THESIS

INTRINSIC MOTIVATION TO LEARN: CAN INDIVIDUAL GOALS DECREASE SUSCEPTIBILITY TO UNDERMINING EFFECTS?

Submitted by

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ABSTRACT

INTRINSIC MOTIVATION TO LEARN: CAN INDIVIDUAL GOALS DECREASE SUSCEPTIBILITY TO UNDERMINING EFFECTS?

This study extended the theory of the undermining effect on motivation to a learning context and examined the interaction with individual goals for learning. The undermining effect suggests that the removal of external rewards can decrease levels of internal motivation. Students possessing a desire to improve, or learning goal individuals, often appear to be more internally motivated to engage in challenging tasks, whereas, performance goal individuals tend to engage in tasks that confirm their intelligence. Students were assigned to either a reward or non-reward condition and completed a word-learning task. They were allowed to engage in studying the words during a free period. An undermining effect was found: A greater amount of time was spent studying by individuals in the non-reward group, no matter the personal goals for learning. Learning goal subjects were hypothesized to show little difference in study time between groups, whereas performance goal subjects were predicted to be more sensitive to motivational undermining and therefore engage in the task more in the non-reward group; however, the interaction between undermining and goal orientation was not significant and these hypotheses were not supported. These results have significant implications for verifying the impact of motivation on learning behaviors and provide support for the encouragement of intrinsic motivation and contribute to the current literature exploring the cause for differences in performance success among students.

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CHAPTER 1: INTRODUCTION

Motivation is generally regarded as the underlying reason for completing a behavior, but conceptualizations of motivation vary widely. Different theories have proposed that motivation arises from adaptive purposes, seeking to obtain external rewards, or is a result of internal fulfillment. The drive theory of motivation emphasizes the adaptive purposes of the behavior intended to satiate survival needs (White, 1959). Drive theories of motivation are often compared to homeostatic models for balancing and maintaining our physiological states. For example, when our internal states of hydration drop from healthy levels, motivation's main purpose is to assure that we seek an action that will counteract that state of dehydration. The physiological drive that we experience from dehydration, or other needs, is proposed to be the main source of motivation (Berridge, 2004). This explanation is evident in behavioral research concerned with rats solving mazes for food but leads to simplistic explanations of reward that neglect how a rat would choose between two food items when hungry or continue eating when satiated.

Incentive theory emphasizes external rewards received for completing a task (Schmidt et al., 2012). It seeks to explain how motivational drives may differ in response to pleasure of the item. For example, Stasiak and Zernicki (2000) deprived cats of taste sensations during early development by feeding them through their gastrointestinal system. Once the cats were allowed to eat orally, they initially refused to eat food rewards and only gradually accepted the rewards. After reward acceptance, the cats still did not form the typical excitatory responses to food reward. The researchers theorized this was due to taste deprivation in early development. This indicates that satiating our drives for needs like hunger may be mediated by our perceived pleasure of the reward in addition to drive.

Utilizing incentive theory, Schmidt et al. (2012) explored the extent to which external rewards could influence our behaviors. He showed that monetary incentives increased subjects' effort and preparation for both physically and cognitively demanding tasks. Offering workers, or even students, incentives for higher performance could have obvious advantages for improvement. This efficient solution for insufficient behaviors suggests the potential value of monetary rewards to be implemented in order to increase productivity (Weibel, Rost, & Osterloh, 2009). With increased emphasis placed on external rewards it is easy to disregard motivation for tasks conducted only for personal fulfillment, or intrinsic motivation. It is argued that increased emphasis on external rewards and performance outcomes can inhibit the motivation individuals have to complete a behavior for personal satisfaction (Deci, Koestner, & Ryan, 1999).

Intrinsic Motivation and the Undermining Effect

Researchers disagree on constructs, and even the existence, of intrinsic motivation. White (1959) argued for a broadened view of motivation, past biological drives that typically described a limited view for satisfying survival requirements. White posited that biological needs are not all that humans seek to fulfill and reinforcement learning does not explain all of our behaviors. Once humans have successfully learned from reinforcement and have been shaped by their environment, there is still motivation for interactions independent from contingent rewards. Such interactions are not well defined by past theories of motivation focusing on drives, and that residual motivation in our behavior could be described as intrinsic (Deci & Ryan, 1985; White, 1959).

The undermining effect demonstrates the overlooked value of intrinsic reward and highlights the possibility that increased monetary reward can lower inherent motivation for tasks (Deci et al., 1999). The undermining effect is commonly demonstrated through a free-choice paradigm (Deci et al., 1999). Participants in a reward condition are provided an incentive to participate in a task, and then frequency of task engagement is observed during a free period once the reward is removed. The amount of time spent engaging in the experimental task is commonly used as a measure of intrinsic motivation. Often, the removal of the rewards will significantly impact intrinsic motivation and reduce the time spent on a task compared to a group that did not receive the incentive (Deci et al., 1999).

Deci et al. (1999) conducted a meta-analysis of undermining effect studies that included a total of 128 studies comparing a reward group with a non-reward group. All studies examined the effect of a reward on the amount of time or number of times subjects participated in the experimental task during an optional practice period. The researchers concluded that rewards, across a variety of tasks, significantly impacted intrinsic motivation to perform the task once the reward was removed.

In their review, they discussed how personality variables and type of reward impacted motivation. Deci et al. (1999) referred to their theory of how individual differences interact with perceptions of reward as cognitive evaluation theory (CET). CET states that people seek different levels of control in a situation. If an individual prefers to be in control of a situation then external reward or feedback guiding their actions might be interpreted more negatively. Consequently, the emphasis a person places on *environmental* measure*s* of performance may determine their susceptibility to the motivational undermining by external reward. In similar form, CET remained a popular explanation for individual differences in perceived ability and motivation to continue self-improvement (Elliot & Dweck, 1988; Miele, Finn, & Molden, 2011) and will be discussed more in depth in regards to individual achievement goals.

In addition to perceptions of reward, Deci et al. (1999) explored how the application of different types of reward could affect the degree of internal motivation by signaling increased regulation or fostering positive benefits through encouragement. The first type of reward described was task-noncontingent. Participants are rewarded simply for being present during the task, and neither accurately completing the task nor finishing the task is required for reward. This category of reward conceivably applies the least amount of control and resultant undermining of internal motivation because pressure to participate in the task is limited and no feedback is provided about performance. Another reward type was engagement-contingent reward, which required active task participation. Directing participants but not providing feedback on behavior was predicted to negatively impact internal motivation because it asserted increased amounts of control. Similar to engagement-contingent, completion-contingent rewards provide more external direction for activity because participants only receive a reward if they finish the task; however, they also potentially receive positive confirmation if finishing the task signals an accomplishment. The final established reward was performance-contingent. This classification of reward threatens the highest impact to internal motivation but conversely the most beneficial effect on performance overall. Participants are only provided a reward if performance is at, or above, a set criterion. If this feedback is negative or supervisory, then it increases the likelihood of undermining intrinsic reward. If performance feedback is informative and positive, then it increases the chances of participants experiencing positive effects on motivation.

Deci et al. (1999) theorized that increasing environmental control negatively affects internal motivation. They argue that internal motivation is a healthy, natural drive that encourages improvement and leads to self-sufficiency. Therefore, although it is important to receive constructive feedback for our goals, a balance between control and positive encouragement needs to be achieved.

Recent interest in the undermining effect was renewed through exploration of the neural mechanism responsible for guiding motivation. Murayama et al. (2010) tested whether or not subjects offered money for each successful completion of a task would suffer decreased motivation to perform the experimental task during a free period once the monetary feedback was removed. They used functional magnetic resonance imaging (fMRI) to investigate whether or not the processing of extrinsic and intrinsic reward affects neural activity in similar ways in conditions of intact and undermined motivation. Murayama et al. emphasized that the task used for exploring effects of motivational undermining needed to be personally interesting to create a valid result.

Murayama and colleagues had the reward group complete two sessions of a stop-watch task. A cue indicated when participants needed to stop the watch. For example, they were cued to stop the watch at 5 seconds. The trial was successful if the watch was stopped within 50 milliseconds of the cue time and feedback was displayed for 3 seconds. During the first session, money was earned for each successful trial, but for the second session no money was earned for performance. The absence of reward during the second session was intended to undermine motivation. The non-reward group performed a watch-stop task. This passive version of the stop-watch task merely required subjects to press a button when the watch stopped. They received no feedback or reward based on their performance, and consequently their behavior during the experimental task was thought to be internally motivated. Both groups performed the stop-watch or watch-stop tasks while fMRI data was collected. In between the sessions, each participant was told they had free time to perform any activities available, including the experimental stop-watch task. The experimenters recorded how often each participant chose to engage in the stop-watch task during that time, and used that as a measurement of internal motivation.

As expected, the behavioral results revealed a significant difference between the amount of time the reward group spent on the free time task compared to the non-reward group. Participants who were not provided any monetary compensation engaged more frequently in the task between sessions. Neurally, the fMRI results showed interesting interactions between the reward and non-reward group and the first and second session. In the first session the reward group activated the lateral prefrontal cortex, midbrain, and anterior striatum significantly more than the non-reward group; however, activity in all these areas decreased in the reward group once monetary incentives were withdrawn resulting in greater activity in these regions in the non-reward group. Midbrain and striatal regions were thought to be active because of their role in encoding and processing rewards, and frontal activity may reflect preparation for future tasks (Murayama et al., 2010). Therefore, both neural and behavioral results provided support for the undermining theory by demonstrating that monetary reward decreases desire to engage in a task or sustain attention during the task.

The Undermining Effect and Individual Differences

Moving beyond demonstrating that overall external rewards can decrease motivation, Hagger and Chatzisarantis (2011) were interested in how the undermining effect might vary depending on individual differences. They examined differences in how those with autonomy causality orientations and those with control causality were affected by monetary rewards (see Table 1). Autonomy-oriented individuals view reward as self-gratifying and possess an internal locus of control with respect to overcoming challenges through their own determination. Control-oriented individuals tend to view external rewards as indicative of their abilities, feel more controlled by their environment, and possess more of an external locus of control. Hagger and Chatzisarantis hypothesized that autonomy-oriented subjects would be less influenced by the presence of monetary rewards and consequently not as likely to experience an undermining of motivation.

They grouped participants as autonomy-oriented or control-oriented based on ratings from a psychometric test of causality developed by Deci and Ryan (1985); half of the participants from each orientation were assigned to reward and non-reward conditions. All participants were asked to complete a SOMA puzzle, which consisted of blocks participants rearranged to match different configurations. The reward group was given money for each successful trial, but the non-reward group received no monetary feedback. The dependent measure of motivation was the amount of time participants continued working on the puzzles during a surprise free period. Consistent with the undermining effect, Hagger and Chatzisarantis (2011) found that subjects with both orientations rated feeling more controlled and bored in the rewarded condition, and overall, there was a significant difference in the amount of time the reward and non-reward group participated freely in the puzzle. In support of their hypothesis, they found that control-oriented individuals in the reward group suffered most from the undermining effect. Autonomy-oriented individuals appeared to be more resilient to the reward and did not exhibit reward-based discrepancies in the amount of time spent voluntarily working on the puzzles. This was consistent with their theory that individuals with a control causality orientation would be more dependent on external cues and vulnerable to manipulations of motivation. Hagger and Chatzisarantis' (2011) results support the idea that although the undermining effect can have a substantial impact on motivation it may be mediated by individual differences.

Effects of Reward and Motivation on Learning

The research reviewed above on motivational undermining has neglected to explore this effect in the context of learning and rarely is concerned with overall performance improvements or abilities. Increased motivation for learning could potentially have a strong impact on improving students' ability to learn; however research has shown conflicting evidence for such improvement.

Research on the effect of motivation in learning contexts has emphasized external reward. Nilsson (1987) tested whether or not word learning was impacted by motivation during the study or test phase. Subjects were informed of performance contingent rewards either prior to a study phase, after the study phase but prior to the test, or not at all. The manipulation of motivation resulted in no difference in memory performance between any of the groups. Murayama and Kuhbandner (2011) found slightly different results in a study examining learning the answers to trivia questions. They cued subjects in the reward group as to the potential reward associated with each item individually at study. The non-reward group was not offered any monetary compensation. The participants completed an immediate test, a surprise delayed test a week later, and rated the interest level of each question. The presence of reward made little difference in recall except on delayed tests and for material that was rated as uninteresting to the participants. In these instances, recall was significantly higher for the reward group. Murayama and Kuhbandner concluded that monetary incentives could therefore create only a slight advantage for learning. Both of these studies find that reward motivation does not negatively impact learning, but only has, if any, minimally positive benefits. Neither study accounted for any changes in learning behaviors elicited by the presence of reward or allowed students to change their study habits in response to rewards.

Ariel et al. (2009) explored students' study behaviors in response to varying amounts of reward, which was manipulated as the percent likelihood of information to be on a final test or as point-values. Students were shown a series of word-pairs and were allowed to select pairs to re-study before a final test. The researchers also manipulated item difficulty. When selecting items for re-study, students were shown the percent likelihood that information would be tested or the associated points. Ariel et al. found that students chose to study items most often that offered the highest potential reward regardless of whether the items were difficult or easy. The researchers suggested that maximizing reward was a guiding factor to study time allocation. Consequently, items that were studied longer also showed significant improvements in accuracy as well. These results suggest that regarding information as potentially more rewarding to students may mediate their self-guided learning.

Soderstrom and McCabe (2011) also observed how increasing levels of reward influenced recall accuracy as a result of students' time spent studying word pairs but similar to Murayama and Kuhbandner (2011), their results suggested a selective benefit for reward. They offered students points for accurately recalled words and observed how offering students low and high point-values affected recall depending on the associative context of the word pairs. Soderstrom and McCabe found the words that had the highest recall were highly related and offered the highest reward; however, among words that were highly related there was not much discrepancy between low and high value words in either accuracy or study time. The word pairs that were poorly associated showed a significant difference in both low and high values and increased study time. Essentially, the higher the reward value, the longer the pair was studied and the better the recall. These results imply that the greatest effect extrinsic motivation may have is in improving learning behaviors and increasing study time, but does not provide insight into how extrinsic might interact with intrinsic motivation and affect choice of how long to study voluntarily when reward is absent.

The Role of Autonomy Regulation, Achievement Goals, and Intelligence Theories

Researchers have also looked at the impact of personality differences on learning performance. As discussed previously, causality orientations (autonomous vs. controlled) have been shown to correspond with intrinsic and extrinsic motivation for completing tasks. Williams and Deci (1996) adapted the general causality scale to incorporate motivational reasons for student learning into a learning self-regulation questionnaire (SRQ-L). This explored autonomy in regards to an internalized or externalized regulation for why students seek learning opportunities. Williams and Deci explored autonomy regulations and perceptions of others' regulations within a classroom setting by tracking ratings of autonomy for second year medical students participating in an interpersonal skill development course. They surveyed students when they first entered the course and after their final for that course.

Williams and Deci found that medical students entering the class with higher ratings of autonomy regulation maintained a higher level of internal motivation and interest for participating in the course. Students that reported a higher level of autonomy also reported feeling more capable of completing the course goals and had a higher sense of task mastery. Furthermore, Williams and Deci found that students who entered the course with a low sense of autonomy received benefits from an instructor those students rated as more autonomous. These results indicated that pre-existing ratings of autonomy can be strong predictors for students' motivation and interest throughout a course, but also that instructors can help facilitate more positive, autonomous regulations in their course.

Black and Deci (2000) completed a similar study tracking students' autonomy regulation and perceptions throughout the course and also explored student performance in relation to orientation. Similar to Williams and Deci (1996), Black and Deci found that students entering the course with high levels of autonomy were able to maintain that sense of interest and consequently were less likely to drop the course compared to more control oriented students. Student performance was only significantly impacted by orientation if they entered with a low level of autonomy. Specifically, if students entered the class with a low level of autonomy but received guidance from an instructor they viewed as highly autonomous their grades showed higher levels of improvements compared to instructors that were viewed as more control oriented. Again, these results show that identification with autonomy regulation can help maintain a sense of intrinsic motivation for task and also that instructors endorsing an autonomous regulation may help improve overall learning for their class.

Achievement Goals and Intelligence Theories

Other research focusing on goals and motivations for learning have operationalized the terms achievement goals and intelligence theories. These are two related concepts that describe how individuals can approach learning. Achievement goals operationally are divided broadly into learning or performance goals. Students who endorse learning goals often desire to improve their skills, whereas performance goal students typically focus on proving their intelligence to others. Intelligence theories can be divided into either incremental or entity theorists. Incremental theorists view intelligence as a malleable characteristic that can be improved but entity theorists consider intelligence to be an innate, concrete trait. Collectively, learning goal and incremental theorists similarly view both learning ability and intelligence as more of a fluid process that requires effort to improve. In contrast, performance goal and entity theorists are parallel in their beliefs that learning ability and intelligence are innate qualities, and that task performance is a reflection of this innate ability.

Achievement goals have been shown to have a significant impact on how students interpret feedback with the goal of improving their educational performance (Elliot & Dweck, 1988; Grant & Dweck, 2003). Individuals who embrace a fluid view of intelligence view both positive and negative feedback as informative, but for individuals who view intelligence as constant, negative feedback can be detrimental to confidence in abilities (Elliot & Dweck, 1988; Grant & Dweck, 2003). Sensitivity to feedback and instruction could alter motivation to engage in educational tasks. For this reason, individual differences in learning goals could predict vulnerability to intrinsic undermining when rewards are used as incentives for education.

Grant and Dweck (2003) examined achievement goals as predictor variables for classroom performance. They found that individuals who were more learning-goal oriented were able to objectively view negative feedback in experimental situations and also in a difficult college course. Learning versus performance goals were the strongest indicators of the final grade (Grant & Dweck, 2003). Elliot and Dweck (1988) further demonstrated that achievement goals might not be immutable personality traits by experimentally manipulating children's learning goals through feedback in order to facilitate either learning-oriented goals or performance-oriented goals. They found that children with facilitated learning goals were less afraid to make mistakes and showed more consistent improvement on the experimental tasks. These studies provided evidence that the goals individuals set for themselves could strongly influence their education in and outside of the classroom.

Blackwell et al. (2007) argued that not only learning goals, but also theories of intelligence, contribute to overall behavior and attitudes towards learning. They distinguished between incremental theorists and entity theorists. Incremental theorists tend to view intelligence as something that can be gained, or improved upon. Entity theorists believe that intelligence is a fixed attribute that cannot be changed. Blackwell et al. observed four incoming classes of seventh graders and tracked their progress in mathematics over two years. The researchers first observed whether or not intelligence theory was correlated with grade outcome. There was a significant difference in the amount students' math grades improved between incremental and entity theorists. Students that embraced an incremental theory of intelligence showed higher rates of change in their grade over the course of their 7th and 8th grade year. In contrast, entity theorists showed few improvements across that time. However, results showed that intelligence theories alone did not fully account for junior high students' improvement in math scores. Blackwell et al. (2007) included achievement goals, positive effort beliefs, helplessness attributions, and strategy variables in the predictor model. Improvement did not appear to be attributed to beliefs alone, but also to motivational aspects that changed as a result of beliefs. Their model suggested that all predictor variables worked together in order to promote more positive learning outcomes.

Incremental theories of intelligence encourage learning-oriented goals over performance goals. The goal outlook, in turn, promotes action towards positive strategies, and effort beliefs can lead to decreased feelings of helplessness. Students with productive learning goals and theories of intelligence possibly showed improvement in a challenging course because of different strategies used, not simply cognitive abilities.

To explore this possibility further, Blackwell et al. (2007) supplemented the results regarding intelligence theories as a predictor of educational success by providing seventh graders in an experimental group with lessons centered on learning strategies. The classes emphasized the idea that learning is a fluid process and directly impacts the brain. Before and after the sessions, Blackwell et al. measured participants' theory of intelligence, and investigated whether those changes in theory of intelligence resulted in behavioral manifestations in school. The majority of the students in the sample had experienced a steady decrease in grades prior to the intervention. After the class, students that subscribed to an incremental mentality were found to adopt more productive study habits and outwardly seek support. Entity theorists, in contrast, changed little about their study habits. Therefore, if a person views intelligence as fixed, they assume little responsibility for self-improvement.

Miele et al. (2011) expanded these results by demonstrating that students' judgments of what they would most easily remember were mediated by their theory of intelligence. Miele et al. manipulated apparent fluency of word pairs by altering font size to be either small or large. Larger fonts were previously shown to increase students' beliefs that they would be able to recall information (Rhodes & Castel, 2008), although this had no actual effect on learning accuracy. Incremental theorists were less susceptible to changes in the perceptual details of word pairs and increased their study time in parallel with increased task difficulty. In contrast, entity theorists decreased study time on more challenging tasks. One explanation proposed, and consistent with the Blackwell et al. (2007) research, was that entity theorists felt their abilities were limited and consequently minimized their efforts (Miele et al., 2011). If the information was perceived as being beyond an entity student's abilities, there would be no conceivable point in spending resources and time engaging in improving on that task.

When examining goals for learning, it appears that those with learning goals are more motivated to engage in tasks that improve learning. Grant and Dweck (2003) demonstrated that individuals with learning achievement goals were also more resilient to negative feedback and external indications of performance (See Table 1). For this reason, it will be valuable to explore the difference between achievement goals when exposed to a situation that might undermine intrinsic motivation for the task. The effect of extrinsic motivation on students will be studied by comparing performance of rewarded and non-rewarded subjects during a word-learning task. Engagement in the task, as well as increased learning accuracy throughout the task will be measured. Grant and Dweck (2003) found that feedback did not easily influence students with learning-oriented goals to change their learning behaviors. If this was because learning goal students experienced more motivation overall to engage in opportunities to expand their knowledge, then they might be more resistant to the undermining effect applied in a learning context.

Table 1
Summary of Personality Factors and Motivation

Motivational Factor	Pre-existing Characteristic	Can be Experimentally Facilitated	Motivational Interaction	
			Intrinsic	Extrinsic
Learning Goal *Associated with: Incremental theorists and challenge mastery*	Yes	Yes	Appear strongly intrinsically motivated to improve despite negative feedback	
Autonomous Regulation *Associated with: internal locus of control; feedback as supportive*	Yes	Yes	Internalization of reward and decisions leads to more robust intrinsic motivation	
Performance Goal *Associated with: Entity theorists and performance abilities*	Yes	Yes		Strongly influenced by extrinsic motivation
Control Regulation *Associated with: an external locus of control; feedback as instructional and critiquing*	Yes	Yes		Reliance on external cues of reward leads to typical extrinsic association

The Current Study

Many factors influence students' success in the classroom and researchers are constantly exploring options that improve their success. It is important to consider the effects that rewards can potentially have on students. Upon first inspection rewards are positive and encouraging but can be detrimental to motivation when removed. This effect has yet to be fully understood in a learning context and it is important to explore the eventual harmful consequences of decreased motivation for pursuing improvement. However, rewards in the classroom are not easy to control when grades are a consistent form of confirmation and feedback acting as inherent classroom rewards. It may be more beneficial for instructors to consider which goals they emphasize in their classroom. Dweck and colleagues' work suggests that increased emphasis should be placed on overall improvement of the task—not quality of performance and final reward output. Furthermore, research with autonomy regulation supports the view that instructors should highlight the importance of self-regulated and internalized motivation (Williams & Deci, 1996; Black & Deci, 2000). An increased emphasis on learning goals and personal improvement may help to buffer students from any negative influence of reward and extrinsic motivation on learning. This study explored individual differences within a student population in order to investigate whether or not preexisting learning oriented goals could truly help shield students from fluctuations in rewards compared to their performance goal oriented peers.

The typical free-choice paradigm popular in undermining literature was utilized to explore these individual differences among students. Subjects were divided into externally rewarded and non-rewarded groups. The free-choice paradigm was used to measure how often subjects engaged in studying during a break after performance incentives were removed compared to students that were never provided external incentives. It was hypothesized that overall an undermining effect would be found and students would study more often in the non-reward group than the reward group. Once students completed the task, an assessment of their achievement goals was acquired in order to group subjects by the degree to which they endorsed learning goals versus performance goals.

Based on the previous literature, it was further hypothesized that students with performance achievement goals in the non-reward group would engage more frequently in a word learning task compared to performance goal subjects previously offered performance-contingent rewards. It was further hypothesized that subjects with learning goals will engage more consistently in the task across groups and continue to engage in a word learning task once the reward for participation is removed.

CHAPTER 2: METHODS

Subjects

Participants were recruited from the Psychology Department's research pool at Colorado State University. The pool consists of all undergraduate students in both PY100 and PY250 classes. The students are required to participate in research studies for the Psychology department and are compensated with class credit.

In order to satisfy the G-Power (Faul, Erdfelder, Lang, & Buchner, 2007) *a priori* estimated effect size of .30, the original goal was to enroll 126 subjects in this study but 122 subjects were actually enrolled. Data from four of the subjects' was not included due recording errors, and one subject's data was not used for regression analyses because of missing data. Therefore, 118 subjects were included in the analyses. Participants were randomly assigned into the reward group (n=58) or the non-reward group (n=60). For the primary between subjects comparison of reward condition utilizing the entire sample size, the a priori effect size was surpassed (d= -.52, SD_1= 89.61, SD_2= 74.45). After categorical groups based on achievement scores were created, only 84 subjects were used and did not achieve the estimated effect size (d= -.13, SD_1=83.91, SD_2=85.48).

Materials

Participants in each group studied 26 Swahili-English word pairs. MatLab (The MathWorks Inc., 2010) was used to randomly present each pair and allowed participants to choose to interact with slides during a free choice period. The word pairs were selected from a corpus developed by Nelson and Dunlosky (1994), who provide normative ratings for each pair for learning difficulty, likelihood of remembrance, and how closely the Swahili words matched their English counterpart. Word pairs were selected to be of a range of difficulty levels (.25-.60) in order to maintain students' interest.

In order to explore individual differences in learning goals and motivation, the achievement goals survey adapted from Grant and Dweck (2003; see Appendix A) was used. The questionnaire was used to categorize students onto a relative scale as either highly learning goal oriented or low learning goal oriented (indicating participants had a higher performance goal orientation). The questionnaire consists of 12 questions that can be divided into 4 subscales (two per achievement goal) with 3 questions each.

Subjects also completed a learning self-regulation questionnaire (SRQ-L) adapted from Williams and Deci (1996) as a complementary measure to the achievement goals survey. The original version explored why students engage in a chemistry class and was changed to reflect class engagement more broadly. It is 14-question survey that consists of two subscales with 7 questions each. The SRQ-L is designed to test whether students' feel more internally or extrinsically motivated to engage in learning tasks.

The revised Sensitivity to Punishment Sensitivity to Reward Questionnaire (SPSRQ-R) (Conner, Jenkins, & Seelbach, 2010) was also used. This is a 48-question survey that consists of two subscales of 24 questions each. The SPSRQ-R is used to explore personality traits of approach and avoidance of rewards and was included to possibly provide more information on how individual differences interact with the undermining effect.

Also, to measure each subject's engagement in the task the Intrinsic Motivation Inventory (IMI) was used (see Appendix B). Four subscales were used to measure how interested subjects were in the task, perceived competency level, how much effort subjects put into the task, and whether or not they felt they had a choice to complete the task. Each of the four areas has 5-7 questions that were averaged to determine engagement in the task.

Procedure

Both groups were exposed to one study block of the word pairs. All 26 of the word pairs were presented once in a random order. Each word was presented for 3 seconds. Before the session they were instructed to learn as many words as possible because they would be tested on them after the study session. Subjects in the reward group were additionally informed that if they answered at least 4 items correctly they would be entered into a drawing at the end of the semester for a gift card.

Students completed a brief distractor task for 90 seconds following the study block. After the task, they completed a cued recall test containing a random selection of thirteen words. The Swahili word was the cue listed on the left side of the paper with a blank for the English word. Participants were encouraged not to worry about spelling and to leave words blank if unknown. Once finished, participants were informed of their score and the reward group was told whether or not they had qualified for the drawing.

After the test, participants in each group were allowed a five-minute break. During the break they had the option to read available magazines, wait for the researcher to return, or an opportunity to continue looking through the study words. The amount of time they spent studying the words and the number of words they studied was recorded by the program. Once the researcher returned, participants completed a series of surveys consisting of the achievement goals survey, SRQ-L, SPSRQ-R, and the IMI.

CHAPTER 3: RESULTS

Average engagement in the task was determined using the Intrinsic Motivation Inventory (IMI). Responses could range from 0 to 175. Participants responded in a range between 54 and 139. Average engagement was compared for the reward group (*M*=102, *SD*=16) and the non-reward group (*M*=106, *SD*=18) using a one-way ANOVA. No significant difference for engagement between groups was found (F (1,116) = 1.6, p >.05) and there was only a weak, positive correlation between the average engagement score and time spent studying in the free-choice period (n=118, r = .199, p < .05).

Consistent with the undermining effect, I predicted that the non-reward group would engage in the experimental task during a free-choice period longer than the reward group (see Figure 1).

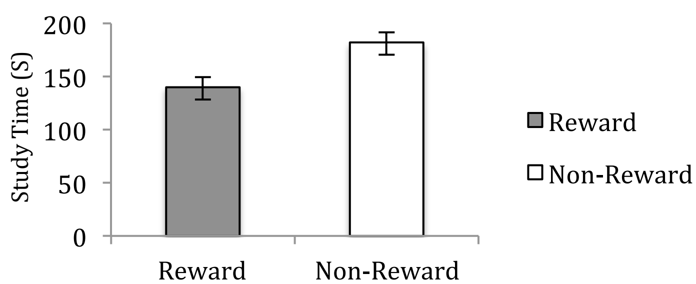

Figure 1. Study Time Between Reward Groups. Average time each group spent studying during the free period.

This would be a replication of the undermining effect. To explore this effect, a one-way ANOVA was first conducted comparing the mean study times for the reward (n=57, M=142, SD= 90) and non-reward group (n=60, M=183, SD= 74). There was a significant main effect for reward on the amount of time spent studying (F (1,116)=7.8, p < .01).

In order to perform specific hypothesis tests, a forced two-dimensional factor analysis was conducted separately on the achievement goals survey, SRQ-L, and SPSRQ. This was done to ensure that neither of the measures was too badly skewed and that the subscales of the measures represented the theoretical use of the composite scores. Items that loaded > .35 were included in the final composite scores.

For the achievement goals survey, items identifying a learning goal loaded onto Factor 1 and items identifying a performance goal loaded onto factor 2 (see Table 2). Six items loaded onto Factor 1 and five out of six items loaded onto Factor 2.

Table 2**.** *Obliquely rotated components for Learning Goal Items*

Component	**1**	**2**
Learning Goal 1	0.760	
Learning Goal 2	.699	
Learning Goal 3	.701	
Mastery Goal 1	.650	
Mastery Goal 2	.715	
Mastery Goal 3	.685	
Ability		.517
Ability 2		
Ability 3		.522
Normative Ability 1		.893
Normative Ability 2		.829
Normative Ability 3		.945

Note. Two factors were selected and loadings were >.4

For the SRQ-L questionnaire, items identifying controlled regulation loaded onto Factor 1 and items identifying autonomous regulation loaded onto factor 2 (see Table 3). Five out of seven items loaded onto Factor 1 and three out of five items loaded onto Factor 2.

Table 3**.** *Obliquely rotated components for SRQ-L*

Component	**1**	**2**
"I would likely get a bad grade"	.730	
"I'm worried I won't perform well"	.572	
"It's easier to follow suggestions"	.440	
"Good grades look positive on my record"	.561	
"I want others to see I am intelligent"	.492	
"It feels good to understand material"		.560
"A solid understanding is important for intellectual growth"		.808
"It's a challenge to understand the material"		.395

Note. Two factors were selected and loadings were >.35

Hypotheses Tests

The responses to items selected from the factor analysis for the achievement goals subscales were combined to determine composite scores for each subscale of learning goals and performance goals. The average performance goal score was subtracted from the average learning goal score to create a relative achievement goal score. A median split was used to divide the data into higher and lower relative scores. In order to create separation of the scores for categorical groups, but not subtract more than necessary from group size, scores above and below half a standard deviation of the median were used to create a high learning goal group and a high performance goal group. A 2 (group: reward (n = 44, M=138, SD = 86) x non-reward control (n = 40, M=180, SD = 78)) x 2 (achievement goal: learning (n = 44, M=152, SD = 84) x performance goal (n = 40, M=164, SD = 85)) ANOVA was performed to analyze the time spent engaging in the free-period learning task.

A main effect for achievement goals was predicted, with subjects indicating a higher likelihood of learning goals predicted to engage more often in the task during the free-choice period than performance goal subjects. However, the main effect for achievement goal on subjects' study time was not significant (F (1, 80) = .17, η^2 = .002, p = .68).

An interaction was predicted with learning goal subjects showing the highest study time in the non-reward group. In addition, performance goal students were expected to show the strongest undermining effect and participate in the task significantly longer in the non-reward group than the reward group. However, the interaction between goal identification and reward group was not significant (F (1, 80) = .16, η^2 = .002, p = .69); and the trend of the data does not support either of these hypotheses (see Figure 2). No matter which goal subjects identified with, they studied almost equally long in the non-reward group and neither group appeared robust to the undermining effect. Students identifying more strongly with learning goals studied slightly less in the reward group (*M* = 132) than students identifying strongly with performance goals in the reward group (*M* =147).

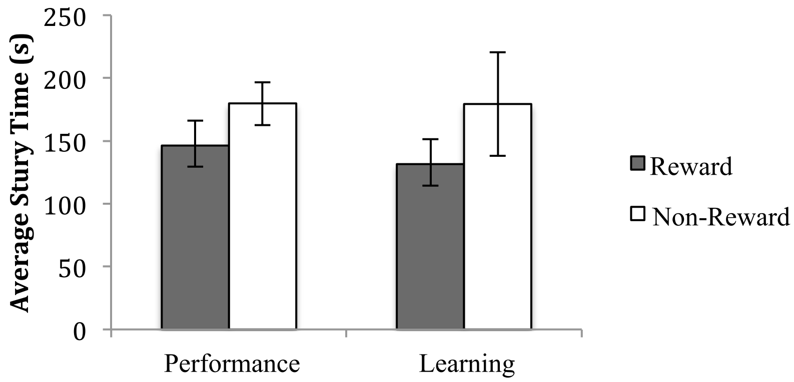

Figure 2. Time Spent Studying Between Achievement Goals and Reward.

The motivational ratings from the Intrinsic Motivational Inventory (IMI) were regressed onto the relative achievement goal scores in order to explore the lack of relationship between goals and performance. A simple linear regression revealed no significant interaction between IMI ratings and relative achievement goal score (F (1,115) = .88, p = .35). The subscale of perceived tension/pressure was analyzed separately to explore if performance goal students viewed the task as more controlling than higher learning goal students. The effect of learning score on perceived ratings of tension was not significant (F (1,115) = .2, p= .65)

The results of the revised Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ-R) were then included as a covariate in an attempt to explore the relationship between reward groups more thoroughly. The results of the ANCOVA did provide a significant model (F (4,84) = 1.4, p = .24). The effect of reward condition was still significant (p < .05) and the effect of achievement orientation was only slightly, and non-significantly, altered (F(1,84) = .076, p = .68). There was a non-significant effect of the covariate (F (1,84) = .08, p = .78).

Secondary Analyses

In order to explore other dimensions of students' personalities that may interact with the undermining effect, the Self-Regulation Questionnaire for Learning (SRQ-L) was also included in analyses. As previously discussed for achievement goals, the responses to items selected from the factor analysis for the SRQ-L subscales were combined to determine composite scores for each subscale of autonomous and controlled regulation for learning. The average autonomous regulation score was subtracted from the average controlled regulation score to create a relative autonomy score. As discussed in the previous section, a median split was used to divide data into higher and lower relative scores and scores above and below half a standard deviation of the median were used to create a higher autonomy group and a higher controlled group.

A main effect for type of regulation was explored. Theoretically autonomous regulation aligns most strongly with learning achievement goals for motivation. Therefore, in conjunction with the previous hypotheses, subjects indicating a stronger identification with autonomous regulation (n = 32, M=169, SD = 80) were expected engage more often in the free-choice task than subjects identifying most strongly with controlled regulation (n = 33, M=148, SD = 85). An interaction was also expected with subjects that were relatively more control regulated to demonstrate the undermining effect more strongly than the higher autonomy group by studying significantly longer in the non-reward group than in the reward group.

A 2 (group: reward (n = 34, M=139, SD = 86) x non-reward control (n = 31, M=180, SD = 75)) x 2 (autonomy regulation: relative autonomous x relative controlled regulation) ANOVA was performed to analyze the time spent in engaging in the free-period learning task. Although there was a significant main effect for reward (F (1, 61) = 4.06, η^2 = .06, p < .05), the main effect for autonomy regulation on subjects' study time was not significant (F (1, 61) = 1.1, η^2 = .02, p = .31).

The interaction between autonomy regulation and reward group was also not significant (F (1, 61) = 2.3, $\eta^2 = .04$, $p = .11$) but the trend of the data does support an unexpected interaction between relatively higher autonomy regulated students and reward condition (see Figure 3). Students identifying with an autonomous regulation studied more in the non-reward group (M = 205, SD = 60) than in all other conditions, and consequently autonomous regulated subjects had the largest difference in study times between reward and non-reward groups.

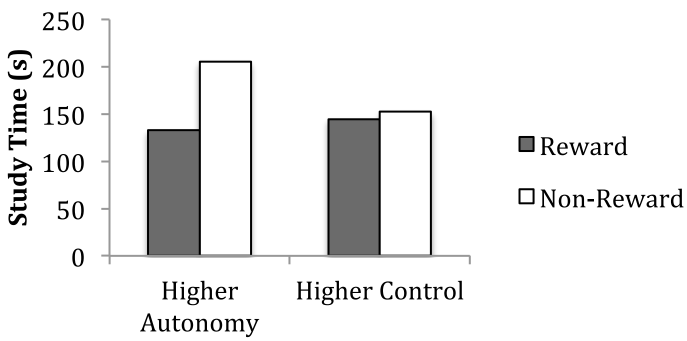

Figure 3. Time Spent Studying Between Autonomy Regulation and Reward groups.

Regression analyses were then performed to explore the personality measures as continuous variables. The responses from the achievement scale were coded on a continuum with higher scores indicating a higher orientation towards learning goals and lower scores indicating an orientation towards performance goals. Simple linear regression was used to explore the relationship between achievement goal ratings and the choice to engage in study behaviors and was predicted to support a positive linear relationship between goal ratings and an increased time spent studying. To first test a linear relationship between achievement scores and reward group, study time was plotted again achievement scores (see Figure 4). The plots and regression analyses did not support a linear relationship between score and study time.

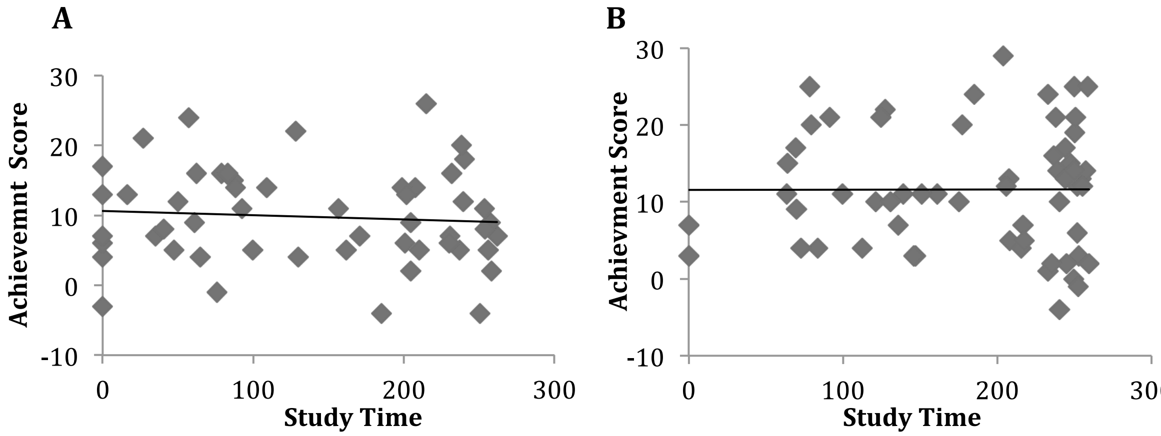

Figure 4. Study Time Plot Between Groups. Study times were plotted onto achievement score to determine if there was a linear relationship between the two variables for each group. A) Reward group's study time. B) Non-reward group study times. Separately, there does not appear to be a relationship.

The observations were not centered around the regression line, indicating a non-linear relationship for the both reward group (b_1=-.69, p = .69) and the non-reward group (b_1= .02, p = .99).

Multiple linear regression was then performed to examine the relationship between achievement score adjusting for reward condition. The results appear to support a significant relationship between achievement score and reward condition (F (2, 115)= 3.9, p< .05). Reward condition was significant different than zero (t=11.9, p< .01); however, the effect of achievement score is not significantly different from zero (t= -.36, p = .72). Although this regression equation (ŷ = 186 - .36**Achievement Score* – 43**Reward*) cannot predict a significant relationship between achievement score, it is predicted that students who receive a reward incentive and have an average achievement score, are predicted to receive a decrease of 43 seconds (t =-23, p < .01) to overall study time (See Figure 5). This model predicts 6.5% of the variance associated with study time (R^2= .065).

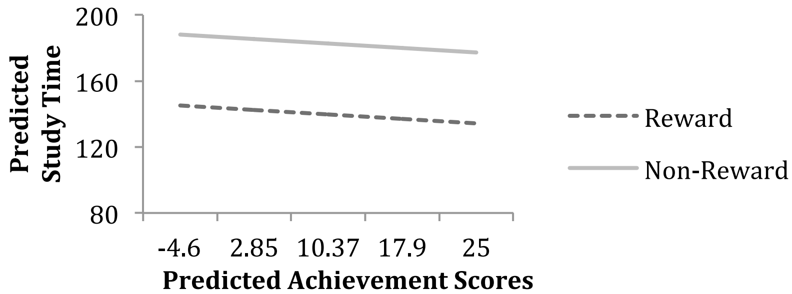

Figure 5. Study Time Plot Between Groups. Study times were plotted onto achievement score to determine if there was a linear relationship between the two variables for each group. A) Reward group's study time. B) Non-reward group study times. Separately, there does not appear to be a relationship.

CHAPTER 4: GENERAL DISCUSSION

This study was an extension of the undermining literature to educational research. It tested whether or not the presence of a performance-contingent reward could influence students' motivation to engage in studying during a free period. It also tested if students' individual differences in motivation would interact with the effect of the reward. Specifically, students' achievement goals (learning vs. performance) and autonomy regulation (autonomous vs. controlled) were explored. The results replicated the undermining effect but did not show an interaction between the undermining effect and either individuals' achievement goals or autonomy regulation. Each of these results will be discussed in turn.

Previous research on the undermining effect has broadly shown that rewards decrease intrinsic motivation to perform a task. Overall, the undermining effect was replicated in this study. Specifically, students offered a reward for better performance chose to study less during their free time than students not offered a reward. This finding complements previous research by Murayama and Kuhbandner (2011) that observed the impact of rewards on learning trivia facts. They found that rewards helped if material was uninteresting and did not interfere with learning interesting material; however their study was not intended to directly test undermining effects on learning or account for the consequence of rewards on learning behaviors. The results of the current study provided a more direct comparison of an externally rewarded group to a non-rewarded group, and more clearly demonstrate the effects of rewards on lowering motivation to actively engage in learning tasks. This extension of the undermining effect indicates that some rewards may undermine students' intrinsic motivation to actively engage in learning tasks.

Another main interest of this study was to explore how the undermining effect interacted with students' individual differences in their preexisting motivations and goals for learning. Both achievement goals and autonomy regulation were broadly used to identify if students were intrinsically motivated (i.e. identified with learning goals and autonomous regulation) or extrinsically motivated (i.e. identified with performance goals or controlled regulation). Neither preexisting motivation for learning appeared to have a significant effect on the amount of time that students chose to study. Specifically, there was no difference between the amount of time learning and performance goal oriented students chose to study; numerically, both groups performed nearly identically. Also, both groups showed the undermining effect: students studied significantly longer in the non-reward group compared to the reward group no matter which goal they identified more strongly with. At present, these results indicate that no matter students' inherent learning goals, they are susceptible to the undermining effect of reward. The lack of a significant relationship between study time and scores on the revised Sensitivity to Punishment and Sensitivity to Reward (SPSRQ-R) further indicate that individual differences in reward processing and motivation may not be the key issue.

It is possible that reward creates a fixation on the task at hand that deters individual goals and motivation. This relates to ideas that Duncker (1945) outlined on "fixedness" of thought. He offered subjects items and tools that could be used to solve puzzles. One crucial item needed for the solution was either placed within the puzzle, creating a fixed purpose for that item, or outside of the puzzle projecting that item's purpose as more flexible. Subjects consistently were able to solve the puzzle if all items were presented without a biased function but were less likely to solve the puzzles correctly if the crucial item's purpose was not obvious. Duncker concluded that this narrowed subjects' thought processes significantly. Glucksberg (1962) performed an experiment using the same tasks but offered high and low monetary compensation if the tasks were completed quickly. He found that subjects offered the highest amount of reward completed the fixed-purpose task in the longest amount of time. Essentially, he found an exaggerated effect of Duncker's "fixedness'' with the addition of reward (Glucksberg, 1962; Glucksberg, 1964). It is possible that within the parameters of this study, students' focus was similarly narrowed by the reward and later engagement was discredited because the goal of the task was fundamentally different for the reward and non-reward group.

If reward creates substantial narrowing of focus and limits flexibility of thought, these results could further indicate that the undermining effect is robust and extends to general task motivation—not easily differentiated by the specific task. This would be supported by results found in the meta-analysis conducted by Deci et al. (1999). They reviewed other studies utilizing a similar reward structure for the impact of rewards offered to subjects depending on how well they completed a task—performance-contingent rewards. They reported that performance-contingent rewards offered to subjects for performing well on a variety of tasks such as: solving puzzles, completing models, playing games, and solving mazes all significantly decreased subjects' intrinsic motivation to complete those tasks during a free period. It is important to consider that the undermining effect may strongly interfere with student performance no matter what their individual goals for learning. High intrinsic motivation to learn may not generalize to specific, performance-contingent, situations and therefore may not provide resistance to the negative impact of reward. However, if rewards are offered indiscriminate of performance, and are less likely to be viewed as directional, intrinsic reward may be more likely to persist. This would be consistent with Deci et al.'s (1999) findings on task-noncontingent rewards, which are not found to consistently undermine intrinsic motivation.

Another possibility for why differences may not have appeared between learning and performance goal students is due to a low effect size for achievement goal due to the small sample size being utilized for those categorical analyses. Therefore, these results cannot confidently reject previous findings on the differences between achievement goals or autonomy regulation.

Similar to the results found for achievement goals, there was not a significant difference between the amounts of time spent studying for subjects who were autonomy regulated versus those who were control regulated. Although there was no significant differences found, there was an unexpected trend within the autonomy regulated individuals. Students with higher ratings of autonomy who were in the non-reward group studied longer during the free-choice period than any other group and therefore appeared more influenced by the undermining effect than students that had higher control regulated scores.

It is not entirely surprising that individuals who identify with higher levels of internal regulation and motivation would study most often when rewards are not present, but this trend contrasts with a study performed by Hagger and Chatzisarantis (2011). They found that subjects identifying with an autonomy orientation completed more puzzles than the control oriented individuals in both a reward and non-reward group. The researchers concluded that the intrinsic motivation autonomy oriented subjects may have is more robust to the impact of rewards. In contrast, in the current study, high autonomy regulated subjects studied longer when they were in the non-reward group than any other group of subjects.

It is important to note that Hagger and Chatzisarantis were viewing general autonomy orientation through the General Causality Orientation scale (Deci & Ryan, 1985) and this study used an adapted version, Learning Self-Regulation Questionnaire (SRQ-L), specifically directed at reasons for learning (Williams & Deci, 1996). It is possible that motivation is internalized differently for learning behaviors. Another key difference is that Hagger and Chatzisarantis rewarded their subjects on an item-by-item basis that could have created a more general feeling of pressure and external control for the participants and resulted in performance differences due to how autonomy oriented individuals internalize pressure and rewards compared to control oriented individuals. They reported different ratings of subjects' feelings of external control between the two orientations, whereas for the current study there was no difference found between ratings of overall engagement or perceived external control and tension. This indicates that reward offered in the current study did not create a strong sense of pressure or tension for the subjects and therefore did not appropriately highlight these individual differences.

An extension of the current study will also be conducted in order to explore the facilitation of achievement goals in order to more directly test whether or not actively creating learning goals can help students' behaviors become more resistant to negative effects of reward. Cianci, Schaubroeck, and McGill (2010) used a similar procedure to demonstrate that learning and performance goal students react differently to positive and negative feedback. After completing a reading comprehension task, subjects given a learning goal-objective showed greater improvement only in regards to negative feedback compared to their performance goal peers, and subjects provided a performance goal-objective showed performance improvements only following positive feedback. Cianci et al. further demonstrated that facilitating a learning goal was beneficial to subjects' performance if their underlying theories of intelligence did not match their facilitated objective. Specifically if subjects embraced an entity theory of intelligence before the experiment, and therefore viewed intelligence as a concrete ability, learning goal facilitation still provided improved performance compared to subjects with the same pre-existing trait and no goal facilitation. Providing subjects with a learning goal appeared to provide the greatest benefits compared to other goal facilitation. If providing students with a learning goal can help improve performance despite pre-existing goals (Cianci et al., 2010), it is possible that facilitating a specific achievement goal can help diminish the negative impact of rewards despite the non-significant difference currently found between pre-existing achievement goal and study time. These results and the insufficient evidence found in the current study suggest the need for additional studies.

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APPENDIX 1

Achievement Goal Questionnaire

Each subscale is rated by participants on a 7-point scale (1 indicates that the subject strongly disagrees and 7 indicates that the subject strongly agrees).

Learning Goal Subscales

Learning

1. I strive to constantly learn and improve in my courses.
2. In school I am always seeking opportunities to develop new skills and acquire new knowledge.
3. In my classes I focus on developing my abilities and acquiring new ones.

Challenge Mastery

1. I seek out courses that I will find challenging.
2. I really enjoy facing challenges, and I seek out opportunities to do so in my courses.
3. It is very important to me to feel that my coursework offers me real challenges.

Performance Goal Subscales

Ability

1. It is important to me to confirm my intelligence through my schoolwork.
2. In school I am focused on demonstrating my intellectual ability.
3. One of my important goals is to validate my intelligence through my schoolwork.

Normative Ability

1. It is very important to me to confirm that I am more intelligent than other students.
2. When I take a course in school, it is very important for me to validate that I am smarter than other students.
3. In school I am focused on demonstrating that I am smarter than other students.

APPENDIX 2

Intrinsic Motivation Inventory (IMI)

Each subscale is rated by participants on a 7-point scale (1 indicates that the subject strongly disagrees and 7 indicates that the subject strongly agrees).

Interest/Enjoyment

1. I enjoyed doing this activity very much.
2. This activity was fun to do.
3. I thought this activity was kind of boring.
4. This activity did not hold my attention at all.
5. I would describe this activity as very interesting.
6. I thought this activity was quite enjoyable.
7. While I was doing this activity, I was thinking about how much I enjoyed it.

Perceived Competence

1. I think I am pretty good at this activity.
2. I think I did pretty well at this activity, compared to other students.
3. After working at this activity for a while, I felt pretty competent.
4. I am satisfied with my performance at this task.
5.I was pretty skilled at this activity.
6. This was an activity that I couldn't do very well.

Effort

1. I put a lot of effort into this.
2. I didn't try very hard to do well at this activity.
3. I tried very hard on this activity.
4. It was important to me to do well at this task.
5. I didn't put much energy into this task.

Perceived Choice

1. I believe I had some choice about doing this activity.
2. I felt like it was not my own choice to do this task.
3. I didn't really have a choice about doing this task.
4. I felt like I had to do this.
5. I did this activity because I had to.
6. I did this activity because I had no choice.
7. I did this activity because I wanted to.