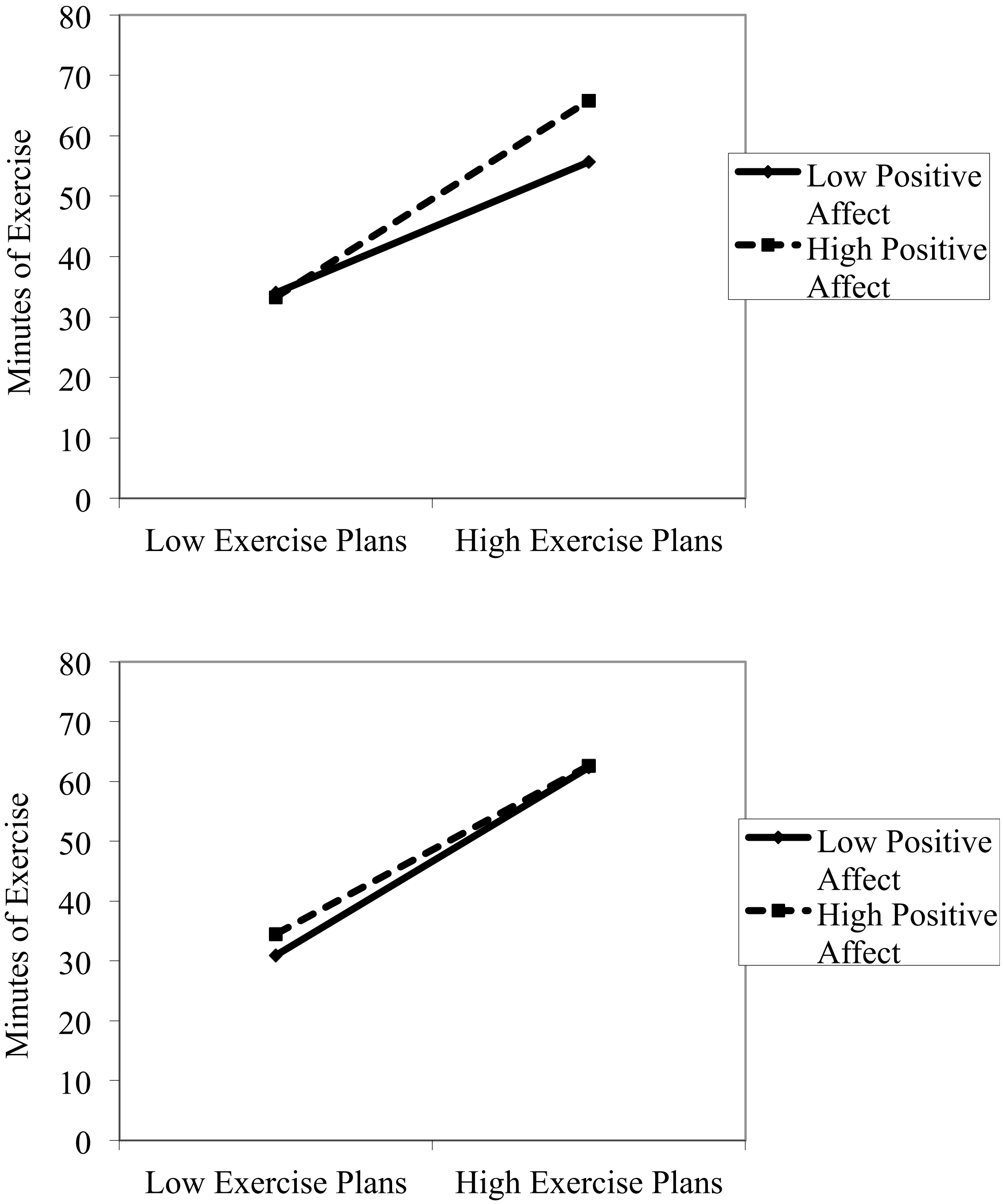

Figure 2. The interaction between exercise plans and positive affect scores when predicting total daily minutes of exercise in the concrete (above) and abstract (below) conditions (Experiment 1).

Table 1. *Means and Standard Deviations for variables in Experiment 1 and 2.*

Note: BMI = body mass index; SAM = Self-Assessment Manikin

	Experiment 1	Experiment 2
Age	19.63 (2.29)	20.01 (3.13)
% Male	23.30%	38.70%
BMI	23.00 (4.76)	23.45 (4.03)
Surveys completed	11.78 (1.77)	12.06 (1.61)
Baseline days of mod. exercise	2.72 (1.93)	2.69 (2.10)
Baseline daily min. of mod. exercise	30.83 (30.15)	28.67 (30.66)
Baseline days of vig. exercise	2.08 (1.50)	2.18 (1.66)
Baseline daily min. of vig. exercise	37.17 (31.58)	40.27 (33.14)
Baseline total min. weekly exercise	197.29 (168.38)	212.27 (193.87)
Meeting goal at baseline (%)	63.90%	60.80%
Exercise importance	5.14 (1.15)	6.14 (.95)
Perceived conflict	1.55 (.679)	1.62 (.82)
Commitment	4.38 (.532)	4.39 (.641)
Trait self-control	3.61 (.50)	3.81 (.55)
SAM valence lab	3.22 (1.60)	3.29 (1.70)
SAM arousal lab	4.31 (1.72)	4.44 (1.93)
Anticipatory positive affect lab	6.30 (.73)	6.23 (.90)
Anticipatory negative affect lab	4.26 (1.61)	4.11 (1.78)
Average daily minutes	42.99 (35.75)	39.07 (35.08)
Total minutes week 1	257.41 (131.67)	213.02 (107.62)
Total minutes week 2	248.26 (145.93)	188.84 (110.09)
Total minutes both weeks	505.66 (248.93)	401.86 (193.41)
Total days of exercise	9.66 (2.66)	9.07 (2.91)
Met goal during week 1	87.20%	82.90%
Met goal during week 2	80.00%	70.30%
Met goal both weeks	73.90%	64.00%

Table 2. *Response times by block in Experiment 3.*

	M	*SD*
Block 1	2235.40	842.96
Block 2	1625.63	590.64
Block 3	1384.78	526.00
Block 4	1244.91	470.18
Block 5	1186.88	484.02
Block 6	1097.28	461.81
Block 7	1021.74	425.55
Block 8	989.69	399.28

Appendix A

Stimuli for the Response Time Task in Study 3

Target	Option 1	Option 2
mind	brain	intelligence
country	community	land
key	solution	access
city	place	town
company	business	visitors
society	culture	civilization
house	building	residence
music	melody	tune
information	data	knowledge
speech	voice	conversation
order	rule	structure
custom	habit	ceremony
wave	gesture	surge
match	pairing	tournament
aim	desire	direction
world	earth	planet
crane	bird	equipment
library	study	building
bark	howl	wood
season	period	time
degree	amount	diploma
type	brand	writing
street	route	pavement
mass	group	weight
cage	crate	jail
state	condition	place
leader	boss	commander
file	data	folder
plant	seedling	shrub
definition	translation	answer
family	group	people
article	piece	essay
staff	assistant	crew
yard	distance	lawn
person	human	individual
address	location	home
energy	power	vitality
dream	fantasy	ambition
race	ethnicity	competition
jam	predicament	condiment
case	container	investigation
idea	belief	thought
book	publication	writing
ground	soil	floor
success	fame	happiness
club	stick	bar
column	article	pillar
style	fashion	elegance
theory	concept	hypothesis
bank	safe	fund
grain	seed	food
memory	thoughts	recollection
air	atmosphere	breeze
story	book	narrative
date	day	meeting
age	life	youth
range	space	length
log	branch	record
rate	estimate	standard
mole	animal	blemish