ENHANCING ACHIEVEMENT THROUGH INTERVENTION: HOW CONSCIENTIOUSNESS AND COGNITIVE ABILITY IMPACT RESPONSES TO GOAL SETTING AND IMPLEMENTATION INTENTIONS INTERVENTIONS

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ABSTRACT

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Developing effective educational interventions is an important goal for educators and researchers alike. Previous research has found associations between performance in academic settings and characteristics such as Conscientiousness and cognitive ability. However, these dispositional characteristics tend to be stable might be difficult to influence without considerable effort. The current research therefore investigated the efficacy of two interventions that attempted to influence lower level constructs that are closer to the performance outcomes. Studies 1a and 1b tested an implementation intentions intervention in two samples (participants at a large Midwestern university and Mechanical Turk workers). The results of these studies showed that merely reminding students to complete their homework was more effective at inducing homework completion than reminding participants to complete it while also having them set implementation intentions to do so. Study 2 tested a boundary goal setting intervention that asked participants to raise their lower boundaries for success in their introductory psychology class, either in conjunction with an implementation intention or not. The results of Study 2 found little indication that raising boundary goals impacted performance in the course independent of the level at which the goals were initially set. Furthermore, setting implementation intentions actually decreased performance levels. There was little evidence that either Conscientiousness or cognitive ability moderated reactions to the interventions across all studies. Overall, the results of the two studies suggest that interventions that attempt to influence

lower level variables such as strategies and goals have promise for promoting achievement in academic contexts. The results add to the literature on the effectiveness of reminders for helping to overcome barriers to the initiation of goal-directed behavior.

For Adam, Collin, and Maddox.

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Introduction

Two distinct and largely independent characteristics are among the most important individual difference contributors to success in achievement contexts such as work and school. First, a large body of research supports the notion that cognitive ability positively predicts academic and work performance (e.g., Judge, Higgins, Thoresen, & Barrick, 1999; Schmidt & Hunter, 1998). Similarly, much research has suggested that the personality factor Conscientiousness is also a key contributor to performance (e.g., Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007; Corker, Oswald, & Donnellan, 2012). Educators may find these results somewhat disheartening, as they suggest little in the way of concrete strategies for improving the performance of those less Conscientiousness and less gifted students, insofar as these characteristics are highly stable and likely resistant to intervention (but see Jackson, Hill, Payne, Roberts, & Stine-Morrow, 2012). However, some recent research has uncovered a few downstream consequences of higher level individual differences (such as Conscientiousness) that are more proximal predictors of performance outcomes and may therefore be more responsive to change through intervention.

Specifically, recent research has identified *effortful strategies* and *boundary goal* levels as two important, proximal associates of task performance. First, effortful strategies consist of a suite of behaviors such as strategic organization, persistence, high attendance, and high task completion that reflect high levels of motivation and the ability to initiate and complete tasks in spite of enticing alternatives. For example, the student who adopts organized and tenacious study strategies can turn down an invitation to socialize if socializing interferes with preparing for an exam or completing a homework assignment. Previous research has shown that the adoption of these strategies mediates the association between Conscientiousness and academic performance

(Corker et al., 2012). That is, students who were more conscientious tended to adopt higher levels of effortful strategies, which in turn were associated with better academic performance.

Second, boundary goal levels are another important contributor to task performance. These goals reflect students' lowest acceptable goal levels, representing the dividing line between success and failure for these students. In previous research (Corker & Donnellan, 2012), these goals showed a moderate to large correlation with performance (r = .51) and were more powerful independent predictors of performance than other types of goals, such as ideal goals (i.e., the criterion at which individuals are aiming, as opposed to their lower boundary for success; Judge & Illies, 2002). That is, as students' self-reported boundary goals increased, their exam performance tended to increase as well. A recent meta-analysis found that Conscientiousness was associated with higher ideal goal levels. However, boundary goals (as a newcomer to the goal setting literature) were not part of that review, so the association between Conscientiousness and boundary goal level is not yet well-established in the literature.

In light of these findings, educators who want to facilitate higher achievement among less conscientious and lower ability students may wish to encourage such students to do the things that more successful individuals do, namely to adopt effortful strategies and to set high boundary goals. Given that effortful strategies and boundary goals are lower level constructs that are more proximal to the behavior that researchers would like to impact, they should be more effective targets for intervention than stable individual differences like Conscientiousness and cognitive ability. However, an important theoretical, as well as practical, question involves understanding how individuals with different characteristics will respond to such interventions. Understanding who benefits most from an intervention may aid future practitioners in delivering the intervention to those individuals who need it most. Furthermore, at a theoretical level,

understanding whether individual differences moderate the efficacy of an intervention can help to shed light on the mechanisms by which the intervention operates.

The overarching purpose of the current research, then, was to evaluate the efficacy of two different interventions and to determine the extent to which individual difference characteristics (specifically Conscientiousness and cognitive ability) moderate the efficacy of the interventions. The first study tests whether students in a laboratory experiment taught a metacognitive strategy (i.e., setting implementation intentions) exert more time and effort on a homework assignment and subsequently perform better on a follow up test than students who simply receive a reminder to do the assignment or who receive no such strategic training or reminder (i.e., control participants).

The second study tests the effects of prompting students in an introductory psychology class to raise their lower boundary goals (or not) in conjunction with setting an implementation intention (or not) on subsequent course performance. At an applied level, both studies test the effectiveness of the interventions to improve performance. In a more basic, theoretical sense, the studies test whether individuals with different characteristics (i.e., different levels of Conscientiousness or cognitive ability) respond differently to interventional treatments, and furthermore, they test some of the predictions made by theories about implementation intentions in both experimental and real-world contexts. Before considering the current research in detail, some theoretical grounding is provided.

Hierarchical Models of Achievement Motivation

Many motivational variables have been shown to affect performance in academic situations. Indeed, students' personality characteristics, cognitive ability, goals, strategic and tactical preferences all combine to influence their day-to-day behavior. In describing the

structure of these many influences, several theorists have postulated hierarchical models of achievement motivation (e.g., Elliot, 2006; Scholer & Higgins, 2007; Sheldon, Cheng, & Hilpert, 2011). What all of these models have in common is that they assert that broad individual difference characteristics do not generally affect behavior directly. Instead, these individual differences are hypothesized to influence behavior indirectly through a variety of lower level goals, strategies, and tactics. The important principle is that individuals' goals and strategic preferences do not exist in isolation. Rather, goals and strategies are nested hierarchically, with temperamental differences (e.g., high levels of Conscientiousness) contributing to the adoption of higher level goals (e.g., getting a well paying job), which give rise to lower level goals (e.g., earn a college diploma), which give rise to sub-goals (e.g., get at least a 3.0 in this marketing class) and ultimately strategies (e.g., study for marketing at least an hour a day).

Some previous research has suggested that broad characteristics such as temperament and even higher level achievement goals (i.e. general approach and avoidance tendencies in performance settings) are relatively stable over time and might be somewhat resistant to direct attempts at change (Roberts, O'Donnell, & Robins, 2004; Corker, Donnellan, & Bowles, 2012). Because lower level sub-goals and strategies are more closely linked to the behavioral outcomes researchers wish to change and may be more malleable than higher level goals, these lower-level constructs would seem to be fruitful targets for intervention efforts in cases of limited resources. Two such constructs – implementation intentions and boundary goals - are the main targets of intervention in the current research. I introduce these below and then describe them in more detail in the sections that follow.

Forming i*mplementation intentions* is one strategy that has been shown in previous research to have clear benefits for improving task performance under conditions in which there is

a gap between intention and action (Gollwitzer & Sheeran, 2006). For instance, a student who has the goal of earning a 4.0 in a class may struggle when it comes to actually executing the behaviors needed to achieve the goal (e.g., studying). In such a situation, the student's intended behavior (studying) and her actual behavior (watching television) may conflict. An implementation intention represents a strategy that the student can use to link a cue in the environment (e.g., an alarm set on her phone) to a desired behavior (studying) through the formation of a prior if-then plan (e.g., when the alarm goes off on my phone, then I will go to my desk and study). The formation of the if-then plan is theorized to automate goal-directed behavior on presentation of the cue, ultimately making execution of the behavior much more likely.

Boundary goals are a type of sub-goal that represents an individual's lowest level of acceptable performance. Higher boundary goal levels are associated with more positive performance outcomes in academic contexts (Corker & Donnellan, 2012). As lower level goals in the hierarchical model, these goals would seem to be more easily changed than the higher level goals from which they stem (e.g., achievement goals), but an important theoretical question concerns the extent to which this is true. That is, are individuals' boundary goals actually changeable in practice? Another important question concerns the extent to which *changes* in boundary goals impact future performance above and beyond effects of boundary goal *levels*. That is, does increasing one's boundary goal have independent and positive effects on performance above and beyond the impact of one's current boundary goal?

Thus, both strategies and sub-goals have the potential to be effective targets for interventions. I now consider each of these potential interventional targets in some detail.

Implementation Intentions: Powerful Links Between Intention and Action

Even individuals who are highly motivated to attain their goals oftentimes fail to do so. Indeed, several common problems occur even for the most well-intentioned individuals (Gollwitzer & Sheeran, 2006). First, difficulties associated with the *initiation* of goal directed behavior can arise. Establishing a new pattern of behavior is difficult, especially when old habits die hard (Rothman, Baldwin, & Hertel, 2004; Neal, Wood, & Quinn, 2006; Wood, Quinn, & Kashy, 2002). In the academic context, students are frequently asked to trade one set of habits and routines (e.g., a lazy summer schedule) for another (e.g., a structured school day with planned study periods), and the initiation of new routines can be difficult. Even remembering to do a new behavior (e.g., meeting up with a study group instead of going to the pool after work) can be challenging. Second, once goal pursuit has been initiated, individuals can become distracted from their goal pursuit by other competing goals with perhaps more immediate rewards. As mentioned previously, students have goals in many non-academic domains competing for their attention – socializing and work to name just two – that must be prioritized effectively in order for students to successfully attain their academic goals.

Implementation intentions (Gollwitzer, 1999) are action plans that specify when, where, and how goal directed behavior will occur. They are plans that take the form of an if-then statement, specifying a link between an environmental cue and a desired goal-directed behavior. For instance, an individual who is striving to maintain a regular exercise schedule might set an implementation intention such as "When I get home from work and see my dog, then I will put on my exercise clothes and take the dog for a run." The environmental signal (dog) serves as a cue that prompts goal directed behavior (getting exercise) through the formation of an if-then plan.

Much previous research has shown that implementation intentions can be effective tools

for combating obstacles to goal completion such as initiation and distraction. For instance, regarding initiation, Orbell, Hodgkins, and Sheeran (1997) found that 100% of participants who intended to perform a breast self-examination (BSE) and who formed an implementation intention to do so reported successfully completing BSE, compared to only 53% of control participants who formed a goal to do BSE, but did not form an action plan for when and where they would do the behavior. Of the women who failed to perform BSE, forgetting was listed as the most common reason for failing to do so.

It should be noted that implementation intentions can be distinguished from mere goal intentions in that goal intentions specify the desired end state a person wants to attain (or the undesired end state s/he wants to avoid), whereas implementation intentions specify when, where, and how goal directed activity will occur. Thus, implementation intentions are subordinate to goal intentions (in terms of a motivational hierarchy); the former is a plan for attaining the latter.

Implementation intentions are a strategy by which individuals can overcome problems with goal initiation and distraction. As noted above, these are two of the chief problems inhibiting students from achieving their academic goals. It stands to reason that if students who fail to initiate goal-directed behavior or who become distracted during goal pursuit underachieve relative to their more focused peers, then helping students to set implementation intentions should help to combat these problems and boost their performance overall. But, an important theoretical question concerns whether the formation of an if-then plan that specifies when, where, and how the goal will be achieved is critical for successful goal completion. It is also important to determine the extent to which simpler interventions (for instance, simply reminding individuals of their goals) might be as effective as implementation intentions.

Recall that an if-then plan formally links a cue in the environment to a desired goal-directed behavior and specifies when, where, and how goal-directed activity is to take place. Previous research has supported the notion that this link formation facilitates goal-directed behavior by automating the initiation of the desired behavior upon presentation of the cue (e.g., Bayer, Achtziger, Gollwitzer, & Moskowitz, 2009; Brandstätter, Lengfelder, & Gollwitzer, 2001; Webb & Sheeran, 2004). That is, initiation resulting from implementation intentions is efficient, immediate, and does not require conscious intent (Gollwitzer & Sheeran, 2006).

However, in the absence of an if-then plan, merely being reminded of a goal by some feature in the environment may be sufficient to trigger goal-directed behavior. With reference to the example given above, simply seeing one's running shoes may be sufficient to prompt goal-directed activity (getting exercise) in the absence of any formal linking of the cue and the behavior through an if-then plan. Indeed, the logic of cognitive accessibility (Higgins, 1989; Moskowitz & Gesundheit, 2009) is applicable here. If a stimulus in the environment is associated with a goal, then perception of that stimulus may increase the accessibility of that goal, via the process of spreading activation. Increased goal accessibility may then trigger increased accessibility of goal means, ultimately making goal-directed behavior more likely (Higgins, 1996). Therefore, a simple reminder may be as effective at inducing goal-directed behavior as a formal implementation intention.

Consideration of some previous implementation intentions research should make these two constructs (if-then plans and reminders) more clear. In a recent study, Milkman and colleagues found that rates of receiving a flu vaccine were higher for individuals who filled out a reminder card with the date and time they planned to be vaccinated compared to controls who received a reminder card but did not form an implementation intention for the specific date and

time they planned to be vaccinated (Milkman, Beshears, Choi, Laibson, & Madrain, 2011). That is, the study compared the rates of vaccinations among individuals who had set implementation intentions to be vaccinated versus having merely been reminded to be vaccinated. The results of the study showed that individuals who formed an implementation intention and were reminded to be vaccinated got vaccinated at higher rates than individuals who merely received a reminder to be vaccinated (the difference between these two groups was about 4.0%, with a 95% confidence interval of 0.3% to 7.7% in a sample of nearly 3,300 individuals) . However, there was no comparison of these two treatments to a no reminder control group. Thus, although setting implementation intentions clearly provided some boost to vaccination rates, it is unclear to what extent merely reminding individuals to be vaccinated also improved vaccination rates relative to no intervention.

Interestingly, data are available on these same individuals in terms of their rate of vaccination in the previous year, so that pre- to post-intervention vaccination rates can be compared. In the year prior to the intervention, only 16% of individuals in the study received an influenza vaccine. In the year of the intervention, about 35% of individuals were vaccinated, amounting to a nearly 20% increase in vaccinations (at least some portion of which may be attributable to reminding individuals to be vaccinated). In the same vein, a recent review in the *Journal of the American Medical Association* (Szilagyi et al., 2000) found increases in immunization rates of 5 to 20 percentage points resulting from reminders across 41 well-designed studies (e.g., randomized control trials). Reminders may therefore have the potential to be effective instigators of goal directed behavior even if they do not directly include an implementation intention.

To be clear, in both formal implementation intentions and mere reminders, a priming

mechanism is used to explain goal-directed behavior. In the case of the formation of an if-then plan, an association between a stimulus and a behavior is being strategically created to produce an (automatic) enactment of the behavior on presentation of the stimulus. In the case of a simple reminder, no prior link between the reminder and the behavior is formed, but goal-directed behavior may nonetheless be more likely following the presentation of the reminder because of the reminder's natural association with the goal. Through this naturally existing association, the reminder primes (i.e., increases the accessibility of) the goal and associated goal means.

The current research tests the efficacy of an implementations intervention in a laboratory experiment (comparing the effectiveness of an implementation intentions treatment to a reminder only and a no-reminder control group; Studies 1a and 1b) and in a college classroom (comparing the effectiveness of setting implementation intentions to raising boundary goals, Study 2). Each of these treatments represents an extension of existing implementation intentions research, for a couple of reasons. First, little previous research has investigated the efficacy of implementation intentions interventions in academic settings. Indeed, there is reason to suspect that the academic context may be somewhat different from previous research contexts because much previous research has investigated one-shot, low-level behaviors (e.g., breast self-exam, perceptual identification), as opposed to more complex, longitudinally influenced behaviors (e.g., weight loss, studying). Second, each study introduces a new component to the implementation intentions treatment that may either help or hurt the efficacy of the treatment. In Studies 1a and 1b, participants set an implementation intention in which the cue (i.e., the "if" part of the if-then plan) is a self-generated reminder. This treatment builds on prior research (Milkman et al., 2011), but is to a large extent a novel addition to the implementation intentions canon. In Study 2, participants first identify obstacles to goal completion, and then they set implementation

intentions that plot planned responses to these obstacles. Again, this manipulation is an extension of previous research (Adriaanse et al., 2010). As such, the current research offers a chance to examine the generalizability of the implementation intentions technique in a new setting and with new intervention methodology.

In sum, implementation intentions are one strategy that individuals can employ in order increase the likelihood that they will act on their intended goals. But a formal implementation intention may not be needed to facilitate goal striving – merely committing to a goal and being reminded to act on it without any specification of when, where, and how one intends to complete the goal may be sufficient. Meta-analytically, implementation intentions have been clearly linked to higher rates of goal completion, with an average effect size of $d = .65$ across a large number of studies (Gollwitzer & Sheeran, 2006). I now consider how encouraging students to raise their boundary goals might be another technique that could help students to perform better.

Boundary Goals as Motivators and Regulators of Task Performance

Another potentially important target for interventions is the construct of boundary goals, which as noted above are a type of *target goal* that represent the lowest acceptable performance level required for successful task performance (Corker & Donnellan, 2012). An important feature of target goals is that they represent a range of acceptable outcomes – not just point estimates. For instance, a student may be aiming for an 'A' in her history class, but would be satisfied with her performance if she obtained a 'C.' Thus the full range of her target goal is 'A' to 'C' and everything in between. Researchers have variously called the upper bound of this range (that is, the goal at which the student is *aiming*) level of aspiration (Lewin, 1959), target goal (Harackiewicz, Manderlink, & Sansone, 1984), goal difficulty level (Locke & Latham, 2002), or ideal goal (Higgins, Shah, & Friedman, 1997). Thus target goals as conceptualized here represent

a range of possible values that is bounded on the upper end by the goal level at which an individual is aiming (hereafter simply referred to as *ideal goal*) and on the lower end by an individual's bottom line for successful performance (the *boundary goal*).

Nearly all research to date has focused on the former goals (ideal goals) to the exclusion of the latter (boundary goals). This lack of attention may be problematic for two reasons. First, although many years of research indicate that setting specific high goals promotes performance (Locke & Latham, 2002), students' ideal goals may not always be set at attainable levels. For instance in classroom settings, many students express the sentiment that they are "shooting for an A." However only a handful of them will actually achieve that goal, and very few of them are even capable of it, given maximal effort. Thus, the goal to get an 'A' is unattainable for some portion of the students. Consistent with Goal Setting Theory (Locke & Latham, 2002), when goals are set at levels so high that they are virtually unattainable, they are generally ineffective in regulating behavior. Thus, by focusing on the upper end of the range of possible target goals to the exclusion of the lower end, researchers and educators may be inadvertently focusing on goals that are actually predicted by theory to have only weak predictive validity of outcomes. Boundary goals, in contrast, have the potential to be more powerful predictors of outcomes, insofar as they are set at more realistic and attainable levels.

Indeed, previous theorizing and research suggest that boundary goals have two important functions in the goal pursuit process (Lewin, 1959). First as *motivational* entities, boundary goals energize goal-directed behavior, providing the impetus needed to initiate goal pursuit (Harackiewicz & Elliot, 1998; Locke & Latham, 2002; Manderlink & Harackiewicz, 1984). Second, as the dividing line between success and failure, boundary goals serve an important *regulatory* function in the goal pursuit process. Regulatory models of goal pursuit, such as

Carver and Scheier's (1990) model, assert that goal pursuit functions as a negative feedback (i.e., discrepancy reducing) system in which a person's current state is repeatedly compared to a reference point. Goal striving behavior represents an individual's attempts to match their current state to the reference point. Boundary goals are one such reference point that anchor striving behavior to a concrete benchmark to which goal progress can be compared. Having a more concrete reference point means that individuals are able to more adequately monitor goal progress (Carver & Scheier, 1990; Carver, Sutton, & Scheier, 2000).

It therefore follows that encouraging students to adopt higher boundary goal levels should be beneficial for outcomes, insofar as doing so provides them with increased motivation and enhanced ability to self-regulate (through more efficacious monitoring processes). Indeed, previous correlational research supports this proposition as boundary goals were found to be moderate to strongly associated with performance on exams in a research methods course (Corker & Donnellan, 2012). More specifically, for each grade point average unit that a student's boundary goal increased, a 10% increase in exam scores and an 11% increase in final grades was expected based on a regression analysis.

What is unclear from previous research is whether asking students to raise their boundary goals has any benefit for subsequent performance, above and beyond the effects of the level at which the boundary goal was initially set. An ideal test would allow random assignment of students to boundary goals, but ethically and practically this is not permissible in real classrooms. Assuming the treatment worked, a high achieving student could be assigned to a low boundary goal and thus underperform, violating the ethical imperative to minimize harm. Practically, there is the question of whether it would be possible to convince a high achieving student to commit to a low boundary goal. In a real classroom setting, then, a much more viable

option is to allow students to set their own boundary goals, and then determine whether asking them to raise their lower boundaries has any benefit for subsequent performance, beyond their self-selected boundary goal. This was one of the major goals of the current research.

As noted above, the individual difference characteristic of Conscientiousness has a well-established association with academic performance. I now briefly consider how the previous research has examined Conscientiousness and effortful strategies in the context of academic performance before considering the design of the current research and study hypotheses in more detail.

Effects of Effortful Strategies and Conscientiousness on Academic Performance

Conscientiousness is a broad personality trait that captures differences in individuals' "socially prescribed impulse control that facilitates task- and goal-directed behavior, such as thinking before acting, delaying gratification, following norms and rules, and planning, organizing, and prioritizing tasks," (John, Naumann, & Soto, 2008, p. 120). In a recent meta-analysis, Conscientiousness was identified as the only significant Big Five personality predictor of academic performance (O'Connor & Paunonen, 2007), and of the narrower facets that compose Conscientiousness, the research so far seems to suggest that the facets of self-discipline (reflecting individuals' ability to complete tasks in spite of enticing alternatives) and achievement (reflecting individuals' motivation to succeed) are the most important for predicting performance (Corker et al., 2012; Noftle & Robins, 2007; Paunonen & Ashton, 2001).

Very little research has investigated the mechanisms underlying these effects. As a preliminary examination of the question of mechanisms, college students in an upper-level course were asked to report on their personality characteristics early in the semester, and later they were surveyed about the effortful strategies they used in the course, including their study

strategies, effort in exam preparation, and homework completion. Grades were obtained from the instructor at the end of the term. A structural equation modeling analysis revealed that Conscientiousness predicted increased effort in exam preparation, more tenacious and less disorganized study strategies, and higher homework scores, each of which mediated the effects of Conscientiousness on exam performance (Corker et al., 2012). That is, Conscientiousness, a global personality trait, predicted situation-specific behavioral strategies that ultimately contributed to higher levels of performance. Thus, effortful strategies might be an important mechanism by which Conscientiousness is linked to academic performance.

Much previous research has supported the proposition that the use of effortful strategies is associated with positive academic outcomes. For instance, Keith, Diamond-Hallam, and Fine (2004) found that the amount of time spent doing homework was positively associated with grades in high school (*r*s ranged from .21 to .31). A recent meta-analysis (Cooper, Robinson, & Patall, 2006) reported a similar association between the same two variables ($r = .14$). Staff, Schulenberg, and Bachman (2010) found that effort exerted in school was positively associated with high school grade point average ($r = .36$). Thus, there are compelling reasons to expect that an intervention that facilitates spending more time and exerting more effort on goal-directed behaviors should have positive consequences for students' academic performance.

Though no published work of which I am aware has investigated the relation between Conscientiousness and boundary goals specifically, many studies have investigated the associations between Conscientiousness and goal-setting behavior more broadly. A meta-analysis (Judge & Ilies, 2002) found that Conscientiousness predicted higher ideal goal levels, and these results are at least suggestive of the idea that Conscientiousness may be predictive of boundary goal levels as well (a proposition tested in the current research).

In sum, much previous research has linked trait Conscientiousness to positive academic performance outcomes, and some recent research has begun to investigate the mechanisms underlying this effect, identifying effortful strategies as an important mediating factor underlying this association. Understanding these associations is important for the current research, as they provide a backdrop for developing effective interventions that have the potential to help students improve their performance.

Major Purposes and Goals of the Current Research

The current research had several goals, some applied and some theoretical. At an applied level, the purpose of the research was to investigate the efficacy of two interventional techniques designed to improve students' academic performance. As a whole, the evidence presented above suggests that effortful strategies and boundary goals are likely to be fruitful targets for interventions to improve student performance, because these constructs exist at a lower level of a hierarchy of motivation and are therefore more likely to be influenced than the higher level variables from which they are derived (e.g., cognitive ability and Conscientiousness). One major goal of the current research, then, was to demonstrate the efficacy of these new interventions.

At a theoretical level, the research sought to answer three major questions. First, to what extent do individual differences matter in influencing responses to intervention? This question has practical consequences because it can help practitioners deliver the interventions to those most likely to benefit from them. But at a theoretical level, the question is important because it can help to shed light on the reasons underlying the efficacy of the intervention. For instance, if an intervention works better for more conscientious students, it could reveal that the intervention requires high levels of self-control to execute. Such a finding would be important because it reveals something about the mechanism underlying the effect. Examining individual difference

moderators, then, is important for uncovering information about the workings of an intervention.

The second theoretical question that the research sought to answer was addressed only in the first study. As discussed above, this question concerned the extent to which the formation of an implementation intention was more effective than a mere reminder of the goal. Theories of implementation intentions would predict that the specification of an if-then plan that spells out where, when, and how one intends to fulfill a goal is the critical piece underlying the success of various implementation intention interventions. The basic mechanism by which implementation intentions are proposed to function is that the formation of the if-then plan increases the accessibility of the relevant cue, making it more likely that a good opportunity to act on the goal will not be missed. Furthermore, goal-directed behavior follows effortlessly and automatically upon presentation of the relevant cue. The current research tested whether a formal implementation intention was needed to observe an increase in goal directed behavior by comparing performance under conditions of no reminder/no implementation intentions (control), reminder only, and reminder plus implementation intentions.

The final theoretical question that the research sought to answer was addressed only in the second study. As mentioned previously, boundary goals represent an important component in the process by which achievement motivation influences academic performance. To the extent that increasing these goals positively impacts future performance, above and beyond the effects of initial boundary goal levels, educators would potentially have a very powerful tool in their hands. But, to the extent that preexisting goal levels swamp any effects of asking students to increase their boundary goals, then any intervention attempting to influence boundary goals would have to be redesigned with this limitation in mind. That is, the current study sought to test whether changes in boundary goals would be impactful enough to exert influence above and

beyond the effects of initial goal levels.

Developing Strategic Interventions: Design and Hypotheses

There are a number of considerations to take into account when attempting to develop a successful intervention. Of utmost concern in the current efforts was designing interventions that could easily be put into place in real classrooms. This meant that the interventions needed to be brief, unobtrusive, and easily administered by teachers or professors with minimal training. Furthermore, the interventions were designed specifically with helping less conscientious students in mind. Accordingly, it was important that the interventions required little self-regulatory strength to complete. Interventions that require a great deal of willpower to implement are likely to be out of reach for less conscientious students (Kochanska & Knaack, 2003). Keeping these considerations in mind, two strategic interventions were designed to manipulate each of the important predictors of academic performance identified in previous research (effortful strategies and boundary goals).

Effortful strategy intervention. Considering first the development of an intervention to increase effortful strategy use, it was initially necessary to determine which strategies should be the most responsive to intervention, as well as how to best encourage strategy use. As mentioned above, implementation intentions have been shown in previous research to be effective at encouraging goal initiation and combating problems with goal distraction. Among the effortful strategies known to be important for explaining links between Conscientiousness and performance – homework completion, effort in exam preparation, higher tenacity, and less disorganization in study strategies – homework completion seemed to be the strategy that could be most effectively combated using implementation intentions (Gollwitzer, 1999). The reasoning was as follows: If students who have low levels of Conscientiousness fail to complete their

homework in part because they have trouble initiating it or become distracted by competing goals while attempting it, then an intervention that helps them to form a concrete plan and provides the means to implement it should be an effective way to increase their homework completion and ultimately their performance. The current intervention uses an online productivity tool (Remember the Milk; Boyd & Kilani, 2012) in combination with the technique of implementation intentions to help students with both the formation and execution of study plans.

The first study of the current research tests the efficacy of this strategy intervention using a three-part experiment that closely mimics typical experiences that occur in college classes. The design was as follows: participants signed up for a two-session study with sessions separated by 24 hours. In the first session participants received one of three treatments (no reminder/no implementation intentions control, reminder only, or reminder with implementation intentions). Then, participants were informed that in the time between the sessions (i.e., on their own time), they would need to learn some new information by visiting a website. They were further told that they would be tested on the information when they return for their second session the next day. This experience is similar to in-class experiences that students may have in which a professor tells them that they'll need to review some materials before the next class for an upcoming assessment. As explained in more detail below, reminder with implementation intention participants learned how to use Remember the Milk in conjunction with implementation intentions to help them plan and remember to initiate this study time.

As noted above, it is unclear whether a formal implementation intention (i.e., an if-then plan) is required to facilitate goal-directed behavior. Thus in the current research, the main intervention condition (reminder plus implementation intentions) was compared to a reminder

only treatment, as well as a no reminder, no implementation intention control. If a reminder is sufficient to promote goal directed behavior, then the reminder only and reminder plus implementation intention conditions should outperform the control. Furthermore, if formal implementation intentions provide value added beyond a mere reminder, then there should be significant differences for practice completion and final test performance between each of the three conditions (assuming that a mere reminder is more effective than the no reminder control). Furthermore, these basic effects may be moderated by participants' levels of Conscientiousness and cognitive ability, an issue to which I return shortly.

Boundary goal intervention. In developing the second intervention, which sought to increase boundary goal levels, I tested the effectiveness of the intervention in a real classroom setting. The basic premise of the intervention was that if participants' boundary goal levels impact their motivation and ability to self-regulate goal directed activity, then raising those goal levels would increase motivation and regulatory ability, leading to higher performance levels. There is, however, the procedural question of how one should encourage participants to raise their sights. Self-determination theory (Ryan & Deci, 2000) would suggest that allowing students to exercise autonomy and self-select how much they increase their goals should lead to an enhanced sense of intrinsic motivation, which should positively relate to task performance. However, by allowing students to decide on their own how much to raise their goals, one risks allowing them to choose not to raise their goals at all. This would suggest that directing students to raise their goals a specific amount might ultimately be a more effective strategy.

I created different intervention conditions designed to test the possibility that directing students to raise their goals might be more effective than allowing them to set their own boundary goal increase. All participants in the study identified their boundary goals for the

course (just as in Corker & Donnellan, 2012). For control participants, the study ended there; they were not instructed to raise their boundary goals. Participants in the intervention conditions were directed to raise their boundary goals either as much as they deemed fit (self-set) or a specified amount of 0.5 grade point average units (other-set). Furthermore, to determine whether the goal setting manipulation would help students above and beyond the effect of setting implementation intentions, participants were randomly assigned to complete an implementation intentions exercise after they had set and raised their boundary goal. This created a 3 (control vs. self-set raise vs. other-set raise) × 2 (no implementation intentions vs. implementation intentions) design.

The basic predictions for the study were as follows. First, if boundary goal levels affect performance levels, then students in the raise aspirations conditions should outperform students in the control conditions. However, this effect may depend on whether aspirations were raised autonomously or in a directed way. Self determination theory would predict that choosing how much to raise one's own aspirations should be more effective than being directed in how much to raise one's aspirations, controlling for any differences in how much individuals raise their sights. Furthermore, as with the strategy intervention detailed above, individuals with different levels of Conscientiousness and cognitive ability could respond to the intervention differently, a possibility I now consider in more detail.

Interaction hypotheses.

The role of regulatory fit in responses to intervention for individuals with high versus low levels of Conscientiousness. According to regulatory fit theory (Higgins, 2000), individuals experience feelings of "rightness" when their orientation toward a task fits with their means of goal pursuit. The experience of fit can translate into increased motivation and better performance

than non-fit (e.g., Förster, Higgins, & Idsen, 1998; Shah, Higgins, & Friedman, 1998). How might the logic of regulatory fit apply in the current context? As noted above, conscientious individuals prefer to use effortful strategies for goal attainment, so the use of such strategies may generally fit with their orientations, leading to more favorable performance outcomes for these individuals. An intervention that encourages the use of effortful strategies, then, may boost performance for highly conscientious individuals because the use of these strategies fits with their orientations. On the other hand, if conscientious individuals prefer only their existing strategies then the introduction of a new strategy may disrupt their normal process of goal pursuit. Such regulatory misfit would lead to underperformance compared to typical circumstances because the strategy recommended by the intervention misfits with high conscientious individuals' preferred strategies.

Given these possibilities, there are a number of potential outcomes when considering how students with varying levels of Conscientiousness will respond to intervention. First, as noted above, the strategies that conscientious individuals use are especially suited to their typical tendencies and habits. Therefore, an intervention designed to heighten these strategies would benefit them more so than students lower in Conscientiousness because the recommended strategies fit with their personal characteristics (the regulatory fit hypothesis). Another possibility also concerns regulatory fit predictions. If Conscientious students already have strategies that they prefer and that work for them, then introducing a new strategy could misfit with their orientation resulting in worse performance in the intervention condition than in the control condition (the regulatory misfit hypothesis).

A third possibility (unrelated to regulatory fit) is that the interventions should benefit students low in Conscientiousness the most, as these students have the most room to improve in

their strategies. Students high in Conscientiousness may already be maximizing their performance so further improvement may be unlikely (the ceiling hypothesis). Consistent with this hypothesis is the fact that one study has found such a pattern (Webb, Christian, & Armitage, 2007). In this study, an implementation intentions intervention to increase class attendance was effective for participants low in Conscientiousness; those high in Conscientiousness were already attending at a very high rate. A recent meta-analysis also suggested that implementation intention effects are larger for individuals who have problems with self-control (e.g., schizophrenics) and for tasks known to tax self-control resources (e.g., ego depletion and ironic rebound tasks; Gollwitzer & Sheeran, 2006). A final possibility is that interventions will affect students high and low in Conscientiousness equally, which would be reflected in a main effect of the intervention and the absence of an interaction with Conscientiousness (the main effect hypothesis). Each of these four different possible interaction patterns is displayed in Figure 1.

Responses to intervention for individuals with high versus low levels of cognitive ability. As noted above, cognitive ability also plays an important role in determining student performance, and it may also be the case that students with different levels of cognitive ability respond differently to different interventions. It seems likely to be the case that individuals with less cognitive ability stand to gain the most from any intervention that improves their effortful strategies, given that they have the most room for improvement and because individuals with higher levels of cognitive ability may perform at high levels even in the absence of such strategies (similar to the ceiling hypothesis mentioned above for Conscientiousness).

However, it may also be the case that individuals low in cognitive ability would be unresponsive to strategy interventions, if the intervention requires high levels of cognitive ability to implement. In such a case, individuals with high levels of cognitive ability would stand to

benefit from the intervention, but individuals low in cognitive ability would not. Such a pattern seems unlikely in the current research given that neither intervention was designed to be particularly complicated to use (i.e., the Remember the Milk website and the goal-setting worksheet were designed to be simple to use). A final possibility is that cognitive ability will not interact with the intervention – individuals with both low and high levels of cognitive ability could respond in the same way to the treatment.

The interaction hypothesis: How individuals with different combinations of cognitive ability and Conscientiousness may respond to interventions. There is a longstanding debate on the role of interactions between Conscientiousness and cognitive ability in predicting task performance. Supporters of the interaction hypothesis theorize that Conscientiousness reflects task motivation and that in the absence of task motivation, there will be no effect of cognitive ability on performance (e.g., Perry, Hunter, Witt, & Harris, 2010). Only individuals who have high levels of cognitive ability and Conscientiousness are expected to perform well. This *joint* interaction pattern would be predicted by theories of bounded rationality, which assert that both motivation and ability are necessary for high levels of performance (see Jones, 1999). There is some evidence for joint interactive effects (Perry, et al., 2010), but the majority of reports fail to find evidence for an interaction in spite of high power to detect an effect (e.g., Mount, Barrick, & Strauss, 1999; Sackett, Gruys, & Ellingson, 1998).

Despite some theorists' reference to the joint interaction pattern as the only interaction hypothesis, there remain other patterns of interactions that could be predicted. A *compensatory* model is one type of interaction pattern that may occur between Conscientiousness and cognitive ability. In this type of model if either or both variables are present at a high level, favorable outcomes are predicted to result. The presence of one variable compensates for the absence of

another. In one study that showed this pattern (Cheng & Ickes, 2009), Conscientiousness and another related trait known as self-motivation interacted to predict college grade point average. The interaction was such that individuals who had a high level of either or both of these traits had higher grade point averages than individuals who lacked both of these traits, implying that a high grade point average was attainable for individuals who were either motivated or conscientious – having just one of these characteristics was enough to facilitate performance. Thus, in the current research the compensatory pattern predicts that only in the absence of both cognitive ability and Conscientiousness are negative outcomes predicted. Again, there is little evidence for interactions (of any type) in this literature, but there are several reasons why this may be the case.

One issue is that the existing research literature has not examined the question of how Conscientiousness and cognitive ability interact when comparing individuals' performance under different situational conditions. Even if there is typically no interaction between Conscientiousness and cognitive ability on task performance in natural settings, the interaction may still be observed under the conditions of an intervention. If individuals with high levels of cognitive ability and high Conscientiousness respond more favorably to the intervention than individuals with other characteristics, there would be evidence for the joint interaction pattern *in response to the intervention*. If individuals with low levels of cognitive ability and low Conscientiousness respond especially poorly to the intervention, there would be evidence for the compensatory interaction pattern in response to the intervention.

Why might one expect differential performance depending on traits but only in the presence of a strong situation such as an intervention? If the intervention is such that it helps or hurts individuals only with a particular combination of traits, then we would expect a main effect

under the control condition (as is typically obtained) and but an interaction under the treatment condition. An intervention treatment that requires cognitive ability to understand and Conscientiousness to be able to execute should produce the joint interaction pattern: benefits of the intervention would be observed only for individuals with high levels of both of these characteristics. An intervention that helps either individuals who are cognitively able or conscientious (but not those who lack both characteristics) would produce the compensatory interaction pattern. Thus, combinations of individual characteristics may moderate reactions to similar situations (see Funder, 2008; Marshall & Brown, 2006). It should be noted that given that the correlation between cognitive ability and Conscientiousness is typically very small ($r < |.10|$), there should be roughly equal numbers of individuals with various combinations of these two characteristics, which should have the effect of making the interactions easier to detect if they do in fact exist.

Summary

In sum, the purpose of the current research was to test the effectiveness of two interventions designed to improve academic performance and to examine whether the effectiveness of these interventions differs for individuals with different levels of Conscientiousness and cognitive ability. First, an experimental laboratory study tested the effectiveness of an intervention to decrease disorganization in study strategies through the use of an online planning tool in combination with an implementation intention, as compared to a simple reminder and a no reminder, no implementation intention control. Second, a randomized control trial tested an intervention to increase students' boundary goal levels in a college classroom. Both studies tested for interactions of the treatment with Conscientiousness and cognitive ability to determine whether the interventions are more or less effective for individuals

with different levels and combinations of characteristics.

Studies 1a and 1b

Two studies employing nearly identical designs were conducted using college student participants (Study 1a) and workers from the Amazon Mechanical Turk worker pool (Study 1b). Although the current research was designed to be applicable especially in academic contexts, limitations on the availability of research participants at the university where the student sample was collected precluded the collection of a sufficiently large sample with adequate power to test study hypotheses. The Mechanical Turk sample was therefore collected to attempt to replicate the basic pattern of results found in the student sample with a much larger sample.

Power Analysis

An a priori power analysis was conducted in order to determine required sample sizes for each of the three conditions in Study 1b. Two main effects were the targets of this power analysis. The first effect represents the difference between the no treatment control condition and the reminder with implementation intentions condition. A previous meta-analysis reported that the typical effect size in studies of implementation intentions was $d = .65$, a large effect (Gollwitzer & Sheeran, 2006). This effect size was used as the estimated magnitude of the predicted difference between the no treatment control condition and the reminder with implementation intentions condition. The second effect represents the difference between the reminder only condition and the reminder with implementation intentions condition. A null effect was predicted here, so the power analysis was conducted under the assumption of a small effect ($d = .10$) to estimate how many participants would be needed to detect an effect of meaningful size, in the event that one existed. Because of this difference in predicted effect sizes, unbalanced cell sizes were collected in order to maximize the power to find the small effect (if it existed).

The power analysis was conducted using a Monte Carlo simulation technique in the statistical program R, according to the technique outlined in Bolker (2008). The model tested in the simulation was specified as follows:

y = a + b1*x1 + b2*x2 + b3*x3 + b4*x4 + b5*(x1*x2) + b6 (x1*x3) + b7 (x2*x3) + b8 (x1*x4) + b9*(x2*x4) + b10*(x1*x2*x3) + b11*(x1*x2*x4)

The preceding equation represents a regression model with two continuous predictors, cognitive ability (x1) and Conscientiousness (x2), two contrast-coded variables representing the three experimental conditions (x3 and x4), and all two-way and three-way interactions among the variables. Data for the continuous predictors were drawn from normal distributions with $M = 0.0$ and $SD = 1.0$ (i.e., as if the predictors were standardized). Data for the outcome variable (y) were drawn from a normally distributed distribution with a mean equal to the fixed portion of the regression model above and a standard deviation equal to .775 (which sets the residual standard error for the model at .60, making the model $R^2 = .40$).

Data for the contrast code needed to test the main effect of the two treatment conditions versus the control condition was specified as a vector of -2s (indicating control group) and 1s (indicating the other two conditions) in different proportions that corresponded to several possible unbalanced cell sizes. Similarly, data for the contrast code that tested whether the reminder only condition differed from the reminder with implementation intentions condition was specified as a vector of -1s (reminder only), 0s (control), and 1s (reminder with implementation intentions). The cell size for the control group was set at $N = 50$, and the cell sizes for the other two conditions were tested at Ns = [100, 200, 300, 400].

It was further assumed that the regression coefficients for the interactions were small effects ($b = .10$), as was the main effect for the contrast code for the difference between the reminder only and the reminder with implementation intentions condition. The effects for

cognitive ability and Conscientiousness were assumed to be moderate in size (b = .30), and the effect for the contrast code testing the difference between the control condition and the other two conditions was assumed to be equal to the meta-analytic value (b = .65). The simulation was conducted with 10,000 resamples. For each resample, the p-values for the main effects for the contrast codes were extracted. Thus, the proportion of observed values of these main effects that were less than .05 served as the index of power. Table 1 displays the results of this analysis. Acceptable power to find the small effect ($\beta > .80$) was obtained with a sample of 650 subjects; excellent power ($\beta = .95$) was obtained with a sample of 850 subjects. Excellent power to find the large effect was obtained for all sample sizes ($\beta > .99$).

Methods

Participants. Study 1a participants (n = 283) were recruited from the human participation in research pool at Michigan State University. Students received credit in their psychology classes for participating. Study 1b participants (n = 920) were Mechanical Turk workers who were paid $2 for participation in the study. Workers were compensated regardless of whether or not they completed the study. An additional 364 Mechanical Turk workers began the study but dropped out before completing any of the experimental procedures; they are not considered in any of the following analyses. Participants in both studies were randomly assigned to receive one of three treatments in a between-subjects design. The conditions were no treatment control, reminder only, and reminder with implementation intentions.

In both studies, a computerized randomization algorithm was used to assign participants to condition, such that the control condition was undersampled relative to the other two conditions. In Study 1a, participants had a 16.67% chance of being assigned to the control condition and a 41.67% chance of being assigned to each of the two remaining treatment

conditions. Given a target sample size of 300, these percentages corresponded to an expected value of 50 participants in the control condition and 125 participants in each of the two experimental conditions. In Study 1b, participants had a 5.88% chance of being assigned to the control condition and a 47.05% chance of being assigned to one of the remaining to conditions. Given a target sample size of 850, these proportions corresponded to an expected value of 50 participants in the control condition and 400 participants in each of the two experimental conditions.

Three participants in Study 1a experienced a technical problem during their first session and were excluded from the data. Participants in both studies were excluded from analyses if they failed to pass an attention check. The attention check was a single item embedded in a larger personality questionnaire that simply asked participants to select "Agree" (corresponding to the fourth option on a five-point scale) for quality control purposes. Six participants in Study 1a and 29 participants in Study 1b failed the attention check. Thus, the final sample sizes used in all analyses were $N = 274$ (Study 1a) and $N = 891$ (Study 1b). The actual number of participants in each of the three conditions was 79 (control), 111 (reminder only), and 84 (reminder with implementation intentions) in Study 1a and 50 (control), 435 (reminder only), 406 (reminder with implementation intentions) in Study 1b. [1]

Measures and materials.

Personality and cognitive ability. Personality was assessed using the IPIP-300 item form for Conscientiousness and the IPIP-120 item form for the other Big Five factors (Goldberg, 1999). Items were assessed on a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). These scales have been shown to be valid and reliable measures of personality (Goldberg, 1999).

Cognitive ability was assessed using the Wonderlic Personnel Test Quicktest (WPT-Q;

Wonderlic, 2004). The WPT-Q is a 30-item timed assessment (lasting eight minutes) that has been shown to correlate highly with scores on the WPT Classic (Wonderlic, 2004), a highly reliable and valid cognitive ability test (reliability and validity coefficients in excess of .90; Schraw, 2004). Scores are reported in terms of number of items correct that have been converted to WPT classic scores. Wonderlic (2007) reports an average adjusted score on the WPT-Q of 20.30 (*SD* = 7.00) in a sample of 109,729 test takers.

Intervention materials. Participants in the reminder with implementation intentions condition viewed a three and half minute long video describing the features of the Remember the Milk program (http://youtu.be/FxRZQp7vuG8). After viewing the video, participants visited the Remember the Milk website, at which point they were guided through signing up for their own account and posting a task (specifically, the task to complete the homework assignment).

Remember the Milk is a free, online planner. Site users simply log on and list tasks that need to be completed. They then check tasks off the list when they are done. Users can indicate task deadlines, make tasks repeat (e.g., daily or every Monday), and importantly for the current purposes, they can set up e-mail, text message, or instant message task reminders at specified times (e.g., daily or near deadlines). Finally, users can specify exactly where they plan to complete a task (e.g., at home, at the library). The current research uses these planning features of Remember the Milk to help students set an implementation intention to complete their assigned homework task, and it uses these reminder features to serve as the cue in the implementation intention.

After viewing the video, participants were asked to visualize when and where they would complete the homework task and were asked to set a reminder message to be sent to themselves 15 minutes before the time that they wished to complete the task. Finally, participants were

asked to reflect on and commit to the following implementation intention: "When I receive the reminder message, I will go to my computer and complete the homework task."

Control task materials. Participants in the no treatment control condition and the reminder only conditions in Study 1a viewed a four-minute long video about the effects of alcohol on the teen brain (http://www.youtube.com/v/ svZcChJozac). After viewing the video, they visited the Michigan State University social norms campaign website (http://socialnorms.msu.edu/index.php?page=about-the-campaign), which contains information about the normative drinking habits of students at MSU. The materials are designed to correct norms misperceptions concerning alcohol use. Participants in these same two conditions in Study 1b viewed a two-minute long video about the My Plate healthy eating initiative (http://www.youtube.com/embed/SEFmSk08LIE). After viewing the video, they visited the Choose My Plate website (http://www.choosemyplate.gov), which contains information and resources on healthy eating. Different materials were used in the different samples to target issues that were most relevant to the different populations from which the samples were drawn (students vs. ordinary adults).

Stock prediction task. When completing the homework assignment, participants learned how to do a new task – how to predict stock prices for companies based on the principles of multiple regression. The task has been used successfully in previous research (Fisher & Ford, 1998) and has desirable characteristics for the purposes of the current research. Specifically, in prior research, time on task was positively associated with performance on the knowledge and application criterion measures (*r*s = .31 and .09, respectively). In the task, participants studied and attempted to learn two pages of written materials describing a technique that investment counselors purportedly use to give their clients advice about what stocks to buy. They could use

whatever learning strategies they wished to complete the task.

The exact text of the materials is displayed in Appendix A. The first part of the materials focuses on how investment counselors make predictions regarding stock prices for their clients, and the second part of the materials focuses on the use of the multiple regression technique to do so. The final part of the learning materials provides a worked sample problem and an incomplete sample problem that participants can use to practice the multiple regression technique (answers to the practice problem are provided on a separate page).

Performance measures. Two types of performance measures were assessed, the first concerning attributes of the homework period and the second assessing performance during the follow-up period. Regarding the practice period, two measures of effort exerted on the homework were assessed: time on task and mental workload. The mental workload scale assesses the self-perceived amount of effort exerted on the homework. Two measures of effort exerted were taken, because there is some dispute about the validity of both measures as the best measure of effort. Each measure reflects a slightly different component of effort that was desirable to capture; mental workload captures self-perceived intensity of effort, whereas time on task captures duration of effort.

Mental workload was assessed using the six-item scale from Fisher and Ford (1998; Appendix B). Time on task was assessed simply by recording how much time participants spent on the practice materials website. Practically, this measure was ascertained by subtracting the time stamp taken at the start of the survey from the time stamp taken at the end of the survey. Some participants visited the page with the homework materials multiple times; in this case, their cumulative time spent on the homework was used as the measure of time on task. Participants who did not complete the homework received a value of zero on this variable – this was true for

32 participants in Study 1a (11.7%) and 360 participants in Study 1b (40.4%). A dichotomous measure of whether participants spent any time on the homework was also computed (1 = did the homework; 0 = did not do the homework). Participants' responses to the practice problem were also coded to form a measure of sample problem completion (1 = attempted the practice problem; 0 = did not attempt the practice problem).

Because participants in both studies completed the homework assignment unsupervised, time stamp data are not perfect measures of time on task. For instance, if a participant opened the homework assignment, but was distracted by another task while completing it (perhaps by a phone call or an e-mail), their time on task includes this time in which they were not actually working on the homework. A participant could even open the website with the homework assignment and leave it open on their computer or mobile device for an indefinite amount of time. As a result, many participants had unreasonably high values on this variable. As a solution, all data points above a cutoff value (2,500 seconds or about 42 minutes) were deemed out of bounds and rendered missing for the purposes of the analyses. This value represented a clear break point in both samples when examining the distribution of scores on this variable. Fifty-four (19.7%) of participants in Study 1a and 78 (8.8%) of participants in Study 1b had values that were out of bounds on this variable. These participants were not removed completely from the analyses (because of the use of full information maximum likelihood estimation to handle missing data).

Regarding performance on the stock prediction task as assessed at the follow-up session, performance was measured on two tests, knowledge and application, which are displayed in Appendices C and D. The knowledge test is an 18-item multiple-choice test that is scored as percent correct. For the application test, participants must calculate predicted stock prices for 10

companies; it is also scored as percent correct. Participants who did not take the tests were coded as missing on that variable (the use of full information maximum likelihood estimation means that the best fitting model given all available data is computed).

Procedure. Student participants (Study 1a) enrolled for a two session, in-lab study, with sessions separated by 24 hours. Mechanical Turk workers (Study 1b) enrolled for a study consisting of multiple surveys. They were informed when they enrolled how much time would be needed for each of the multiple parts of the study. Participants in both studies were told they could spend "as much time" as they wanted on the homework materials. All participants were told that the purpose of the study was to determine the effects of learning new information on subsequent storage and retention of additional information. They were then told that as a result, in the first part of the study they would learn some new information, and then later on, they would learn some new, unrelated information and be tested on that information to determine whether their initial learning affected later learning.

In the first session, after providing informed consent, participants completed the personality and cognitive ability measures. Participants were then randomly assigned to the control condition, the reminder only condition, or the reminder with implementation intentions condition. In the control condition and the reminder only condition, participants viewed a video and explored a website before setting a goal intention to complete the homework. In the reminder with implementation intentions condition, participants learned a meta-cognitive strategy for self-regulation known as strategic prompting with implementation intentions. An instructional video demonstrated how to set up a Remember the Milk account and walked them through the implementation intentions exercise.

In Study 1a, participants spent equivalent amounts of time on the videos/websites across

all three conditions, F (2, 273) = 1.28, MSE = 17.41, p = .28 (Ms = 10.82, 10.07, 10.94 minutes and SDs = 4.61, 4.03, 3.90, respectively). In Study 1b, participants in the control and the reminder only condition spent less time on the videos/websites than participants in the reminder with implementation intentions condition, F (2, 890) = 33.46, MSE = 31.68, p < .001 (Ms = 5.01, 5.18, 8.26 minutes and SDs = 5.50, 4.70, 6.49, respectively). This is likely due to the shorter video that was used for the control and reminder only condition in Study 1b.

Following the exercises, all participants learned that during their follow-up session the next day, they would be tested on a new task. They were then told that in order to learn how to do the new task and prepare for the upcoming test, they would need to spend some time learning about and practicing the task on a website, on their own time, prior to the next day's follow-up session. The reminder with implementation intention participants then set up a reminder message using Remember the Milk and set an implementation intention to complete the online practice. They did so by first spending "a few moments visualizing exactly when and where you plan to complete the homework task." They then answered two questions specifying where they planned to complete the task and "how many hours from now" they planned to complete it. Participants planned to complete the homework in an average of 5.67 hours in Study 1a (SD = 6.12) and 8.31 hours in Study 1b (SD = 7.85 hours). Participants then programmed Remember the Milk to send a reminder message 15 minutes before their desired completion time. Finally, they were asked to form an implementation intention to complete the homework by reflecting on and committing to the following statement: "When I receive the reminder message from Remember the Milk, I will complete the homework task."

In the control condition and the reminder only condition, participants were asked to form a goal intention to complete the homework in the next twenty-four hours. This was done by

asking participants to "set a goal to complete the homework assignment. Please reflect on and commit to the following statement: 'I intend to complete the homework assignment within the next 24 hours.'" Participants in the reminder only condition received an unanticipated, automated e-mail from the researchers eight hours after they completed the first experimental session, which simply reminded them to complete the homework assignment before their follow-up session (see Appendix E). Participants in the control condition received no such reminder. Neither group formed implementation intentions.

In Study 1a, participants in all three conditions received a piece of paper that contained the website for the learning/practice materials and the time and location of their follow-up session the next day. In Study 1b, participants were provided with the website for the homework assignment and instructed to make note of it because it would not be provided to them again. For participants in all three conditions in both studies, this was the only time they were provided with the web address for the homework assignment.

At their leisure, participants did or did not visit the website that contained the learning materials for the stock prediction task. The amount of time that passed between participants' first in-lab session and when they accessed the learning materials, as well as how much time they spent with the materials, was recorded.

The final test occurred exactly 24 hours later for participants in Study 1a; they returned to the lab to complete the test. Participants in Study 1b were e-mailed automatically exactly 24 hours from their first session, and they were instructed to complete the follow-up test as soon as possible after receiving the e-mail. Sixty percent of final test completers in Study 1b completed the follow-up test within 28 hours (*M* time to test = 35.52 hours, *SD* = 27.69, *N* = 503 completers). After completing the final test, participants were fully debriefed.

Results

Tables 2 and 3 display the means, standard deviations, alpha reliabilities, and intercorrelations between the variables in Study 1a and Study 1b. Tables 4 and 5 display condition means and standard deviations for each outcome variable.

Missing data treatment. The linear and logistic regression analyses described below were conducted using the software Mplus (Muthén & Muthén, 1987-2007), which uses full information maximum likelihood (FIML) methods to handle missing data. FIML is a recommended method for treating missingness (Widaman, 2006), especially when data are missing at random. In the case that missingness is due to one or more of the predictor variables in the analysis (e.g., Conscientiousness, cognitive ability), FIML estimation yields less biased parameter estimates than other traditional methods of handling missing data such as listwise deletion (Schafer & Graham, 2002).

To examine predictors of missingness, I checked for differences on study variables based on whether or not an individual completed the final test. In Study 1a, participants who completed the final test (vs. those who did not complete it) spent more time on the homework (M = 11.34 minutes, SD = 9.10 vs. M = 2.97 minutes, SD = 4.54, t (218) = 2.22, p = .007) and were more likely to have done the homework assignment (86.7% vs. 30.0%, χ^2 (1) = 23.90, $p < .001$. Participants who completed versus did not complete the test did not differ in terms of cognitive ability, Conscientiousness, time spent on the intervention materials, or mental workload (all ts < 1.52). There was a trend toward higher rates of completion of the practice problem (47.3% vs. 20.0%, χ^2 (1) = 2.90, p = .09) for those who completed the final test.

In Study 1b, participants who completed the final test scored higher on the cognitive ability test (M = 26.89, SD = 3.94 vs. M = 25.80, SD = 4.58, t (675) = 3.309, $p < .001$), spent

more time on the intervention materials (M = 7.55 minutes, SD = 6.21 vs. M = 5.40 minutes, SD = 5.10, t (889) = 5.59, $p < .001$, spent more time on the homework (M = 10.06 minutes, SD = 9.19 vs. M = 2.04 minutes, SD = 4.31, t (811) = 15.67, $p < .001$, were more likely to have done the homework (80.3% vs. 28.0%, χ^2 (1) = 246.00, $p < .001$), and were more likely to have worked the sample problem (43.7% vs. 10.6%, χ^2 (1) = 118.10, $p < .001$) than participants who failed to complete the final test. Participants did not differ in terms of Conscientiousness or mental workload (ts < 1.32).

Analytic strategy. It was hypothesized that participants in the reminder only condition and the reminder with implementation intentions condition would complete the homework at a higher rate, spend more time on the homework, exert more mental effort (i.e., have a higher mental workload), and ultimately perform better on the final knowledge and application tests than participants in the control condition. Outcomes for participants in the two treatment conditions were not hypothesized to differ from one another. All analyses were conducted with two contrast coded predictors to test these hypotheses. The first contrast code tested whether the treatment conditions differed from the control condition (-2 = control condition; 1 = either treatment condition), and the second contrast code tested whether the treatment conditions differed from one another (-1 = reminder only, 0 = control condition, 1 = reminder plus implementation intentions).

In all analyses, Conscientiousness and cognitive ability (both mean-centered) were entered in the regression equation along with the two contrast codes. Furthermore, all two-way and three-way interactions between Conscientiousness, cognitive ability, and the contrast codes were also entered to test the possibility that treatment effects varied based on these individual differences. If neither three-way interaction was significant, the three-way interactions were

removed, and then the two-way interactions were examined. If none of the two-way interactions were significant, they were also removed, and the main effects of treatment and the covariates were then examined.

Homework completion. To examine the effects of Conscientiousness, cognitive ability, and the treatments on rates of homework completion, a logistic regression analysis with homework completion as the dependent variable (1 = attempted the homework; 0 = did not attempt the homework) and Conscientiousness, cognitive ability, the two contrast codes, and all two-way and three-way interactions was conducted. None of the interactions were significant (all *t*s < 1.91 in Study 1a and *t*s < 1.06 in Study 1b), so an analysis with only the main effects was conducted.

Study 1a. The results of the logistic regression revealed a significant main effect of cognitive ability (Table 6), such that a one-unit increase in cognitive ability was associated with a 1.11 higher likelihood of doing the homework. A one standard deviation increase in cognitive ability was associated with a 1.41 higher likelihood of doing the homework.

There was also a marginal effect of the second contrast code ($p = .10$), reflecting the fact that students in the reminder with implementation intentions condition completed the homework at a lower rate than students in the reminder only condition (80.9% vs. 89.1%; see Figure 2). Put another way, students in the reminder only condition were 1.97 times as likely as students in the reminder with implementation intentions condition to complete the homework. The effects of Conscientiousness and the first contrast code were not significant, indicating that Conscientiousness was not associated with completing the homework, nor was there any difference between the reminder only and reminder with implementation intentions treatments versus the control treatment.

Study 1b. The results of the logistic regression revealed a significant main effect of cognitive ability (see Table 6), such that a one unit increase in cognitive ability was associated with a 1.09 higher likelihood of doing the homework. Thus, a one standard deviation increase in cognitive ability was associated with a 1.40 times higher likelihood of doing the homework.

There was also a significant effect of the second contrast code ($p < .001$). Participants in the reminder with implementation intentions condition completed the homework at a lower rate than participants in the reminder only condition (50.0% vs. 63.2%; see Figure 2). In terms of likelihood, participants in the reminder only condition were 1.82 times more likely to complete the homework than participants in the reminder with implementation intentions condition.

As above, neither the effect of Conscientiousness nor the first contrast code was significant, indicating that Conscientiousness was not associated with completing the homework, nor was there any difference between the reminder only and reminder with implementation intentions treatments versus the control treatment.

Summary. The results of both studies suggested that the reminder only condition was associated with higher rates of homework completion than the reminder with implementation intentions condition. Examination of study means revealed this was due to a boost in completion in the reminder only condition, compared to control (though this difference was not statistically significant in either study, perhaps due to the small sample size in the control condition). The reminder with implementation intentions condition did not differ from the control. There was no evidence of any interactions with cognitive ability and Conscientiousness in either study.

Homework time on task. A multiple regression with time spent on the homework assignment as the dependent variable was conducted. None of the two- or three-way interactions were significant (ts < 1.42 in Study 1a and ts < 1 in Study 1b), so a regression with only the main

effects was conducted (see Table 7).

Study 1a. The results of the multiple regression on time spent on the homework revealed that none of the main effects was significant (*t*s < 1.50; see Figure 3).

Study 1b. The results of the multiple regression on time spent on the homework revealed a significant effect of cognitive ability, $b = .16$, $SE = .08$, $t = 2.08$. The effect was such that a one standard deviation increase in cognitive ability was associated with 40.45 seconds longer spent on the homework. There was also a significant effect of the second contrast, $b = -.69$, $SE = .30$, $t = -2.30$. The effect was such that being in the reminder only condition predicted spending an average of 82.80 seconds longer on the homework assignment compared to the reminder with implementation intentions condition. The effects of Conscientiousness and the first contrast were not significant, again indicating that Conscientiousness was not associated with time on task and also that the reminder and reminder with implementation intentions conditions were not significantly different from the control condition.

Summary. The results in Study 1b are largely consistent with the results above for homework completion. Individuals in the reminder only condition spent more time on the homework than individuals in the reminder with implementation intentions condition. The pattern of means reflected the fact that individuals in the reminder with implementation intentions condition spent similar amounts of time on the homework to individuals in control condition, whereas individuals in the reminder only condition spent more time on the homework than individuals in the control condition.

Mental workload. A multiple regression with mental workload exerted on the homework as the dependent variable and Conscientiousness, cognitive ability, the two contrast codes, and all two-way and three-way interactions was conducted. None of the two- or three-way

interactions was significant (ts < 1.25 in Study 1a and ts < 1.87 in Study 1b), so a regression with only the main effects was conducted (see Table 8).

Study 1a. The results of the multiple regression on mental workload revealed that none of the main effects was significant (ts < 1.86).

Study 1b. The results of the multiple regression showed that the main effect of cognitive ability was significant, b = -.06, SE = .01, t = -4.38. Examination of the standardized effect revealed that a one standard deviation increase in cognitive ability was associated with a .23 standard deviation decrease in mental workload. None of the remaining effects were significant.

Summary. Overall, the evidence did not support an effect of treatment on mental workload exerted. That is, individuals across the three conditions reported exerting similar amounts of effort on the homework. Examination of the correlations between mental workload and cognitive ability, as well as between mental workload and final test performance, revealed a pattern of negative associations. That is, as self-perceived mental workload increased, cognitive ability and final test performance tended to decrease. This suggests that the mental workload scale may have actually been measuring not effort exerted, per se, but perceived strain and task difficulty. Put another way, these negative correlations could reflect the following interpretation: as the perception of homework difficulty increased, final test performance (and cognitive ability) decreased.

Effects of homework completion and time spent on homework on performance outcomes. Considering the effects of treatment on homework completion and time spent on the homework, let us now consider how these two variables affected final test performance. Two independent samples t-tests were conducted with knowledge and application test performance as the dependent variables to compare participants who did vs. did not complete the homework

assignment. These analyses were followed up with examination of the correlation between time spent on the homework and final test performance. Finally, some additional analyses were conducted to further examine the effects of homework completion on the application test. In these analyses, performance on the application test was dictomized (0 = earned zero points on the test; 1 = scored more than zero points on the test) because the distribution on this variable was extremely skewed (the modal score was zero, with 43.93% of participants earning a zero on the test).

Study 1a. The *t*-tests predicting final test performance from homework completion were significant, $t(262) = 4.47$, $p < .001$ for the knowledge test and $t(262) = 3.19$ for the application test. Individuals who completed the homework earned an average score of 56.36% (*SD* = 17.47%) on the knowledge test and 30.61% (*SD* = 32.17%) on the application test, compared to average scores of 42.14% (*SD* = 17.91%) and 12.29% (*SD* = 27.66%) among individuals who did not complete the homework. Correlational analyses showed a similar pattern of results with the amount of time spent on the homework assignment correlating .47 with performance on the knowledge test and .42 with performance on the application test.

A chi-square test comparing the proportion of participants who did versus did not complete the homework to the proportion of participants who did versus did not score zero on the application test was significant, $\chi^2 (1) = 15.09$, $p < .001$. Of participants who did not complete the homework, only nine (25.71% of non-completers) earned a score greater than zero on the application test. By comparison, of participants who did complete the homework, 139 (60.70% of completers) earned a score greater than zero. This analysis therefore agrees with the *t*-test just presented (but it handles the dramatic skew present in this variable more appropriately).

Study 1b. An independent samples *t*-test comparing the knowledge and application test performance of participants who did vs. did not complete the homework assignment was significant, $t(501) = 13.26$, $p < .001$ for the knowledge test and $t(501) = 9.15$ for the application test. Individuals who completed the homework earned an average score of 61.45% (*SD* = 20.61%) on the knowledge test and 33.87% (*SD* = 36.68%) on the application test, compared to average scores of 32.77% (*SD* = 17.19%) and 1.30% (*SD* = 9.08%) among individuals who did not complete the homework. Correlational analyses showed a similar pattern of results with the amount of time spent on the homework assignment correlating .55 with performance on the knowledge test and .46 with performance on the application test.

A chi-square test comparing the proportion of participants who did versus did not complete the homework to the proportion of participants who did versus did not score zero on the application test was significant, $\chi^2 (1) = 97.91$, $p < .001$. Of participants who did not complete the homework, only three (2.78% of non-completers) earned a score greater than zero on the application test. By comparison, of participants who did complete the homework, 222 (56.20% of completers) earned a score greater than zero.

Summary. In both studies, homework completion and the amount of time spent on the homework were associated with performance on the final knowledge and application tests, supporting the prediction that improving homework completion and time spent on homework should be associated with better academic performance.

Effects of treatment on performance outcomes. Two regressions with performance on the multiple-choice knowledge test and performance on the open-ended application test as the dependent variables and Conscientiousness, cognitive ability, and all two-way and three-way interactions as the independent variables were conducted to examine the effect of treatment on

final test performance. Performance on the knowledge test was approximately normally distributed so a linear regression was performed, but performance on the application test was extremely positively skewed. In fact the modal score on the application test was zero. As above, to treat the skew, the data were dictomized, and logistic regressions were conducted to compare the effects of the independent variables on answering no items correctly (coded 0) versus answering at least one item correctly (coded 1).[2]

As in the analyses above, FIML estimation was used to treat missing data. Individuals who did not complete the final test (N = 10 in Study 1a; N = 388 in Study 1b) were coded as missing. Performance data for these students who did not take the test is not directly estimated, but instead the FIML analysis calculates the best fitting parameters for the model using all available data. In Study 1b, 16 individuals completed the final test, but left every item blank; these individuals were awarded a score of zero. The results presented below do not change if the outcomes are modeled simultaneously; separate tests are presented for clarity.

Study 1a, knowledge test. For the regression on the knowledge test, none of the two- or three-way interaction terms were significant, so a model with only the main effects was conducted (Table 9). The only significant main effect was for cognitive ability, b = .01, SE = .003, t = 3.74. A one standard deviation increase in cognitive ability was associated with a 3.42% increase in knowledge test performance.

To test whether time spent on homework mediated any of the effects between Conscientiousness, cognitive ability, and the two contrast codes and performance on the knowledge test, a mediational model with the two contrast-coded variables, Conscientiousness, and cognitive ability as the independent variables, time spent on the homework as the mediator, and performance on the knowledge test as the dependent variable was conducted. Consistent

with the fact that none of the 'a' paths (i.e., the paths from the independent variables to the mediator) were significant in the analysis above, there were no significant indirect effects. Mplus cannot calculate indirect effects for categorical variables, so a test with the dictomously coded homework completion variable as the mediator was not possible.

Study 1b, knowledge test. For the regression on knowledge test, none of the two- or three-way interaction terms were significant, so a model with only the main effects was conducted (Table 9). The only significant main effect was for cognitive ability, b = .01, SE = .003, t = 4.78. A one standard deviation increase in cognitive ability was associated with a 4.23% increase in knowledge test performance.

To test whether time spent on the homework mediated any of these effects, a mediational model with the two contrast-coded variables, Conscientiousness, and cognitive ability as the independent variables, time spent on the homework as the mediator, and performance on the knowledge test as the dependent variable was conducted. There were significant indirect effects from cognitive ability and the second contrast code. The indirect effect from cognitive ability (β = .04, b = .002, SE = .001, t = 2.01) reflected the fact that higher levels of cognitive ability were associated with more time spent on the homework and subsequently higher scores on the knowledge test. The direct effect of cognitive ability on the knowledge test was also significant (β = .22, b = -.01, SE = .002, t = 5.18), as was the total effect (β = .26, b = .01, SE = .002, t = 5.66; this effect represents the sum of the direct and indirect effects and captures the overall effect of cognitive ability on knowledge test performance).

The indirect effect from the second contrast code (β = -.04, b = -.01, SE = .004, t = -2.35) reflects the fact that participants in the reminder only condition spent more time on the homework than participants in the reminder with implementation intentions condition, and

subsequently, they performed better on the final test. Neither the direct effect (i.e., the effect from the second contrast directly on the knowledge test) nor the total effect (i.e., the sum of the direct and indirect effects) was significant for this variable.

Summary, performance test. In Study 1a, there was generally no evidence for effects of the independent variables on knowledge test performance, nor mediation of these effects by time spent on the homework. In Study 1b, however, both cognitive ability and the second contrast code had mediated effects on test performance through time spent on the homework. The effects reflect the fact that individuals who were higher in cognitive ability spent more time on the homework and ultimately performed better on the performance test. Furthermore, individuals who received a reminder to do the homework spent more time on the homework and performed better on the knowledge test than individuals in the reminder with implementation intentions condition.

Study 1a, application test. A logistic regression on performance on the application test was conducted. None of the two- or three-way interactions were significant, so a model with only the main effects was conducted (Table 10). There was a significant main effect of cognitive ability, $b = .08$, $SE = .04$, $t = 2.12$, Odds Ratio = 1.09. That is, a one unit increase in cognitive ability was associated with a 1.09 times higher likelihood of scoring more than zero on the application test. Thus, a one standard deviation increase in cognitive ability was associated with a 1.33 times higher likelihood of scoring greater than zero.

There was also a significant main effect of Conscientiousness, $b = .64$, $SE = .31$, $t = 2.03$, Odds Ratio = 1.89. A one unit increase in Conscientiousness was associated with a 1.89 times higher likelihood of scoring more than zero on the application test. A one standard deviation increase in Conscientiousness was associated with a 1.31 times higher likelihood of scoring more

than zero on the application test.

There were also main effects of the contrast coded variables, for the first contrast b = .24, SE = .10, t = 2.46, Odds Ratio = 1.26 and for the second contrast b = -.28, SE = .15, t = -1.81, Odds Ratio = .76. Translating these results into a probability metric, students in the control condition had a 49% chance of scoring greater than zero on the test, students in the reminder only condition had a 67% chance, and students in the reminder with implementation intentions condition had a 54% chance. Taken together, these effects imply that participants in the reminder only and the reminder with implementations intention conditions were on average more likely than participants in the control condition to score more than zero on the application test. At the same time, participants in the reminder with implementation intentions condition were significantly less likely to score more than zero than participants in the reminder only condition.

Study 1b, application test. A logistic regression on the application test was conducted. None of the three-way interactions were significant, so a model with the two-way interactions and the main effects was conducted (Table 10). There was a significant main effect of cognitive ability, b = .13, SE = .05, t = 2.71, Odds Ratio = 1.14. That is, a one unit increase in cognitive ability was associated with a 1.14 times higher likelihood of scoring more than zero on the application test. Thus, a one standard deviation increase in cognitive ability was associated with a 1.73 times higher likelihood of scoring greater than zero. There were no other significant main effects.

There was, however, a significant interaction between Conscientiousness and the first contrast coded variable, b = -.39, SE = .20, t = -1.98, Odds Ratio = 1.18. The interaction reflected the fact that Conscientiousness was positively associated with likelihood of scoring greater than zero on the test in the reminder only condition, whereas it was negatively associated in the

control and the reminder with implementation intentions condition (see Figure 4). The simple slope for Conscientiousness was not significant in any of the conditions, however. The odds ratios for the slope of Conscientiousness at +1 *SD* of Conscientiousness were .78 (b = -.37, SE = .30, t = -1.25) in the control condition, 1.22 (b = .41, SE = .26, t = 1.58) in the reminder only condition, and .83 (b = -.37, SE = .30, t = -1.25) in the reminder with implementation intentions condition.

Summary, application test. The results of these analyses showed slightly different results in Study 1a and Study 1b. In both studies, cognitive ability was positively associated with scoring greater than zero on the application test. In Study 1a, Conscientiousness was also positively associated with scoring greater than zero. In Study 1b, the effect of Conscientiousness depended on condition, such that Conscientiousness was positively associated with test performance in the reminder only condition, but negatively associated with performance in the other two conditions. These results are to some extent consistent with a regulatory fit explanation for participants in the reminder only condition. However, this result should be interpreted with caution as it was not replicated in Study 1a, nor in analyses with performance test scores as the outcome variable.

Consistent with the effects on homework completion and time spent on homework, participants in Study 1a were the mostly likely of the three conditions to score greater than zero when they were in the reminder only condition. These results are consistent with a process in which participants in the reminder only condition were more likely to complete the homework (and spend more time on it), which predicted a higher likelihood of scoring more than zero on the application test.

Discussion, Studies 1a and 1b

The results across both studies were to some extent consistent. In both samples, there was evidence that a reminder message alone was more effective at increasing rates of homework completion and time on task compared to a reminder with implementation intentions. Additionally, completing the homework was associated with better performance on the final tests. Although the reminder only message was not significantly more effective than the control treatment, this lack of significance was potentially due to low power to detect the effect (as a result of the unbalanced sampling design). The pattern of results in both studies suggested that a simple reminder boosted homework completion rates, whereas setting implementation intentions was generally ineffective in increasing completion (see Figures 2 & 3). Subsequently, completing the homework and spending more time on the homework was associated with better performance on the knowledge and a greater likelihood of scoring more than zero on the application test.

There are therefore two effects that require some consideration. The first is the positive effect of sending a reminder message on homework completion rates (and subsequent test performance), and the second is the absence of an effect of implementation intentions on homework completion and test performance. Considering first the effect of the reminder message, there is ample evidence in the literature that priming a goal is related to goal striving behavior (see Moskowitz & Gesundheit, 2009, for a review). Indeed, goal priming can increase the accessibility of the goal and associated goal means, and such an explanation is consistent with the results observed in the current research. The reminder e-mail may have served to increase the accessibility of the goal to complete the homework, and means to complete the homework may have become more accessible as a result (Higgins, 1989), contributing to a great likelihood of homework completion.

In the current study, however, setting an implementation intention was less effective than would have been expected based on prior research and theory. There are several possible reasons why this may have been the case. First of all, the implementation intention formation procedure used in the current research was slightly more complex than that which has been used in much previous research. This complexity may have undermined the effectiveness of the technique, to the extent that a simple, easy to understand plan is an important part of the mechanism by which implementation intentions operate. Some previous research suggests that implementation intentions are more effective for difficult than for easy *goals* (Gollwitzer & Brandstätter, 1997), but the effect of the relative simplicity vs. complexity of the if-then plan has not, to my knowledge, been formally examined.

Another intriguing explanation for the lack of effect in the current research is perhaps that participants in the study may have lacked self-awareness as to what would be the most convenient or optimal time for them to complete the homework assignment. Therefore, when the reminder and the critical time for completing the homework arrived, these participants may have been more likely to postpone the homework, ultimately making it less likely overall that it would get completed. A final possibility is that it may have been the case that participants in the implementations intentions condition felt obligated to complete their homework at their self-specified time (and only at that time). If these participants believed that they were not completing the experiment correctly by doing the homework at an alternate time, then their overall rates of completion would be lower than they were for participants in the reminder only condition, who may have felt more free to complete the homework at any point within the 24 hours available.

At a theoretical level, the results of the study make clear that goal directed behavior can be increased by mere reminders, in the absence of an implementation intention. However, there

is one potential problem with the research design needs to be addressed. Recall that in the reminder only condition, the reminder originated from a source outside of the participant, whereas in the reminder with implementation intentions condition, the reminder originated from the participant's own actions. This difference in treatment could potentially be considered a confound in the design, insofar as it is impossible to determine if it was the implementation intention or the self-originated reminder that was responsible for the differences between these two treatments.

However, it is an intriguing possibility that one of the reasons for the success of the reminder only condition may have been the fact that in that condition, the reminder originated from an outside source. Theoretically, this might make sense insofar as it requires no willpower, foresight, or self-perception on the part of the individual to initiate the prompt. To the extent that willpower and self-perception may serve to undermine an individual's successful goal completion (via the processes of ego depletion or lack of insight, perhaps), then finding ways to influence behavior without invoking these variables should be a more successful tactic. Lewin (1947) called such subtle, but powerful, environmental influencers of behavior "channel factors"; more recently, Thaler and Sunstein (2008) have called them "nudges." Such nudges, when encountered, represent potentially powerful tools for practitioners of behavior change. Reminder messages, when properly applied, could be one such nudge.

Turning to the applied implications of the results, the results do not support the use of reminder messages in concert with implementation intentions in academic contexts. However, reminder messages on their own appear to be an effective tool for combating problems of failing to initiate goal directed behavior. In the current research, this tactic translated into increased rates of homework completion and ultimately better performance on the final tests. In spite of a large

sample size in Study 1b, there appeared to be no moderation of the basic effect by cognitive ability or Conscientiousness. This finding suggests that such an intervention can effectively be used on students of a variety of characteristics. Surprisingly, there were very few effects of Conscientiousness in the current research, which stands in stark contrast to a large body of literature supporting the important role of conscientious strategies in facilitating academic success. For the current task, it seems, cognitive ability was a more important predictor of homework completion and final test performance. One reason for this is the fact that performance on the tasks in this study had no real consequence for participants in the way that performance on a test or an annual review does for a student or an employee. The relatively decontextualized nature of the task may have weakened the importance of Conscientiousness as a predictor of task performance. If this was the case, then in Study 2, which takes place in a real classroom context, Conscientiousness should again arise as an important predictor of academic performance.

Study 2

The results of Study 1 revealed an interesting and potentially very useful technique for increasing student performance by increasing completion of homework assignments: reminder messages. Study 2 sought to examine the effectiveness of another technique, and it did so in a real classroom setting, allowing its utility for helping real students to be directly assessed. Participants in the study were students in a college introductory psychology class who were randomly assigned one of six conditions in a 3 (raise boundary goal self vs. raise boundary goal directed vs. do not raise goal) × 2 (implementation intentions vs. no implementation intentions) design. The study tested whether raising one's boundary goal (either in a self-directed or an other-directed fashion) was an effective way to boost performance in the course, as compared to a no raise control. It further tested whether setting implementation intentions improved performance compared to a no implementation intention control, as well as whether the size of the boundary goal raising effect was moderated by having set an implementation intention. Finally, it tested whether cognitive ability and Conscientiousness moderated how students responded to the different interventional treatments.

Because academic performance unfolds over the course of an entire semester, establishing an implementation intention that would cover the range of possible situations that a student might encounter was difficult. As a remedy, a slightly modified version of a typical implementation intention manipulation was used, based on the procedure in Adriaanase et al. (2010). The details of that study are worth explaining. Those researchers were comparing the effectiveness of a technique known as mental contrasting with implementation intentions (MCII) to mental contrasting and implementation intentions alone. Mental contrasting is a procedure in which a hoped-for, ideal future state is compared to the realities of the present. For instance, an

obese person might imagine him or herself as healthy and fit, and this hoped-for state is contrasted with obstacles in the present (e.g., eating fast food for lunch every day). When mental contrasting is combined with implementation intentions, these obstacles that are identified in the mental contrasting phase of the intervention are fed forward to form implementation intentions. So in the prior example, a person might form an implementation intention to overcome the obstacle of eating too much fast food by asserting "If a colleague invites me out for lunch to eat fast food, then I will turn him down and eat a sandwich instead."

Thus, in the full MCII condition, participants in Adriaanse et al. (2010) thought about a desired future and contrasted it with the present, identifying obstacles that were fed forward into the if- portion of a series of implementation intentions. This MCII treatment was compared to a treatment in which participants only did the mental contrasting portion of the exercise (they compared the desired future with the realities of the present, but did not form if-then plans), as well as a treatment in which participants only formed implementation intentions (they simply thought of three obstacles, without any consideration of a desired future, and then used those obstacles to form if-then plans). The results of that study showed that participants who completed the full MCII treatment were more successful at achieving their goals then participants who only did the mental contrasting portion of the exercise or the implementation intentions portion of the exercise. However, there was no true control group in the study that completed no treatment, so it was not possible to compare the performance of any of these interventions to no treatment. In the current research, the effectiveness of the implementation intention manipulation was compared to a no implementation intention control, allowing the effectiveness of this version of the manipulation to be demonstrated relative to no treatment.

In the current study, students who were in the implementation intentions conditions were

asked to first identify three obstacles that they might encounter that could prevent them from attaining their lower boundary goals. They then formed if-then contingencies based on these obstacles (just as in the implementation intention only condition in Adriaanse et al., 2010). The manipulation was selected keeping in mind the idea that such obstacles likely occur repeatedly over time. Such repeated opportunities to experience the obstacles should result in the associated contingency plans being triggered frequently and ultimately provide the implementation intentions with a better chance to have an effect.

Methods

Participants. Of 525 students in an introductory psychology course who were invited to participate in the study, 415 students (79%) consented to participate. Of these students, 19 joined the class late and did not complete the first assessment containing the experimental manipulation. These 19 participants are not considered in any of the analyses. The total number of participants was therefore $N = 396$. The majority of participants were female (63%), White (78%), and first-year students (64%). Participant age ranged from 18 to 32 ($M = 18.99$, $SD = 1.52$).

Materials.

Personality and cognitive ability. As in Study 1, personality was assessed using the IPIP-300 item form for Conscientiousness and the IPIP-120 item form for the other Big Five factors (Goldberg, 1999). Items were assessed on a Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Cognitive ability was assessed using participants' self-reported ACT test scores. The ACT test is a highly reliable standardized achievement test ($\alpha = .95$; ACT Technical Manual, 2007) required for admission at the university where the data were collected. Self-reported ACT scores have been found to be highly correlated with scores obtained from university officials ($r = .95$; Cole & Gonyea, 2010).

Boundary goals and boundary goal intervention. Boundary goals were assessed in all conditions as in Corker and Donnellan (2012) by asking students to report "the lowest grade for this course that would be acceptable to you" on a scale from 7-point scale from 1.0 to 4.0 (half grade point average unit increments). The scale was consistent with the grading scheme at the university where the research was conducted. For readers more accustomed to a letter grading scale, these values equate to 4.0 = A, 3.5 = A-/B+, 3.0 = B, 2.5 = B-/C+, 2.0 = C, 1.5 = C-/D+, 1.0 = D. A score lower than 1.0 is a failing grade.

The exact text of the interventions is displayed in Appendices F to K. These appendices represent the six treatment conditions in the 3 × 2 design (raise boundary [did not raise, self-set raise, directed raise] × implementation intentions [set implementation intentions, did not set implementation intentions]). Participants in all conditions identified their boundary goals for the course, and then participants in the raise boundary conditions were directed to raise their boundary goal (either as much as they personally deemed fit or by 0.5 grade point average units). Finally, participants in the implementation intentions conditions identified three obstacles to achieving their boundary goals and made if-then plans for dealing with those obstacles (as in Adriaanse et al., 2010).

Course performance. A variety of performance data were provided by the instructor at the end of the term. These include: total points earned (out of 500), exam scores (out of 400), and extra credit points earned (out of 20). [3] Students completed up to five course exams (which consisted of approximately 60 multiple choice questions each), and the top four scores earned were converted to percentages and summed to form the measure of exam scores. Earning 90% of the total points resulted in a final grade of 4.0, 85% = 3.5, 80% = 3.0, 75% = 2.5, 70% = 2.0, 65% = 1.5, and 60% =1.0.

Extra credit points were awarded in two ways. First, after each of the four regular exams (the fifth exam was a cumulative final), students could review the exam in small groups (up to five individuals), and using their book and course notes, they could attempt to ascertain the correct answer to all of the exam questions. These "second-chance" exams were then scored (one score sheet per student), and extra credit was awarded based on the number of points correct. Students were awarded five points of extra credit if they got all of the questions correct, four points if they missed one or two questions, three points if they missed three or four questions, and two points if they missed more than five, but no more than 30 questions (i.e., half of the items). Students could also choose not to stay for the second-chance exam, in which case they were awarded zero points. Second, extra credit points were awarded twice in the term based on participation in in-class activities (these participation opportunities were worth up to an additional five points). The total amount of extra credit that was allowed from any source was 20 points (only one student earned more than the 20 allowable points). Extra credit points were therefore based on effort to a greater degree than exam scores. To earn the full five possible points for a given exam, for instance, a great deal of effort was required to remain after the exam and diligently comb one's textbook to ensure that all answers were correct.

Procedure. All 525 students in the course were randomly assigned to one of six conditions in a 3 (control, raise boundary self, raise boundary directed) × 2 (implementation intentions, no implementation intentions) design. On the first day of class, all students were contacted via e-mail and invited to participate in the study in exchange for course credit. If they agreed to do so, they then completed a series of questionnaires including personality, cognitive ability, demographic, and baseline boundary goal measures. At the conclusion of the first questionnaire, participants then completed the intervention according to condition (Appendices F

- K). Participants completed follow-up questionnaires online prior to the first exam and directly following the release of grades for each of the four exams. Students were reminded via e-mail to complete each questionnaire, and questionnaires were typically available to be completed for four days. Participants' grades and course records were obtained from the instructor at the conclusion of the course.

Results

Descriptive statistics and correlations for key study variables are displayed in Table 11. As in Studies 1a and 1b, all analyses were conducted in Mplus (Muthén & Muthén, 1998-2007) in order to utilize FIML estimation procedures to handle missing data. Data are missing to a small degree throughout the dataset. Twenty-eight participants completed the first occasion of measurement (and therefore the experimental manipulation) but have no performance data because they later dropped the course. Use of the FIML estimation procedures ensures that the results are not biased by this attrition.

Boundary goals. As a preliminary assessment of the effectiveness of random assignment, a multiple regression predicting boundary goal level from condition was conducted. Baseline boundary goals should not differ from one another due to random assignment (recall that the boundary goal measure was taken pre-manipulation). The analysis revealed that baseline boundary goals did not differ between conditions, all ts < 1.69. Descriptive statistics for boundary goals in each condition are displayed in Table 12.

Furthermore, there were no differences between the conditions with regard to Conscientiousness, cognitive ability, high school grade point average, or college grade point average, indicating that randomization was successful.

Boundary goals were correlated .14 with Conscientiousness, consistent with previous

research that has found a positive correlation between ideal goals and Conscientiousness meta-analytically (Judge & Illies, 2002). Boundary goals were correlated .21 with cognitive ability (Table 11).

Boundary increases. In order to determine whether the different methods of asking participants to raise their boundary goals impacted how much they subsequently raised them, a multiple regression predicting amount of boundary goal increase in the four conditions in which participants were instructed to raise their boundaries was conducted. The amount of the increase was either self-set or directed, and furthermore, participants either set implementation intentions or they did not. Two effects-coded variables were specified to test the effect of these manipulations on amount of boundary goal increase (1 = self-set, -1 = directed; 1 = implementation intentions, -1 = no implementation intentions). The interaction between these variables was also computed.

The results of the analysis showed that participants who self-set their boundary goal increase ultimately increased their goal less than participants who were directed as to how much to raise their boundary goal, b = - .09, SE = .02, t = 4.92. Students in the directed raise condition increased their boundary goals by M = .47 grade point average units (recall that the directed amount was .5 grade point average units), whereas students in the self-set raise condition increased their boundary goals by M = .29 grade point average units (see Table 12). There was no effect of setting implementation intentions on the magnitude of the boundary goal increase, b = .01, SE = .02, t = -.70, and there was no interaction, b = -.01, SE = .02, t = -.60. In sum, directing students as to how much they should raise their boundary goals resulted in greater boundary goal increases than allowing them to choose how much to raise their goal.

Treatment effects. As an initial examination of treatment effects in the 3 × 2 design, a

series of regression analyses on the three performance variables (total points, exam points, and extra credit points) was conducted. In the first step of the analysis, variables that coded for treatment condition were entered without any covariates or interactions with covariates to assess the basic effect of treatment. In the second step of the analysis, boundary goal level and boundary goal raise were entered to ensure than any observed effects were not due to any small baseline differences in boundary goals or differences in the amount of boundary goal increase across conditions. The purpose of these analyses was to examine the effect of the experimental treatments on performance.

Two contrast coded variables and one effects coded variable were used to assess treatment effects. The first contrast coded variable tested whether raising boundaries affected performance compared to not raising boundaries (control condition = -2, self-set raise = 1, and other-set raise = 1). The second contrast coded variable tested whether choosing the magnitude of one's own boundary increase was a more successful strategy than being directed as to the magnitude of the increase (control condition = 0, self-set raise = 1, other-set raise = -1). A final effects coded variable tested whether setting implementation intentions predicted a higher level of performance compared to not setting implementation intentions (implementation intentions = 1, no implementation intentions = -1).

Two interaction variables were also constructed. The first interaction (the first contrast by implementation intentions) tested whether the magnitude of the effect of raising one's boundary goal varied depending on whether one adopted implementation intentions. The second interaction (the second contrast by implementation intentions) tested whether the magnitude of the effect of self-set vs. other-set boundary goal increases depended on whether one adopted implementation intentions. Descriptive statistics for each of the four outcome variables across

conditions are displayed in Table 12.

Effects on total points earned. The results of the regression on total points earned in the course are displayed in Table 13. These results showed that there was a significant negative main effect of implementation intentions on total points earned. Participants in the implementation intentions conditions earned on average 11.22 fewer points in the course than participants who did not set implementation intentions. There were 500 points possible to earn in the course, so this 11.22 point decrement translated to a 2.24% decrease in the final grade. This result held when the effects of boundary goal and boundary goal raise were controlled for, with an average decrease of 13.58 points or 2.71% of the final grade observed in the final analysis. The only other significant effect was a main effect of initial boundary goal levels. A one grade point average unit increase in initial boundary goal level was associated with a 45.73 point increase (9.17% of the final grade). Thus, setting implementation intentions was detrimental to total points earned in the course, but raising boundary goals had no effect on performance above and beyond effects of initial boundary goal levels.

Effects on exam scores. A regression on exam scores showed similar results to the analyses on total points (Table 14). These results again showed a significant negative main effect of implementation intentions on exam scores. Students in the implementation intentions conditions earned on average 8.74 fewer points on exams than students who did not set implementation intentions, which amounted to 2.18% of 400 exam points. This result held when controlling for boundary goal and boundary goal raise, with an average decrease of 10.72 points observed in this analysis (2.68%). The only other significant effect was a main effect of initial boundary goal levels. A one grade point average increase in initial boundary goal level was associated with a 41.16 point increase in exam score (10.29%). Thus, as with total points earned,

the results showed a negative effect of setting implementation intentions but no effect of raising boundary goals on exam scores.

Effects on extra credit. A final regression on extra credit earned was conducted to determine if an outcome that was more effort-based than ability-based would be especially responsive to the interventions. If boundary goals impact performance because they reflect heightened motivation, then increasing boundary goals should have a particular impact on these more effort based variables. However, the results of this regression also showed results similar to the previous analyses (Table 15). In the first step there was a trend toward a negative main effect of implementation intentions that became significant in the second step when boundary goals were controlled. In the second step, setting implementation intentions was associated with a 1.06 point decrease in extra credit earned (5.30% percent of 20 possible extra credit points). A one grade point average unit increase in initial boundary goal levels was associated with a 2.43 point increase in extra credit earned (12.15%). No other effects were significant. Thus, setting implementation intentions may have negatively impacted students' motivation, resulting in less extra credit being earned. However, there was no effect of raising boundary goals on this effort-based dependent variable.

Summary. Overall, then, there were no effects of raising boundary goals on any of the three performance outcomes examined (total points, exam points, and extra credit). As in previous research, there was a large association between initial boundary goal levels and performance, but there was no additional benefit to performance afforded by the magnitude of students' boundary goal increases. Additionally, there was a negative main effect of setting implementation intentions on performance on these three outcomes. It seems that in this study, there was a small detrimental effect of setting implementation intentions on performance in the

course. Furthermore, this negative effect did not depend on whether or not students had raised their boundary goals. Before considering the implications of these results, let us consider whether individuals with different characteristics responded to these experimental treatments in a similar fashion.

Treatment effects for individuals with different combinations of Conscientiousness and cognitive ability. A series of multiple regressions were conducted with the effects of treatment (specified as in the previous analyses – i.e., two contrast-coded variables, one effects-coded variable, and two interaction variables), Conscientiousness, cognitive ability, and all interactions between these variables as the independent variables. The performance outcomes examined were total points earned, exam scores, and extra credit. Conscientiousness and cognitive ability were centered prior to constructing the interactions. The analyses were conducted such that all terms up to the highest order interactions were entered first, and then non-significant interactions were removed (e.g., if four-way interactions were not significant, then an analysis with all three-way interactions was conducted).

For each of the three outcome variables, none of the interactions was significant, with the exception that there was one (uninterpretable) four-way interaction on extra credit. (The interaction was between Conscientiousness, cognitive ability, the first contrast-coded variable, and the effects-coded implementation intentions variable.) When this four-way interaction was removed, none of the remaining three-way or two-way interaction terms was significant. Thus, regressions for each of the three outcome variables with the main effects of Conscientiousness and cognitive ability included are presented and interpreted. These results are displayed in Tables 16-18.

Effects on total points earned. The analysis on total points earned revealed main effects

of implementation intentions, Conscientiousness, and cognitive ability. The main effect of implementation intentions was, as above, a negative effect: students in the implementation intentions conditions earned 9.70 fewer total points than students who did not set implementation intentions (corresponding to a 1.94% decrease in points earned). Conscientiousness was positively associated with total points earned. A one standard deviation increase in Conscientiousness was associated with 5.43 more points earned in the course (1.08%). Cognitive ability was also positively associated with total points earned. A one-standard deviation increase in cognitive ability was associated with a 19.08 point increase (3.82%). There were no other significant effects.

Effects on exam scores. The pattern of results on exam scores was similar, but the main effects for implementation intentions and Conscientiousness did not attain statistical significance. Setting implementation intentions was associated with a 7.42 point decrease (1.86%) in exam scores, controlling for Conscientiousness and cognitive ability. A one standard deviation increase in Conscientiousness was associated with a 3.53 point increase in exam score (0.88%). The effect of cognitive ability on exam scores was statistically significant, however. A one-standard deviation increase in cognitive ability was associated with a 21.38 point increase in exam scores (5.35%). There were no other significant effects.

Effects on extra credit. The results on extra credit showed a slightly different pattern of results. The effect of implementation intentions did not attain significance, but was in the same direction as in the preceding analyses. Setting implementation intentions was associated with 0.84 fewer points of extra credit earned (4.20% of possible extra credit). Cognitive ability was not associated with extra credit earned. Conscientiousness, however, was associated with extra credit earned. A one-standard deviation increase in Conscientiousness was associated with a .79

point increase in extra credit earned (3.95% of possible extra credit), consistent with the interpretation of this dependent variable as being particularly influenced by increases in effort. There were no other significant effects.

Summary. Overall, there was little support for the notion that individuals with different levels of Conscientiousness and cognitive ability responded differently to the different interventions. In terms of total points earned in the course there was a small positive main effect of Conscientiousness and a medium-sized main effect of cognitive ability. Cognitive ability was positively associated with exam scores, but not extra credit, whereas Conscientiousness was positively associated with extra credit, but not exam scores. Throughout these analyses, the most consistent effect was again a negative effect of setting implementation intentions on performance. In terms of Cohen's *d*, the size of this effect ranged from -.18 (extra credit) to -.24 (total course points), when calculated using the raw means and standard deviations of the implementation intention treatment versus no implementation intentions treatment. In terms of percentage of course grade this amounted to a decrease of about 2.25% in the final grade.

Discussion

On the whole, the hypotheses in Study 2 were not supported. Asking students to raise their boundary goals had little effect on their course performance above and beyond the relatively large effect of initial boundary goal level. As in previous research, Conscientiousness and cognitive ability were positively associated with course performance, though each variable was more strongly uniquely associated with the component of performance reflecting the core of that trait (an effort-based assessment for Conscientiousness and a more skill-based assessment for cognitive ability).

The most unsettling finding was an unpredicted small to moderate negative effect of

setting implementation intentions. Students who set implementation intentions earned a lower final grade, lower exam grades, and less extra credit than students who did not set implementation intentions. This result is not directly comparable with Adriaanse et al. (2010) who did not compare the performance of participants in their study to a no treatment control group (recall that the implementation intention manipulation used in the current research was directly adopted from Adiaanse et al.).

There are a few issues to consider that could help to explain this troubling effect. First, Parks-Stamm and Gollwitzer (2009) note that if the response specified in the then portion of an if-then plan is not instrumental to achieving the goal, then task performance may suffer as a result. Put another way, to the extent that an if-then plan does not facilitate progress towards the goal, one might expect a negative effect of implementation intentions. Students in the current research generated their own if-then plans after considering three obstacles to achieving their boundary goals that might occur. To the extent that these if-then plans were non-instrumental, it might be reasonable for these to have impaired, rather than helped, performance.

Such a result would be consistent with the findings of Jaudas, Achtziger, and Gollwitzer (2006), who provided participants in their study with an if-then plan that was faulty by design. Participants in that study were told that a green arrow would indicate a shortcut in a maze that they were attempting to solve, but in reality the green arrow indicated a shortcut only 30% of the time. Participants in the implementation intentions condition formed an if-then plan, "If I see a green arrow, then I'll quickly press the button," that was therefore non-instrumental to the goal to solve mazes quickly. Control participants did not form such a plan but were told the same information about the green arrow. The results showed that participants who formed implementation intentions were slower to disengage from the faulty plan than control

participants, and they therefore performed worse at the mazes. The researchers concluded that the automatic nature of the if-then plans likely undermined these individuals' ability to evaluate the plan as a bad one and disengage from it. In the current data, it would be possible to code the implementation intentions with regard to their instrumentality (i.e., whether the response specified in the plan was likely to be a useful one) and determine whether the instrumentality of the plans moderated the effect of implementation intentions on performance. To the extent that instrumentality is important for the success of an if-then plans, instrumental plans should have helped students' performance, whereas non-instrumental plans might have hurt their performance.

Second, in a similar vein, some students may have identified very unlikely events in the if-portion of their if-then plan. To the extent that the if-cue was never encountered, then the implementation intention would never have been set into motion. In reviewing the content of students' implementation intentions, such an explanation is plausible. Several students, for instance, mentioned their own deaths or the death of a close family member as situations that might interfere with the achievement of their lower boundary goals. Such events are thankfully very rare (and perhaps it's a little absurd to propose that one's own death would keep one from earning a desired grade in a class), so students' implementation intentions would have little relevance in such a situation. It is not immediately clear how these unfulfilled implementation intentions could have undermined students' performance, but one could at least check for evidence supporting this proposition by coding students' implementation intentions for absurdity/unlikeliness, which could reveal that students with more mundane/reasonable "if" portions of the plan showed benefits from setting implementation intentions that may have been off-set by negative effects for individuals with more absurd plans.

A third possible explanation that has been noted previously is that the rigidity associated with implementation intentions can be detrimental to performance (Gollwitzer & Sheeran, 2006; Parks-Stamm & Gollwitzer, 2009), because committing oneself to a specific if-then plan may close one off to other possible routes to goal achievement. For example, a person might set an implementation intention to exercise, asserting that "When I get home and see my dog, then I will take the dog for a run." But if that person returns home to find that their partner is already a mile down the road with the dog in tow, then he or she might fail to act on what is still an ample opportunity to exercise. In such a case, the if-then plan (if dog, then run) has formed a response contingency that is too rigid to adapt to a changed circumstance. In such a situation, a simple reminder (e.g., a note on the fridge that says "Go running!") might be more effective at inducing the desired goal-directed behavior. In the case of the current research, students may have believed that they were locked in to their implementation intentions, which may have ultimately resulted in poorer performance. Future research can continue to directly compare implementation intentions with other techniques (such as simple reminders, as in Study 1) to identify instances in which rigid adherence to the implementation intention ultimately undermines performance.

A fourth possibility that could explain this negative effect is that it may have been the case that asking students to consider these negative possible situations ultimately led to a focus on the negative and triggered an avoidance orientation with regard to the course. Avoidance goals have been shown in much previous research to be negatively associated with performance in academic settings, in part because they may lead to increased levels of anxiety, which can negatively impact performance (Elliot, 1999). Although not all of the obstacles that the students' identified in the if portions of their if-then plans were as extreme as the examples noted above, there was a sense in reading through the students' responses that many students were trying to

come up with worst-case scenarios for the course. This makes sense if one considers that the directions for the intervention asked students to consider obstacles that could prevent them from obtaining their lower boundary goals (for participants in the control condition) or the newly raised lower boundary goals (for participants in the four conditions that raised their boundaries).

Given that their lower boundary goal was supposed to represent their bottom-line, worst-case grade that would be acceptable to them, it makes sense that the situations in which they might not be able to attain these goals might be relatively extreme. Students mentioned asthma attacks, other serious health problems, and international conflicts (think September 11) among the situations that could keep them from achieving their goals. Although most stated concerns were more mundane and reasonable (things such as not attending class, forgetting to read the textbook, losing focus), the priming of these considerations may have been enough to trigger an avoidance orientation and ultimately undercut students' performance.

In the Adriaanse et al. (2010) study from which this version of the implementation intentions manipulation was adopted, participants who completed the implementation intentions exercise in combination with a mental contrasting technique (MCII) were more successful at achieving their goals then participants who merely completed the implementation intentions exercise. In line with the logic just outlined, this might have been because participants in the MCII treatment condition contrasted the hoped-for, desired future with the realities of present obstacles. Their focus on this ideal, positive outcome might have protected them from the potentially detrimental consequences of focusing only on current obstacles. Follow-up research could continue to directly compare these MCII and implementation intentions interventions, monitoring affect in response to the interventions to determine whether a state of heightened anxiety is induced in the implementation intentions without mental contrasting manipulation and,

furthermore, whether this heighted anxiety translates into worse performance later on.

Finally, given the relative novelty of the current implementation intentions manipulation, it may be the case that this version of the technique is simply not as effective as other versions of the technique that have been more thoroughly investigated. There are at least two major issues related to this concern. The first is that implementation intentions with reference to a broad array of behaviors over a relatively long span of time (e.g., studying for a semester-long course) may not be as effective as implementation intentions directed at one-shot behaviors (e.g., breast self-examination). It is perhaps a much more complicated endeavor to encourage a diffuse behavior such as studying or exercising than it is to encourage simpler, one-time, or infrequent behaviors such as voting, vaccinations, or cancer screening. The vast majority of previous research has investigated short-term behaviors such as these, concluding that longer-term effects may result as these short-term behaviors become habits (but rarely providing evidence of such effects). A second, but related, issue is that an implementation intention technique that is based on identifying obstacles may be less effective than implementation intentions based on more active strategies. For instance, imagine two different implementation intentions designed to encourage reading a textbook. An implementation intention based on identifying obstacles might take the form, "If I'm feeling lazy and it's time to study, then I will go to the library and read the textbook." Contrast that implementation intention with a more active plan of the form, "If I see my textbook laying on my desk, I will go to the library and start reading it." There are many potential differences between these two plans, any of which could be responsible for the effects observed in the current research (as detailed above), but one obvious difference is that the former plan, with its focus on obstacles, ultimately specifies a less clear plan of action than the latter plan. In any event, a future study that attempts to tease apart differences in implementation

intentions of these two forms (implementation intentions based on obstacles vs. more traditional if-then plans) could help to shed light on what components of the plan are important for its success.

Turning now to consider the remaining study results, as in previous research, there was a large positive association between boundary goal levels and performance in the course. That is, students who had higher boundary goal levels tended to perform much better in the course than students with lower boundary goal levels, just as Corker and Donnellan (2012) found. There was, however, no impact of asking students to raise their boundary goals above and beyond these effects of initial boundary goal levels. One concern with these results is the possibility that students in the raise boundary goal conditions were not as committed to their new boundary goals as their initial boundary goals, and therefore they may have not been as influenced by their new goals as their old goals. This did not seem to be the case, however, as commitment to the final boundary goal did not vary by condition (ts < 1.40), and commitment was high in all conditions (M = 4.31, SD = 0.59 on a five-point scale; the range of the means across conditions was 4.20 to 4.47).

What, then, could be underlying these results? First, as with nearly any null effect, low power could be the culprit; in the current design with six treatment conditions, only very large effects should be detectable. Second, it may be the case that the effects of initial boundary goal level were so large that they swamped any possible effects from raising boundary goals. As mentioned in the introduction, it was not possible to randomly assign individuals to boundary goal levels, and as a result, any effects of boundary goal increases have to be considered in the context of students' initial boundary goal levels. To the extent that these initial boundary goal levels capture important differences between students that are far more powerful than the

experimental manipulation, we would expect any effect of the treatment to be small. A final consideration is that the intervention in the current research was a one-shot intervention that was not followed up with any additional reminders, re-commitment exercises, and so on. It may have been the case that the intervention was simply not strong enough to have lasting effects on students over time in a dynamic classroom setting. Future attempts at such interventional work should consider shorter-term assessments or repeated doses of the interventional treatment.

In sum, the results of Study 2 showed no evidence that asking students to raise their lower boundary goals was effective at enhancing course performance in a real classroom setting. Furthermore, there was no evidence of moderation of reactions to the treatment by individual differences. There was, however, a negative impact of setting implementation intentions on all three performance outcomes.

General Discussion

Overall, the results of these two studies seem to provide a fairly accurate glimpse into the world of designing educational interventions. Indeed, designing successful interventional techniques is no easy feat, and many interventions do not work out as expected. If changing people's lives were simple and easy, humanity would have no doubt already solved many of the world's most pressing behavioral change concerns (including but not limited to ending poverty, childhood hunger, obesity, teenage pregnancies, international conflict, and so on). In terms of the applied implications of the current studies, there do seem to be some important principles that were learned as a result of the current research. First, sending simple reminders or prompts seems to be an effective way to encourage behavior in the service of valued goals. These reminders have the added benefit of being relatively easy to distribute, they are inexpensive, and no specific message tailoring is required. As such, they have the potential to be a very effective and useful tool for practitioners of behavior change.

Participants in Studies 1a and 1b were instructed to commit to a goal to complete a homework assignment, and those participants who received a reminder to do so completed the homework at a higher rate than participants who received a reminder but also set implementation intentions to complete the task. Ultimately those participants who completed the homework assignment outperformed participants who did not complete the homework on the final assessments, and these results were for the most part not moderated by individual differences. At a theoretical level, the results highlight that if-then plans are not necessary to prompt the initiation of goal-directed behavior in all cases; mere reminders can also be an effective technique. Indeed, in the current research, setting implementation intentions was less effective than would have been expected by previous research – individuals who completed the

implementation intentions intervention did not complete the homework at a higher rate than individuals in the control group.

Another take-away principle was found in Study 2. In this study, although the main interventional technique did not work out as expected, there was an effect of setting implementation intentions on course performance, such that individuals who set implementation intentions ultimately performed more poorly than individuals who did not set implementation intentions. Although the reasons underlying this effect are not immediately clear, it is an intriguing finding, perhaps in part because it is rare and unusual (in Gollwitzer & Sheeran's 2006 meta-analysis, only 2 of 94 studies showed a negative effect size). Taken together, the results of this study highlight the trials and tribulations associated with doing interventional research and prompt further thought on when implementation intentions can cause goal pursuit to go awry.

Both of the interventions in the current research (but especially the boundary goal intervention in Study 2) attempted to change behavior at a fairly broad level. That is, these interventions were designed to resolve a fairly large scale problem (student underachievement), that is not the result of merely one behavior or even a series of behaviors. Rather this outcome is the result of many actions and characteristics that when taken together combine to result in higher levels of performance for some students and lower levels of performance for other students. One thing that is interesting to consider is whether or not the level at which the interventions were designed to work is the same as the level at which they needed to be deployed in order to successfully change behavior. As noted in the discussion for Study 2, many previous attempts to use implementation intentions to change behavior have successfully done so, but this seemed to especially be the case when the desired behaviors were one-time, easily changeable behaviors (e.g., voting, breast self-exams). Relatively more complex behaviors of the type

examined in the current research may be beyond the capabilities of this simple technique to influence – at least in any impactful way, for any lasting period of time.

Consideration of this issue of levels brings us to what is perhaps one of the most fundamental issues at the root of interventional research. At what level should interventions be delivered in order to not only successfully change behavior in the short term but to change behavior meaningfully in the long term? On the one hand, as I have argued, interventions should perhaps be delivered to the lowest level variables possible (low level goals, strategies), as these are the most proximal predictors of behavior. Therefore, any interventions that act on these variables should have the best chance at meaningfully changing behavior – at least in the short term. Longer term change via this route may come about through feedback processes. For instance, a short-term intervention that facilitates study behavior and ultimately improves performance on an exam might be enough to improve a student's academic self-efficacy and to slightly shift the student's self-perceptions of him or herself towards a "good student" identity. These improvements in self-efficacy and self-perception might then result in the student acting in ways that are consistent with the new identity, making future studying behavior more likely (Bem, 1972). In this way, the intervention has its success through a long-term process of bottom-up change. That is, change in lower level variables ultimately results in higher level change via a feedback mechanism.

There are others scholars, however, who argue that changing higher level variables (such as personality characteristics) is a more effective way to produce long-term behavioral changes (e.g., Jackson et al., 2012; Roberts, Donnellan, & Hill, in press). These researchers assert that because higher level characteristics like personality have such broad ranging influence, changing them is likely to have broader ranging impacts than changing lower level, context specific

variables. For instance, Roberts et al. (in press) write: "Instead of hewing to the prevailing ethos that change efforts should be focused on narrow constructs, policy makers may want to contemplate the potential benefits of focusing on a broad domain such as personality traits. The initial research not only points to the potential for this approach, but also [to] the fact that changing something like a personality trait may leverage positive outcomes across numerous domains." Such a sentiment is behind many policy campaigns already in existence. The principles underlying Head Start early childcare, for example, are working under the assumption that early intervention on important, high level variables will have echoing ramifications throughout a child's life.

Such top-down models of change stand in stark contrast to the bottom-up approaches advocated in the current research, but certainly it is not the case that either one or the other approach must be correct; change can occur via both processes. The challenge for researchers and practitioners alike, however, is to determine which method of change is most effective, for the greatest length of time, and for the largest number of people. In the current research, a relatively simple low-level tweak (a reminder e-mail) was able to produce some evidence of behavioral change. Whether such change would have an impact beyond the context of study is a question for another time, but it is an interesting first-step nonetheless.

Future Directions

Each of these studies prompt interesting future directions in which to take this research. As noted in Study 1's discussion, there is a lack of clarity regarding which component of the reminder with implementation intentions condition is causing it to underperform relative to the reminder only condition. On the one hand, it could be something about the if-then plan itself that is causing that group to underperform (e.g., if individuals who receive this treatment feel

compelled to complete the homework at the pre-determined time and only that time; they are locked in to their plan). On the other hand, it could be the case that the source of the reminder is an important contributing factor – if sending a reminder to oneself requires willpower and self-perception to properly execute and if these variables lead to sub-optimal reminders, then it may be the case that an unprompted reminder from an outside source is a more effective technique. A future study could tease these explanations apart. One could easily imagine other variables that might be important for the success of a reminder (e.g., timing, frequency, and content of a reminder); each of these variables could be investigated in future studies.

Regarding future directions for boundary goal interventions, it would seem that an important next step would be to bring the research back into the laboratory where boundary goals can be manipulated with greater freedom. To the extent that such interventions are successful on short-term outcomes explored in the laboratory, they can then be scaled up and brought back into use in actual classrooms. An important question that needs to be addressed is the extent to which boundary goals causally influence behavior, as all current research with the construct has been done with measured boundary goal levels in a correlational framework. By randomly assigning individuals to boundary goals and observing effects on performance, a stronger argument for a pattern of causal influence can be made.

Final Thoughts

In conclusion, the current research highlights the potential utility, but also the challenges and pitfalls, associated with doing interventional research. Such work is clearly needed and important, as now more than ever educators are being pushed to enable their students to meet ever rising standards in order to retain funding for their schools and even to keep their own jobs. Recognizing students' individual differences is indeed needed in the educational process, but

what is also needed are techniques that cut across these individual differences, helping as many students as possible to fulfill their full potential.

APPENDICES

APPENDIX A

Stock Price Prediction Learning Task

Instructions

Take as much time as you need to learn the material on the following pages. You may use any method you choose to learn the material. Tomorrow when you return the lab for your follow-up session, you will be asked to predict stock prices for 10 companies and take an 18 item multiple-choice test on the material. Later we will score your tests so you will know how well you have done on the test.

Learning Materials

The following task focuses on how an investment counselor makes stock recommendations to a client. During the course of the session, you will be asked to learn how an investment counselor might make decisions about stock values.

More specifically, you will learn about making estimates concerning the behavior of the stock for a variety of similar large multi-national corporations based in the United States. The current market value of each company's stock as listed on AMEX is $80 per share. The stock price for a given company will rarely fall below $10 per share, or rise above $150 per share. In addition, the performance of each company is independent. That is, the performance of company #10 does not influence the performance of company #11.

Stock prices can be predicted from performance data about each company. Three divisions of each company are considered in the prediction of stock prices: (1) marketing, (2) research and development, and (3) production. Each division reports quarterly performance levels, measured in millions of dollars gained or lost. A positive value reflects a profit, while a negative value reflects a loss. Information concerning quarterly performance can be found in each company's shareholder disclosure reports.

The shareholder disclosure reports also contain information such as the previous annual dividend and the change in company profits. The previous annual dividend gives an indication of how much money was paid to investors during the previous year. The change in company profits indicates how much money the company as a whole made during the previous year. The relationship between the previous annual dividend is positive but low, usually a correlation of .15.

The prediction of stock prices is somewhat uncertain. In a given year, the average fluctuation in stock prices is $25. Investment counselors cannot always perfectly predict the prices of stocks. In fact, they usually succeed only 65% of the time. The stock market is affected by many factors outside of organizational performance, such as interest rates, political events, and economic cycles.

Investment counselors also track the trends of stock prices. Short term stock trends refer to the

movement of the stock price over the past three months. Long term stock trends refer to the general movement of stock prices over a longer period of time, usually a year or more. These trends allow counselors to give stock ratings. An A+ is the top stock rating, while a C- is the lowest possible rating.

Multiple regression is a statistical technique which can be used to predict one number from a weighted combination of other numbers. The goal in multiple regression is to reduce, or minimize, the errors one makes in prediction.

Multiple regression is based on the general linear model. Thus, the basic equation for multiple regression is similar to the equation for a line:

$$y = a + b_1x_1 + b_2x_2$$

y is the number you want to predict
a is the intercept term, or the place where the line crosses the y axis
b_1 is the weight given to the first number that you know
x_1 is the first number that you know
b_2 is the weight given to the second number that you know
x_2 is the second number that you know

For example, you could predict the weight of children (y) from the number of hours of television watched (x_1) and their age (x_2).

Assume that $b_1 = 2$ and $b_2 = 7$. Assume also that $a = 8$, because that is the average weight of a newborn. If a child spends 7 hours a week watching TV and is 10 years old, then the equation will look like this:

$$y = 8 + (2 \times 7) + (7 \times 10)$$
$$y = 92$$

Thus, one would predict that this child weighs 92 pounds.

Multiple regression can be used to predict stock prices from performance data, and it can be used with any number of x terms.

→ The b value for each term can change depending on the performance level of each division. If the quarterly performance for one division is between 0 and 50, b = .5. If performance is between 51 and 100, b = .2. If performance is between 101 and 150, b = .1. If the performance value is negative, use the absolute value (remove the negative sign) to determine the b value.

→ The a value will always be the current price of the stock.

Two examples of the use of regression in predicting stock prices are on the next page.

Example 1:
At Bob's Kreme Filling, Inc., the following quarterly performance data were reported:

- Marketing 20
- Research and Development -60
- Production 100

The regression equation for predicting the stock price of Bob's Kreme Filling, Inc. is:

y = 80 + (.5) 20 + (.2) -60 + (.2) 100
y = 80 + 10 – 12 + 20
y = 98

Example 2:
At Mike's International BrewPub, the following performance data were reported:

- Marketing 70
- Research and Development 10
- Production -20

Feel free to practice predicting the stock price for Mike's International BrewPub in the space below. The completed regression equation is displayed on the next page.

Answer to Example 2:

- Marketing 70
- Research and Development 10
- Production -20

y = 80 + (.2) 70 + (.5) 10 + (.5) -20
y = 80 + 14 + 5 – 10
y = 89

Feel free to look over any portion of the Stock Prediction materials until you feel you have learned the materials. When you are finished learning the material, you may click continue to go on to the final part of today's task.

APPENDIX B

Mental Workload Scale

Please respond to the following items concerning the stock price prediction learning materials using the scale below. [Scale was 1 = *strongly disagree* to 5 = *strongly agree*.]

1. I felt mentally tired and worn out after learning the stock price prediction materials.
2. Learning the stock price prediction materials was a difficult and complex task.
3. The overall mental workload I felt while learning the stock prediction materials was low.
4. Learning the stock price prediction materials was easy.
5. Learning the stock price prediction materials required a lot of mental activity.
6. I had to work very hard to learn the stock price prediction materials.

APPENDIX C

Knowledge Learning Outcome Measure

In this part of the session you will be asked to choose the correct answer to the 18 multiple-choice items below. Please circle the correct answer.

1. The divisions of a company an investment counselor uses to predict stock prices are:
a) marketing, sales, and human resources
b) marketing, research and development, sales, and production
c) finance, customer service, and research and development
d) marketing, research and development, and production
e) production, sales, and customer service

2. When evaluating how well a division has done, the investment counselor looks at:
a) percentage of goal met
b) profit/loss
c) receivables
d) market share
e) stock ratings

3. Predicted stock prices generally range from:
a) $20 - $200
b) $10 - $150
c) $80 - $150
d) $10 - $80
e) $25 - $150

4. The investment counselors make predictions about:
a) chemical companies
b) large auto supply companies
c) a wide range of companies
d) large multi-national companies
e) large financial companies

5. Performance is measured for each division in the companies:
a) yearly
b) monthly
c) weekly
d) quarterly
e) bimonthly

6. External influences on the stock market include:
a) seasons, weather, and mergers
b) interest rates, political events, and economic cycles
c) Supreme Court decisions, acquisitions, and the Fed

d) major holidays, product cycles, and inflation
e) the global economy, elections, and downsizing

7. Multiple regression is based on:
a) the weighted geometric model
b) the general liner model
c) Euclidean geometry
d) vectors and angles
e) the factor analytic model

8. Investment counselors are correct about stock price predictions:
a) half the time
b) very rarely
c) two-thirds of the time
d) always
e) one-fourth of the time

9. The primary goal in multiple regression is to:
a) choose between several options
b) maximize the value of the stock price
c) reduce the amount of information needed
d) minimize errors in prediction
e) find the absolute value of performance

10. The b value in a regression equation is:
a) the number you are trying to predict
b) the place where the line crosses the y axis
c) one of the numbers that you know
d) the weight given to one of the numbers that you know
e) the current value of the stock

11. In the first multiple regression example, we were trying to predict:
a) the weight of an average newborn
b) a child's age
c) a child's weight
d) the amount of time a child watched TV
e) the number of Twinkies eaten by a child each week

12. The companies list their stocks on the following stock exchange:
a) NYSE
b) OTC
c) NASDAQ
d) CBOT
e) AMEX

13. The current value of each stock is:
a) $50
b) $80
c) $10
d) $25
e) $100

14. Performance information for each firm can be found in:
a) the annual report
b) the Wall Street Journal
c) shareholder disclosure reports
d) Business Week
e) the business section of any newspaper

15. The average annual fluctuation of stock prices is:
a) $10
b) $80
c) $25
d) $50
e) $15

16. The lowest possible stock rating is:
a) C
b) E
c) C-
d) F
e) D-

17. If the performance value for the research and development division of a company is 50, the b value for that term is:
a) .1
b) .2
c) .3
d) .4
e) .5

18. The relationship between change in company profits and previous annual dividend is:
a) high and positive
b) moderate and negative
c) low and positive
d) low and negative
e) zero

APPENDIX D

Application Learning Outcome Measure

In this part of the session, you will play the role of an investment counselor. After examining the performance of several divisions for each of ten companies listed below, you should estimate the price of the stock for that company.

Write your prediction in the box labeled "Predicted Stock Price." You should try to predict as close as possible to the actual stock price for that company.

You will be provided with a calculator to assist with the math. If you have any questions at this time please feel free to ask the experimenter. Please begin the test now.

The starting value for all companies is $80.

The b value for each term can change depending on the performance level of each division. If the quarterly performance for one division is between 0 and 50, b=.5. If performance is between 51 and 100, b=.2. If performance is between 101 and 150, b=.1. If the performance value is negative, use the absolute value (remove the negative sign) to determine the b value.

Company 1:
- Marketing 20
- Research and Development 10
- Production 40

Company 2:
- Marketing 110
- Research and Development 120
- Sales 70
- Production 130

Company 3:
- Marketing 70
- Research and Development 50
- Production -30

Company 4:
- Marketing 140
- Research and Development 110
- Sales 50
- Production 40

Company 5:

- Marketing 80
- Research and Development 60
- Production 90

Company 6:

- Marketing 140
- Research and Development 80
- Sales -20
- Production -60

Company 7:

- Marketing 100
- Research and Development 120
- Production 120

Company 8:

- Marketing -110
- Research and Development -70
- Production 40

Company 9:

- Marketing 20
- Research and Development -70
- Sales 40
- Production 30

Company 10:

- Marketing -70
- Research and Development 90
- Production -80

APPENDIX E

Text of Reminder E-Mail to Participants in Reminder Only Condition – Studies 1a [1b]

Dear Participant,

This e-mail is a **reminder** to complete your homework assignment for the research study [Mechanical Turk study] in which you participated earlier today if you have not already done so. You were provided with the web address for the assignment at the end of first part of the study. This homework assignment should be completed prior to your follow-up session, which will occur 16 hours from now.

Thank you for your continued participation in the study.

Katherine Corker

Michigan State University

corkerka@msu.edu [mturkstudy2012@gmail.com]

APPENDIX F

Control, No Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

101 Goals: **Answer the following questions about your <u>LOWEST ACCEPTABLE GRADE GOAL</u> (item 2, above).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

3. It's hard to take this goal seriously.
4. Quite frankly, I don't care if I achieve this goal or not.
5. I am strongly committed to pursuing this goal.
6. It wouldn't take much to make me abandon this goal.
7. I think this goal is a good goal to shoot for.

Prior Scores: **Please WRITE your answer in the blank.**

8. What is your college GPA? _____
9. What was your score on the ACT or SAT? _____

APPENDIX G

Control with Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

101 Goals: **Answer the following questions about your <u>LOWEST ACCEPTABLE GRADE GOAL</u> (item 2, above).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

3. It's hard to take this goal seriously.
4. Quite frankly, I don't care if I achieve this goal or not.
5. I am strongly committed to pursuing this goal.
6. It wouldn't take much to make me abandon this goal.
7. I think this goal is a good goal to shoot for.

Prior Scores: **Please WRITE your answer in the blank.**

8. What is your college GPA? _____
9. What was your score on the ACT or SAT? _____

Steps to Success: **Write your answer in the spaces below.**

List 3 things that could stop you from attaining your lowest acceptable grade goal (item 2, above).

Situation A:

Situation B:

Situation C:

Construct a plan of action for dealing with the challenges listed above by filling in the blanks below.

1. When situation A happens, then I will

2. When situation B happens, then I will

3. When situation C happens, then I will

APPENDIX H

Raise Aspirations (Self-Set), No Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

IMPORTANT: **Our previous research has shown that setting higher goals is associated with better course performance in PSY101. We encourage you to raise your aspirations and set a higher goal for yourself.**

3. Based on the preceding information, what's the lowest grade for this course that would be acceptable to you now?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

101 Goals: **Answer the following questions about your <u>NEW LOWEST ACCEPTABLE GRADE GOAL</u> (item 3).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. It's hard to take this goal seriously.
5. Quite frankly, I don't care if I achieve this goal or not.
6. I am strongly committed to pursuing this goal.
7. It wouldn't take much to make me abandon this goal.
8. I think this goal is a good goal to shoot for.

APPENDIX I

Raise Aspirations (Other-Set), No Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

IMPORTANT: **Our previous research has shown that setting higher goals is associated with better course performance in PSY101. Therefore, to facilitate higher performance, you should increase your lowest acceptable grade goal by 0.5. So if your previous goal was 3.0, your new goal is 3.5. The maximum goal is 4.0, so if your previous goal was 4.0, your new goal is 4.0.**

Write your NEW goal in the blank below.

My new lowest acceptable grade goal is _____.

101 Goals: **Answer the following questions about your <u>NEW LOWEST ACCEPTABLE GRADE GOAL</u> (assigned above).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. It's hard to take this goal seriously.
5. Quite frankly, I don't care if I achieve this goal or not.
6. I am strongly committed to pursuing this goal.
7. It wouldn't take much to make me abandon this goal.
8. I think this goal is a good goal to shoot for.

APPENDIX J

Raise Aspirations (Self-Set) with Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

IMPORTANT: **Our previous research has shown that setting higher goals is associated with better course performance in PSY101. We encourage you to raise your aspirations and set a higher goal for yourself.**

3. Based on the preceding information, what's the lowest grade for this course that would be acceptable to you now?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

101 Goals: **Answer the following questions about your <u>NEW LOWEST ACCEPTABLE GRADE GOAL</u> (item 3).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. It's hard to take this goal seriously.
5. Quite frankly, I don't care if I achieve this goal or not.
6. I am strongly committed to pursuing this goal.
7. It wouldn't take much to make me abandon this goal.

8. I think this goal is a good goal to shoot for.

Prior Scores: **Please WRITE your answer in the blank.**

9. What is your college GPA? _____
10. What was your score on the ACT or SAT? _____

Steps to Success: **Write your answer in the spaces below.**

List 3 things that could stop you from attaining your NEW lowest acceptable grade goal.
Situation A:
Situation B:
Situation C:

Construct a plan of action for dealing with the challenges listed above by filling in the blanks below.
1. When situation A happens, then I will
2. When situation B happens, then I will
3. When situation C happens, then I will

APPENDIX K

Raise Aspirations (Other-Set) with Implementation Intentions Intervention

101 Goals: **The following questions are about your goals for your performance in this course (PSY 101).**

1. What grade are you aiming for in this course?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

2. What's the lowest grade for this course that would be acceptable to you?						
1	2	3	4	5	6	7
1.0	1.5	2.0	2.5	3.0	3.5	4.0

IMPORTANT: **Our previous research has shown that setting higher goals is associated with better course performance in PSY101. Therefore, to facilitate higher performance, you should increase your lowest acceptable grade goal by 0.5. So if your previous goal was 3.0, your new goal is 3.5. The maximum goal is 4.0, so if your previous goal was 4.0, your new goal is 4.0.**

Write your NEW goal in the blank below.

My new lowest acceptable grade goal is _____.

101 Goals: **Answer the following questions about your <u>NEW LOWEST ACCEPTABLE GRADE GOAL</u> (assigned above).**

1	2	3	4	5
Strongly Disagree				Strongly Agree

4. It's hard to take this goal seriously.
5. Quite frankly, I don't care if I achieve this goal or not.
6. I am strongly committed to pursuing this goal.
7. It wouldn't take much to make me abandon this goal.

8. I think this goal is a good goal to shoot for.

Prior Scores: **Please WRITE your answer in the blank.**

9. What is your college GPA? _____
10. What was your score on the ACT or SAT? _____

Steps to Success: **Write your answer in the spaces below.**

List 3 things that could stop you from attaining your NEW lowest acceptable grade goal.

Situation A:

Situation B:

Situation C:

Construct a plan of action for dealing with the challenges listed above by filling in the blanks below.

1. When situation A happens, then I will

2. When situation B happens, then I will

3. When situation C happens, then I will

FOOTNOTES

FOOTNOTES

[1] In Study 1a, there was a technological failure that impacted the randomization of conditions that was not discovered until data collection was nearly complete. As noted in the methodology, a randomizing algorithm was used to assign participants to condition. The failure occurred because the laboratory computers that were used in the study cached the link between the randomizer and the individual study URLs, resulting in repeated assignment to the same condition on a given computer for a given day. At the end of the day the computers were shut down, and the cache was cleared. Thus, the number of participants assigned to each condition was inconsistent with the planned unbalanced design; cell sizes ended up being more equal than intended. There is no strong reason to suspect that randomization of participants to condition was disrupted, however, given that participants were seated at a given computer in an unsystematic manner.

[2] There are a few possible ways to treat a variable with such a dramatic skew pattern. The current method was chosen because it best reflected the outcome of interest. A zero score on the dictomized measure likely reflects a lack of preparation (i.e., doing the homework), whereas a score of one reflects at least some minimal preparation and understanding of the technique.

[3] There were three other performance outcomes that could have been considered: in-class participation points, points for participating in research, and homework points. Each of these variables exhibited strong negative skew and very little variability; nearly every student earned the maximum points possible. These outcomes were considered as part of the total points earned, however.

Table 1
Power Analysis Results

Control *N*	Reminder *N*	Intervention *N*	Power (*d* = .65)	Power (*d* =.10)
50	100	100	.99	.44
50	200	200	.99	.73
50	300	300	.99	.88
50	400	400	.99	.95

Note. The table displays the results of an a priori power simulation examining the power to (1) detect a large (*d* = .65) treatment effect between the control condition vs. the other two conditions and (2) detect a small (*d* = .10) treatment effect between the reminder and intervention conditions.

Table 2
Descriptive Statistics and Correlations, Study 1a

	M	*SD*	*N*	1	2	3	4	5	6	7	8
1. Conscientiousness	3.76	0.42	274	*.95*							
2. Cognitive Ability	23.70	3.42	269	.02	*.81*						
3. Mental Workload	2.87	0.80	232	-.10	-.12	*.89*					
4. Time on HW	11.00	9.11	220	.04	.10	**-.22**	-				
5. Did Homework	0.85	0.36	274	.04	**.12**	-	**.49**	-			
6. Practice Problem	0.46	0.50	275	-.02	.10	**-.19**	**.24**	**.38**	-		
7. Knowledge Test	0.54	0.18	264	.02	**.22**	**-.31**	**.47**	**.27**	**.23**	*.65*	
8. Application Test	0.29	0.32	256	.02	**.15**	**-.30**	**.42**	**.18**	**.28**	**.48**	*.91*

Note. HW = Homework. Values on the diagonal are α reliabilities. Bolded coefficients are statistically significant at $p < .05$.

Table 3
Descriptive Statistics and Correlations, Study 1b

	M	*SD*	*N*	1	2	3	4	5	6	7	8
1. Conscientiousness	3.76	0.49	891	*.95*							
2. Cognitive Ability	26.46	4.23	677	-.05	*.81*						
3. Mental Workload	3.26	1.12	487	-.03	**-.21**	*.94*					
4. Time on HW	6.23	8.31	813	-.01	.08	**-.14**	-				
5. Did Homework	0.57	0.50	891	-.02	**.14**	-	**.68**	-			
6. Practice Problem	0.29	0.45	891	.01	**.13**	**-.22**	**.52**	**.56**	-		
7. Knowledge Test	0.55	0.23	503	-.01	**.21**	**-.27**	**.55**	**.51**	**.40**	*.81*	
8. Application Test	0.27	0.35	503	.00	**.21**	**-.40**	**.46**	**.38**	**.53**	**.64**	*.94*

Note. HW = Homework. Values on the diagonal are α reliabilities. Bolded coefficients are statistically significant at $p < .05$.

Table 4
Descriptive Statistics by Condition, Study 1a

	Control	Reminder Only	Reminder with II
Did Homework			
M	0.82	0.89	0.81
SD	0.38	0.31	0.39
N	79	111	84
Homework Time			
M	629.83	648.89	704.20
SD	532.06	524.45	595.65
N	59	96	65
Mental Workload			
M	2.98	2.81	2.84
SD	0.81	0.82	0.76
N	65	99	68
Knowledge Test			
M	0.52	0.55	0.56
SD	0.16	0.19	0.19
N	75	109	80
Application Test			
M	0.27	0.30	0.28
SD	0.35	0.29	0.33
N	75	109	80

Note. II = Implementation Intentions.

Table 5
Descriptive Statistics by Condition, Study 1b

	Control	Reminder Only	Reminder with II
Did Homework			
M	0.52	0.63	0.50
SD	0.50	0.48	0.50
N	50	435	406
Homework Time			
M	304.61	415.89	338.03
SD	434.34	502.06	499.45
N	44	393	376
Mental Workload			
M	3.51	3.33	3.14
SD	1.03	1.11	1.13
N	26	268	193
Knowledge Test			
M	0.52	0.55	0.55
SD	0.24	0.22	0.24
N	27	267	209
Application Test			
M	0.20	0.26	0.29
SD	0.28	0.35	0.37
N	27	267	209

Note. II = Implementation Intentions.

Table 6
Results of Logistic Regression on Homework Completion

	b	*SE b*	*t*	Odds Ratio	95% CI
Study 1a					
Contrast 1	0.09	0.12	0.77	1.10	[0.86, 1.40]
Contrast 2	-0.34	0.21	-1.63	0.71	[0.47, 1.07]
Conscientiousness	0.33	0.41	0.80	1.39	[0.63, 3.06]
Cognitive Ability	**0.10**	0.05	1.99	1.11	[1.00, 1.22]
Study 1b					
Contrast 1	0.07	0.10	0.73	1.08	[0.89, 1.31]
Contrast 2	**-0.30**	0.07	-4.14	0.74	[0.64, 0.85]
Conscientiousness	-0.02	0.14	-0.16	0.98	[0.74, 1.29]
Cognitive Ability	**0.08**	0.02	3.97	1.08	[1.04, 1.12]

Note. Bolded coefficients are statistically significant. Contrast 1 compares the two treatment groups to the control group. Contrast 2 compares reminder with implementation intentions to reminder only. The 95% confidence interval is around the odds ratio.

Table 7
Results of Multiple Regression on Time Spent on Homework

	b	*SE b*	*t*	β	95% CI
Study 1a					
Intercept	11.03	.62	17.72	-	[9.81, 12.25]
Contrast 1	.28	.46	0.60	.04	[-0.62, 1.18]
Contrast 2	.47	.73	0.64	.04	[-0.96, 1.91]
Conscientiousness	.88	1.44	0.61	.04	[-1.94, 3.70]
Cognitive Ability	.26	.18	1.50	.10	[-0.09, 0.61]
Study 1b					
Intercept	5.87	.46	12.74	-	[4.97, 6.77]
Contrast 1	.42	.43	0.99	.04	[-0.42, 1.26]
Contrast 2	**-.69**	.30	-2.30	-.08	[-1.28, -0.10]
Conscientiousness	.02	.59	0.04	.00	[-1.13, 1.18]
Cognitive Ability	**.16**	.08	2.08	.08	[.003, 0.32]

Note. Bolded coefficients are statistically significant. Contrast 1 compares the two treatment groups to the control group. Contrast 2 compares reminder with implementation intentions to reminder only. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 8
Results of Multiple Regression on Mental Workload

	b	*SE b*	*t*	β	95% CI
Study 1a					
Intercept	2.88	.05	54.99	-	[2.78, 2.98]
Contrast 1	-.06	.04	-1.51	-.10	[-0.14, 0.02]
Contrast 2	.02	.06	0.28	-.02	[-0.10, 0.14]
Conscientiousness	-.20	.12	-1.60	-.10	[-0.44, 0.04]
Cognitive Ability	-.03	.02	-1.86	-.13	[-0.06, 0.01]
Study 1b					
Intercept	3.36	.08	43.14	-	[3.21, 3.52]
Contrast 1	-.10	.07	-1.40	-.06	[-0.23, 0.04]
Contrast 2	-.08	.05	-1.47	-.06	[-0.18, 0.02]
Conscientiousness	-.11	.11	-0.94	-.05	[-0.33, 0.11]
Cognitive Ability	**-.06**	.01	-4.38	-.23	[-0.08, -0.04]

Note. Bolded coefficients are statistically significant. Contrast 1 compares the two treatment groups to the control group. Contrast 2 compares reminder with implementation intentions to reminder only. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 9
Results of Multiple Regression on Knowledge Test Performance

	b	*SE b*	*t*	β	95% CI
Study 1a					
Intercept	0.54	0.01	49.55	-	[0.52, 0.56]
Contrast 1	0.01	0.01	1.32	0.08	[-0.01, 0.02]
Contrast 2	0.01	0.01	0.42	0.03	[-0.01, 0.02]
Conscientiousness	0.01	0.03	0.23	0.01	[-0.05, 0.06]
Cognitive Ability	**0.01**	0.00	3.74	0.23	[0.01, 0.01]
Study 1b					
Intercept	0.54	0.02	33.49	-	[0.50, 0.58]
Contrast 1	0.01	0.02	0.78	0.04	[-0.03, 0.05]
Contrast 2	-0.01	0.01	-0.50	-0.02	[-0.02, 0.01]
Conscientiousness	0.00	0.02	0.15	0.01	[-0.04, 0.04]
Cognitive Ability	**0.01**	0.00	4.77	0.24	[0.01, 0.01]

Note. Bolded coefficients are statistically significant. Contrast 1 compares the two treatment groups to the control group. Contrast 2 compares reminder with implementation intentions to reminder only. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 10
Results of Logistic Regression on Application Test Score

	b	*SE b*	*t*	Odds Ratio	95% CI
Study 1a					
Contrast 1	**0.24**	0.10	2.46	1.26	[1.04, 1.55]
Contrast 2	-0.28	0.15	-1.81	0.76	[0.56, 1.01]
Conscientiousness	**0.64**	0.31	2.03	1.89	[1.03, 3.48]
Cognitive Ability	**0.08**	0.04	2.12	1.09	[1.00, 1.17]
Study 1b					
Contrast 1	-0.02	0.14	-0.12	0.98	[0.74, 1.34]
Contrast 2	0.05	0.10	0.54	1.06	[0.86, 1.28]
Conscientiousness	-0.14	0.34	-0.43	0.87	[0.45, 1.69]
Cognitive Ability	**0.13**	0.05	2.71	1.14	[1.03, 1.26]
C1 x Conscientiousness	0.16	0.31	0.52	1.18	[0.64, 2.15]
C2 x Conscientiousness	**-0.39**	0.20	-1.98	0.67	[0.46, 1.00]
C1 x Cognitive Ability	-0.01	0.05	-0.11	1.00	[0.90, 1.09]
C2 x Cognitive Ability	0.03	0.03	0.90	1.03	[0.97, 1.09]
Consc. x Cog. Ability	-0.02	0.06	-0.30	0.98	[0.87, 1.10]

Note. C1 = Contrast 1; C2 = Contrast 2. Bolded coefficients are statistically significant. Contrast 1 compares the two treatment groups to the control group. Contrast 2 compares reminder with implementation intentions to reminder only. The 95% confidence interval is around the odds ratio.

Table 11
Descriptive Statistics and Correlations, Study 2

	M	*SD*	*N*	1	2	3	4	5	6	7
1. Conscientiousness	3.74	0.46	384	1.0						
2. Cognitive Ability	24.48	3.28	345	-.04	1.0					
3. Boundary Goal	3.15	0.47	369	**.14**	**.21**	1.0				
4. Boundary Raise	0.25	0.30	381	-.10	-.07	**-.31**	1.0			
5. Total, All	405.27	49.40	368	.09	**.35**	**.41**	**-.14**	1.0		
6. Total, Exams	299.37	42.40	368	.06	**.46**	**.41**	-.09	**.95**	1.0	
7. Extra Credit	11.63	5.10	373	**.16**	-.03	.21	-.08	**.54**	**.36**	1.0

Note. Bolded coefficients are statistically significant at $p < .05$.

Table 12
Boundary Goals & Performance Outcomes by Condition, Study 2

	No Implementation Intentions			Implementation Intentions		
	Control	Self-Set	Other-Set	Control	Self-Set	Other-Set
Boundary Goal						
M	3.15	3.16	3.08	3.15	3.25	3.12
SD	0.50	0.51	0.47	0.46	0.43	0.42
N	68	58	60	57	56	70
Boundary Raise						
M	0.00	0.32	0.48	0.00	0.27	0.47
SD	0.00	0.44	0.11	0.00	0.30	0.22
N	71	57	60	67	56	70
Total Points						
M	415.38	409.56	407.95	403.03	400.32	395.86
SD	42.36	55.51	46.09	46.75	57.15	47.78
N	65	58	59	61	56	69
Exam Points						
M	306.49	304.98	300.05	296.18	297.25	291.90
SD	38.28	46.70	43.34	40.47	43.73	41.92
N	65	58	59	61	56	69
Extra Credit						
M	12.91	11.31	12.00	11.35	11.07	11.06
SD	4.67	5.40	4.85	5.38	5.49	4.80
N	66	58	60	63	57	69

Note. Means represent grade point average units for boundary goals and boundary goal raise. Means represent points earned for performance outcomes.

Table 13
Results of Multiple Regression on Total Points Earned

	b	*SE b*	*t*	β	95% CI
Step 1					
Intercept	405.35	2.56	158.65	-	[400.33, 410.37]
Contrast 1	-1.93	1.79	-1.08	-.06	[-5.44, 1.58]
Contrast 2	1.52	3.15	0.48	.03	[-4.65, 7.69]
Imp. Intentions	**-5.61**	2.56	-2.20	-.11	[-10.63, -0.59]
C1 X Imp. Intentions	0.28	1.79	0.16	.01	[-3.23, 3.79]
C2 X Imp. Intentions	0.71	3.15	0.23	.01	[-5.46, 6.88]
Step 2					
Intercept	405.84	2.33	174.55	-	[401.27, 410.41]
Contrast 1	-2.67	2.21	-1.21	-.08	[-7.00, 1.66]
Contrast 2	-0.32	3.01	-0.11	-.01	[-6.22, 5.58]
Imp. Intentions	**-6.79**	2.33	-2.92	-.14	[-11.36, -2.22]
C1 X Imp. Intentions	-0.73	1.64	-0.45	-.02	[-3.94, 2.48]
C2 X Imp. Intentions	0.47	2.86	0.17	.01	[-5.14, 6.08]
Boundary Goal Level	**45.73**	5.55	8.24	.43	[34.85, 56.61]
Boundary Goal Raise	3.59	11.44	0.31	.02	[-18.83, 26.01]

Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 14
Results of Multiple Regression on Exam Scores

	b	*SE b*	*t*	β	95% CI
Step 1					
Intercept	299.48	2.20	136.35	-	[295.17, 303.78]
Contrast 1	-0.93	1.54	-0.60	-0.03	[-3.95, 2.09]
Contrast 2	2.57	2.71	0.95	0.05	[-2.74, 7.88]
Imp. Intentions	**-4.37**	2.20	-1.99	-0.10	[-8.67, -0.06]
C1 X Imp. Intentions	0.40	1.54	0.26	0.01	[-2.63, 3.42]
C2 X Imp. Intentions	0.11	2.71	0.04	0.00	[-5.21, 5.42]
Step 2					
Intercept	299.75	2.00	150.23	7.08	[295.84, 303.66]
Contrast 1	-3.14	1.90	-1.66	-0.11	[-6.86, 0.58]
Contrast 2	1.91	2.59	0.74	0.04	[-3.16, 6.97]
Imp. Intentions	**-5.36**	2.00	-2.68	-0.13	[-9.28, -1.44]
C1 X Imp. Intentions	-0.47	1.41	-0.33	-0.02	[-3.22, 2.28]
C2 X Imp. Intentions	0.05	2.46	0.02	0.00	[-4.77, 4.87]
Boundary Goal Level	**41.16**	4.76	8.66	0.45	[31.84, 50.49]
Boundary Goal Raise	15.18	9.85	1.54	0.11	[-4.12, 34.48]

Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 15
Results of Multiple Regression on Extra Credit

	b	*SE b*	*t*	β	95% CI
Step 1					
Intercept	11.62	0.262	44.32	2.28	[11.10, 12.13]
Contrast 1	-0.26	0.183	-1.40	-0.07	[-0.61, 0.10]
Contrast 2	-0.17	0.324	-0.53	-0.03	[-0.81, 0.46]
Imp. Intentions	-0.46	0.262	-1.74	-0.09	[-0.97, 0.06]
C1 X Imp. Intentions	0.16	0.183	0.88	0.05	[-0.20, 0.52]
C2 X Imp. Intentions	0.18	0.324	0.54	0.03	[-0.46, 0.81]
Step 2					
Intercept	11.62	0.26	45.35	2.28	[11.12, 12.12]
Contrast 1	-0.31	0.24	-1.28	-0.09	[-0.78, 0.16]
Contrast 2	-0.25	0.33	-0.76	-0.04	[-0.91, 0.40]
Imp. Intentions	**-0.53**	0.26	-2.05	-0.10	[-1.03, -0.02]
C1 X Imp. Intentions	0.13	0.18	0.71	0.04	[-0.23, 0.47]
C2 X Imp. Intentions	0.16	0.32	0.50	0.03	[-0.46, 0.78]
Boundary Goal Level	**2.43**	0.62	3.96	0.22	[1.23, 3.63]
Boundary Goal Raise	0.35	1.26	0.28	0.02	[-2.12, 2.81]

Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 16
Conscientiousness and Cognitive Ability Effects on Total Points

	b	*SE b*	*t*	β	95% CI
Intercept	405.30	2.39	169.89	-	[400.62, 409.98]
Contrast 1	-0.84	1.68	-0.50	-.02	[-4.13, 2.45]
Contrast 2	1.46	2.96	0.49	.02	[-4.34, 7.26]
Imp. Intentions	**-4.85**	2.39	-2.03	-.10	[-9.53, -0.17]
C1 X Imp. Intentions	0.26	1.68	0.15	.01	[-3.03, 3.55]
C2 X Imp. Intentions	0.28	2.95	0.10	.01	[-5.50, 6.06]
Conscientiousness	**11.81**	5.45	2.17	.11	[1.13, 22.49]
Cognitive Ability	**5.82**	0.81	7.18	.39	[4.23, 7.41]

Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 17
Conscientiousness and Cognitive Ability Effects on Exam Points

	b	*SE b*	*t*	β	95% CI
Intercept	299.46	1.95	153.80	-	[295.64, 303.28]
Contrast 1	0.13	1.37	0.09	0.00	[-2.56, 2.82]
Contrast 2	2.33	2.41	0.97	0.04	[-2.39, 7.05]
Imp. Intentions	-3.71	1.95	-1.91	-0.09	[-7.53, 0.11]
C1 X Imp. Intentions	0.13	1.37	0.10	0.00	[-2.56, 2.82]
C2 X Imp. Intentions	-0.22	2.41	-0.09	-0.00	[-4.94, 4.50]
Conscientiousness	7.67	4.44	1.73	0.08	[-1.03, 16.37]
Cognitive Ability	**6.52**	0.65	10.11	0.50	[5.25, 7.79]

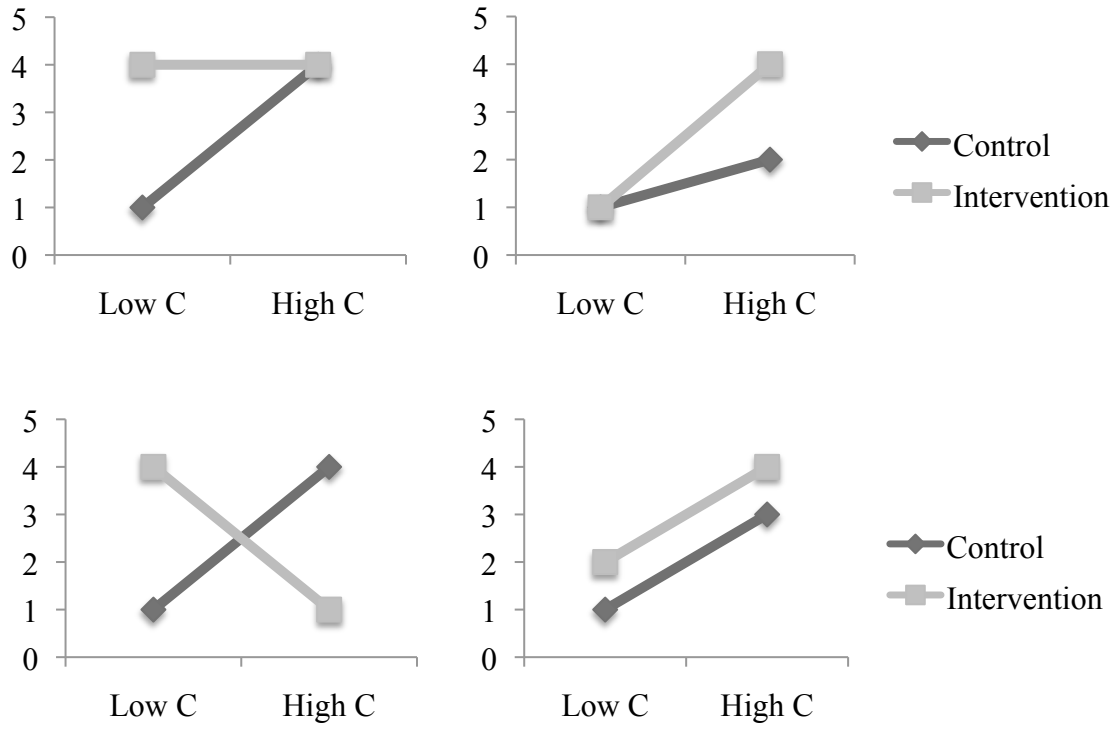
Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Table 18
Conscientiousness and Cognitive Ability Effects on Extra Credit

	b	*SE b*	*t*	β	95% CI
Intercept	11.62	0.26	44.82	-	[11.11, 12.13]
Contrast 1	-0.21	0.18	-1.15	-0.06	[-0.56, 0.14]
Contrast 2	-0.09	0.32	0.26	-0.01	[-0.71, 0.54]
Imp. Intentions	-0.42	0.26	-1.64	-0.08	[-0.93, 0.09]
C1 X Imp. Intentions	0.21	0.18	1.14	0.06	[-0.14, 0.56]
C2 X Imp. Intentions	0.14	0.32	0.45	0.02	[-0.49, 0.77]
Conscientiousness	**1.71**	0.59	2.90	0.15	[0.55, 2.87]
Cognitive Ability	-0.03	0.09	-0.43	-0.02	[-0.21, 0.15]

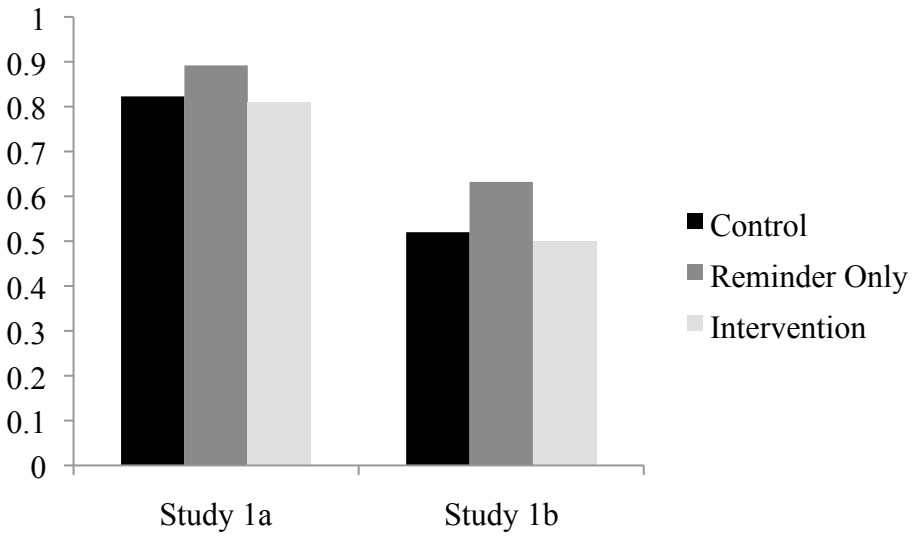
Note. C1= Contrast 1, C2 = Contrast 2. Bolded coefficients are statistically significant. Imp = implementation. Contrast 1 compares the conditions in which students raised their aspirations to the control conditions, in which students did not raise aspirations. Contrast 2 compares the effect of self-raised aspirations vs. other-raised aspirations. The 95% confidence interval is around the unstandardized *b* coefficient.

Figure 1
Interaction Hypotheses



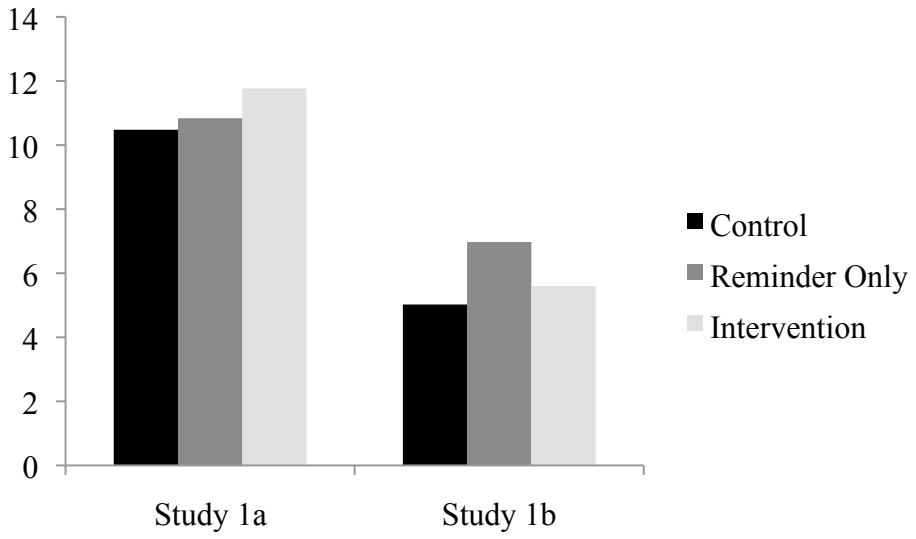
Note. Possible interaction patterns between Conscientiousness (C) and intervention condition. Intervention helps less conscientious students (top left), intervention helps more conscientious students (regulatory fit hypothesis; top right), intervention helps less conscientious students but hurts more conscientious students (regulatory misfit hypothesis; bottom left), main effect for treatment (bottom right).

Figure 2
Proportion Completing Homework



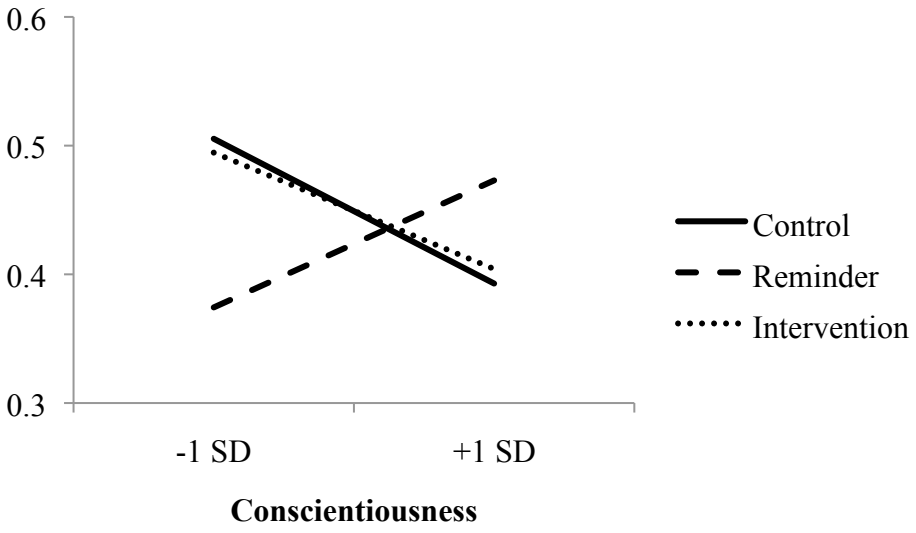
Note. The difference between the reminder only and the intervention conditions was statistically significant in Study 1b ($d = .27$, $t\,(839) = 3.90$, $p < .001$). The pattern of results is the same in Study 1a ($d = .23$, $t\,(193) = 1.63$, $p = .11$).

Figure 3
Minutes Spent on Homework



Note. The difference between the reminder only and the intervention condition was statistically significant in Study 1b (d = .16, t (767) = 2.16, p = .03). There were no significant differences in Study 1a.

Figure 4
Effect of Treatment and Conscientiousness on Probability of Application Test Score > 0



Note. SD = standard deviation. The results are displayed in probability units. Higher probability corresponds to greater likelihood of earning a score greater than zero on the application test.

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