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Temporal Discounting and the Assessment and Treatment of Academic Procrastination

Anthony Concepcion
University of South Florida

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Temporal Discounting and the Assessment and Treatment of Academic Procrastination

by

Anthony Concepcion

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy Degree in Applied Behavior Analysis
Department of Child and Family Studies
College of Behavioral and Community Sciences
University of South Florida

Co-Major Professor: Rachel Garcia, Ph.D., BCBA-D
Co-Major Professor: Kimberly Crosland, Ph.D., BCBA-D
Raymond Miltenberger, Ph.D, BCBA-D
Catia Cividini-Motta, Ph.D., BCBA-D
Diana Ginns, Ph.D., BCBA-D
Jennifer Weyman, Ph.D., BCBA-D

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Dedication

Father,

When I was five, we spent some time in the yard staring at the sky. I asked you if the sun moved around the earth or if the earth moved around the sun. You didn't answer the question initially. Instead, you picked me up with excitement and hugged me tightly. You then asked me to help you build a 3D model of some sort. We used rocks for planets and sprinkled dirt around for distant stars. A fresh cup of coffee was our version of the sun. I asked many other questions that evening, and I can still hear the excitement in your voice and expression on your face with each question I asked. But! Do not think I forgot about your lack of knowledge of clouds. Thank you for teaching me to be curious and the joy of asking questions. Know that without you and the countless sacrifices you made for our family, this would not be possible.

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Abstract

Many individuals engage in procrastination at some point in their lifetime. Although procrastination is usually not detrimental, for college students, academic procrastination is correlated with adverse health effects (e.g., anxiety, depression, sleep hygiene) and poor academic performance (Akinsola, et al., 2007; Ferrari, et al., 1995). Furthermore, the prevalence of academic procrastination is high with reports of up to 95% of college students engaging in detrimental amounts of procrastination (Hussain & Sultan, 2010). Notably, students enrolled in online courses are likely to be at greater risk to experience adverse consequences associated with procrastination (Elvers, et al, 2003). Previous studies have focused on self-report measures and correlational analysis between personality traits and procrastination (Steel, 2007). In contrast, the current series of studies aimed to evaluate a behavioral approach of assessing procrastination through measures of latency and a delay discounting framework. Potential benefits to instructors and students as well as interventions to decrease academic procrastination are discussed.

Chapter 1: Procrastination

In general terms, procrastination is the tendency to delay engaging in a task that would be more beneficial to complete sooner rather than later. Traditionally, procrastination has been defined from a psychoanalytic viewpoint. For example, Tuckman and Sexton's (1989) definition of procrastination focused on "a lack of self-regulated performance." Lay and Schouwenburg (1993) described procrastination as the unnecessary delaying of activities that one ultimately intends to complete, especially when done to the point of creating emotional discomfort. To obscure things further, procrastination is often deemed a personality trait composed of neuroticism, impulsiveness, and fear (Steel, 2007). Most research on procrastination subscribes to ambiguous constructs rather than a specific response. It is therefore unsurprising that mechanisms of procrastination have yet to be identified and so few intervention evaluations exist (Steel & Klingsieck, 2016; Zacks & Hen, 2018).

Prevalence of Procrastination

Many individuals will be able to recall a recent time they delayed completing an important task to a later date. Fortunately, for most individuals a little procrastination is not harmful and important tasks are eventually completed without encountering adverse consequences from delays. However, for some, chronic procrastination can have serious financial, personal, and health related consequences, such as delays in managing bills, resolving conflicts, and seeking medical attention (Ferrari & Diaz-Morales, 2014). Chronic procrastination has also been found to lead to adverse health effects, such as depression and anxiety (Balkis & Duru, 2007; Stead, et al., 2010). It is estimated that 25% of the general

population engage in chronic procrastination (Day et al., 2000; Ferrari, et al., 2007; Ferrari, et al., 2005; Harriott & Ferrari, 1996; McCown & Johnson, 1989) and 50% of the population engage in procrastination routinely (Klingsieck, 2013). Ferrari et al. (2005) conducted a survey spanning the United States, United Kingdom, and Australia to assess differences in self-reported measures of procrastination. All respondents reported similar rates of procrastination with no significant differences among these populations. Another study by Ferrari et al. (2007) extended Ferrari et al. (2005) by including participants from Spain, Peru, and Venezuela. While a slightly lower prevalence of procrastination was reported (13.5% and 14.6% for men and women respectively), no significant differences were found across nationality or gender. Although no other global prevalence measures have been conducted, scholars in Asia, South America, and Middle Eastern territories have also reported similar prevalence rates of procrastination (e.g., Akinsola et al., 2007; Balkis, 2013; Hussain & Sultan, 2010; Jones & Blankenship, 2019; Özer & Ferrari, 2009; Tan et al., 2008) that mimic those of western societies. Together, these data support the notion that procrastination is problematic on a global scale and indiscriminative of culture.

Academic Procrastination

Academic procrastination has been studied as a subfield of procrastination focusing specifically on student issues. Academic procrastination primarily involves delaying studying, writing, and other assignments, but can also include attendance and contact with instructors. One early study by Ellis and Knaus (1977) estimated as high as 70% of college students engage in academic procrastination. Although this figure has been cited often, prevalence rates vary widely, and several scholars have reported more conservative measures. Solomon and Rothblum (1984) distributed a survey to 342 college students and found procrastination varied depending on the assignment ranging from 46% (writing) to 28% (exams). More recent measures have

reported between 70% (Ferrari & Beck, 1998; Ferrari et al., 2005) and 90% (Vargas, 2017) of college students engage in academic procrastination. Vargas (2017) obtained similar findings to Solomon and Rothblum (1984) with students reporting writing assignments as most delayed. Studies that have involved graduate students have reported a similar level of procrastination as undergraduates (Onwuegbuzie, 2004).

Beswisk et al. (1988) observed older students were less likely to procrastinate than younger students, however these findings are inconsistent with more recent research suggesting graduate students may procrastinate more than undergraduates (Onwuegbuzie, 1999; Onwuegbuzie, 2004). There is not enough evidence to suggest age is a relevant factor in procrastination given the contingencies in academic settings that remain stable across a student's academic career (e.g., assignments and deadlines). Likewise, gender has not been reported to be a factor in academic procrastination (Akinsola, et al., 2007; Ferrari & Beck, 1998) which is not surprising given no gender differences have been found in larger international studies on procrastination at-large.

Online Academic Procrastination

Online learning is increasingly more common and as of 2017, the National Center for Education Statistics has reported that one-third of all college students are enrolled in at least one online course. Between 2006 and 2017 enrollment of online students has steadily increased between 3.9% and 12% year-over-year while on-campus enrollments have decreased (Digital Learning Compass: Distance Education Enrollment Report, 2017; National Student Clearinghouse, 2018). Given trends in online enrollments, it is an ideal time to attend more closely to evaluating online learning and issues that distance learners may face. Elvers et al. (2003) note that online students have less structure (e.g., scheduled meetings and study times)

than traditional students, which may contribute to more frequent procrastination. Going to a physical class exposes students to academic material on a regular basis whereas online students may postpone accessing course content until the day an assignment is due. Other features of online learning may also contribute to procrastination. For example, students may study from the comfort of their home, which may also include competing activities that are not typically present in a classroom. Additionally, students may have minimal contact with peers and instructors, which traditionally may serve as prompts to complete work (for a review of barriers in online learning see Gillett-Swan, 2017). Thus, online students may be more prone to procrastinate and encounter adverse effects of procrastination.

Elvers et al. (2003) compared the relation between procrastination and academic performance for students randomly assigned to either an online or on-campus course. Both groups of students had access to identical material with the on-campus students having an advantage of also being able to access the online content in addition to class time. Procrastination was measured based on student access reports (e.g., days logged in and page views) for the course web site. Results of the study revealed no differences between groups on measures of procrastination, academic performance, or class ratings. Notably, procrastination was negatively correlated with academic performance for online students, but not for traditional students. These findings suggest that traditional students may engage in procrastination without suffering significant decreases in academic performance whereas online students may be at higher risk to suffer adverse effects when engaging in procrastination.

Unfortunately, no known study to date has examined the prevalence of procrastination in online learning on a large scale. However, distance learning requires students to manage their time independently (i.e., self-regulate) while balancing jobs and family responsibilities

(Holmberg, 1995). Thus, it is likely online students procrastinate equally if not more so than traditional students. Klingsieck et al. (2012) state the situation for online students quite clearly noting, “One could say that students treat the relatively unstructured learning environment of a distance university as an invitation to procrastinate” (p. 297).

Adverse Effects on Health

It has long been noted that there is a link between procrastination and negative effects on physical and mental wellbeing. Students who procrastinate have reported feeling more anxious (Rothblum et al., 1986) and stressed (Tice & Baumeister, 1997) especially before taking exams. Tice and Baumeister (1997) conducted a longitudinal study with 100 students measuring their self-reported procrastination, academic performance, stress, and illness. Results showed procrastinators reported less stress and illness at the onset of a semester (average of 1.40 symptoms) than non-procrastinators (average of 2.80 symptoms). However, at the conclusion of the semester, the pattern reversed with procrastinators reporting an average increase of 6.80 health-related symptoms compared to an increase of 3.80 symptoms for non-procrastinators. This finding corresponds with Pychyl and Sirois (2016) interpretation of procrastination’s effect on health suggesting procrastination offers short-term states of elevated happiness at the expense of stressors in the future.

Long exposure to stress may lead to depression and anxiety, which have been reported to affect roughly 30% of college students (Ibrahim et al., 2013) and are highly correlated with procrastination (Ferrari et al., 1995; Onwuegbuzie, 2004; Steel, 2007). One study has also reported that procrastination and suicide proneness are highly associated among college populations (Klibert et al., 2011). However, the direction of causality is unclear when it comes to mental or physical illness and procrastination. Sirois et al. (2003) stated that stress caused by

procrastination might lead to physical illness, such as influenza, due to a weakened immune system from prolonged stress.

Procrastination is also associated with poor sleep habits and increased risk of insomnia and daytime drowsiness (Li et al., 2020). Individuals who procrastinate attain shorter weekday sleep, but do not experience any deficits during weekends relative to non-procrastinators (Li et al., 2020). Procrastinators are also more likely to stay up all night working, which has been demonstrated to lead to poor academic performance (Phillips et al., 2017; Thacher, 2008). A meta-analysis of the effects of sleep deprivation has shown that partial sleep deprivation (less than 5 hr of sleep within a day) has a more profound effect on mood and performance than larger amounts of sleep deprivation (Pilcher & Huffcutt, 1996). Students who procrastinate may engage in partial sleep deprivation frequently when acquiring fewer hours of sleep near assignment due dates. Sirois et al. (2015) conducted a study with 141 students who self-reported their levels of procrastination and sleep patterns. Students who identified as procrastinators also reported feeling unrested or fatigued, showing some evidence that even when they sleep, the sleep is non-restorative.

Procrastination may impact health by facilitating a cycle of behavior that leads to physiological stress that further increases the probability of future procrastination. For example, students may stay up through the night to complete an assignment. Because the student did not sleep, the student may lack energy, have problems concentrating, or find further academic tasks aversive (Steel, 2007). This pattern may continue and with less sleep over time and prolonged stress from work, more severe physical and mental illness may emerge.

Adverse Effects on Performance

A moderate body of literature on academic procrastination has shown that academic procrastination almost always results in poor academic performance. For example, Akinsola et al. (2007) evaluated how procrastination affected undergraduate students' performance in a math course. Students first completed a survey on procrastination (i.e., Tuckman, 1991) and were then categorized as low, moderate, or high procrastinators. Student's grade point averages (GPA) were compared following the end of the semester revealing that low and moderate procrastinators significantly ($r = 0.82$) outperformed high procrastinators. Similar findings have been demonstrated with other course subjects such as psychology (Gustavson & Miyake, 2017), accounting (Rotenstein et al., 2009), business (Gafni & Geri, 2010), and English (Babadogan, 2010). Additionally, similar outcomes have been demonstrated in studies with students all over the world including Turkey (Atalayin et al., 2018; Klassen & Kuzucu, 2009), Mexico (Vargas, 2017), Nigeria (Akinsola et al., 2007), China (Geng et al., 2018), and culturally and ethnically diverse groups within the United States (Clark & Hill, 1994; Jones & Blankenship, 2019; Prohaska et al., 2000).

Kim and Seo (2015) conducted a meta-analysis on the relationship between academic performance and procrastination by reviewing 33 studies on the topic. The data suggested that at-large procrastination is negatively correlated with academic performance. These findings are unsurprising. Students who start work late give themselves less time to adequately study or proofread writing and may receive penalties for late submissions. To meet deadlines, work may be rushed or submitted partially incomplete or incorrect (Beswick et al., 1988). There is evidence to suggest cramming or massed-practice is less effective than spaced-responding (Kornell, 2009) in preparing for tests, a technique that students who procrastinate may fall back on due to limited

time. Although contrasting evidence exist (e.g., Seo, 2011), when students who cram perform as well as those who do not, it may be due to the difficulty or amount of content that is required to be learned. Some assignments, such as writing a paper, may produce more discernible differences in performance between students who procrastinate and their peers who do not.

In contrast to most studies on academic procrastination, some researchers have demonstrated procrastination may only slightly effect (Tice & Baumeister, 1997) or have no effect (Lay, 1986; Seo, 2011) on academic performance. Such findings indicate some students may perform well despite their procrastination (Day et al., 2000). For example, Seo (2011) asked undergraduate students a series of questions related to procrastination. First, students were asked to report specific dates they initiated studying for exams. Second, students were asked to report what date they intended to study for exams. The researchers found no correlation between exam grades and the answers provided to questions about procrastination.

Gallagher et al. (1992) reported most students who responded to a survey regarding academic concerns indicated a high need for help managing their procrastination. A more recent study by Knaus (2000) claimed 60% of college students believe professional guidance is necessary to decrease their procrastination. Indeed, it is likely that students identifying as procrastinators would rather not procrastinate. Given the prevalence of academic procrastination, potentially adverse effects, and desire for change from students, some scholars have described the issue of academic procrastination as an endemic in academia (Milgram et al., 1995).

Chapter 2: Traditional Accounts for Procrastination

Procrastination is a complex construct and may occur for a variety of different reasons. Popular explanations for procrastination have been based on cultural myths more so than science (Farrington, 2012). For example, some individuals rationalize their procrastination as a result of striving for perfectionism or a fear of failing a task. Some students claim that working under-pressure allows them to perform at their best, thus they procrastinate as a strategy to perform better. However, none of the research reviewed thus far has demonstrated a positive effect from procrastination. Some individuals can perform adequately despite, rather than because of, procrastination. Steel (2007) conducted a meta-analytic review of procrastination analyzing over 600 possible correlations between procrastination and hypothetical constructs such as neuroticism and sensation seeking in addition to a few behavioral measures, such as task-aversiveness. However, personality theories provide little utility in identifying causes of procrastination. This is similar to associations between mental health and procrastination, the direction of causality is ambiguous.

Perfectionism

A person may procrastinate to maximize the amount of time they have to produce the best possible product (Ferrari, 1992). However, it is difficult to find substantial evidence of the perfectionist procrastinator outside of correlational surveys (e.g., Onwuegbuzie, 2000). Indeed, it is difficult to explain one construct with another. Ellis and Knaus (1977) noted perfectionists engage in irrational thoughts, such as “I must be perfect” and “It’s better to do nothing than to fail,” alluding to the idea that avoidance may be related to procrastination. Ferrari (1992) noted

that perfectionism was attributed to both procrastinators and non-procrastinators suggesting procrastinators are motivated by social anxiety and non-procrastinators by a desire to demonstrate their talent. Many studies refer to perfectionism without providing much evidence or justification for the construct.

Fear of Failure

Solomon and Rothblum (1984) noted fear of failure as a common rationale provided by students for their procrastination. Delaying academic tasks may lead to delaying unwanted feedback or other consequences related to poor performance. However, from a behavioral perspective, this explanation is lacking. In research on avoidant responding, organisms tend to postpone aversive stimuli indefinitely (Sidman, 1953). Delaying studying or submitting an assignment indefinitely would result in an aversive consequence (i.e., failure) rather than postponement. Procrastinators may perform poorly, but do not necessarily fail entirely due to inaction. More recent studies have demonstrated fear may not be related to procrastination. Ackerman and Gross (2005) asked two groups of students described as high and low procrastinators a series of questions related to their fear of assignments. No differences were found between the groups. Steel's (2007) review of the literature also found no significant correlation between fear and procrastination.

Active Procrastination

Active procrastination refers to intentional delay as a strategy to produce a favorable outcome. Some individuals may rationalize that they perform better when under pressure or stress. Chu and Choi (2005) proposed that procrastination could be defined as either passive or active. Passive procrastination involves negative outcomes or experiences whereas active procrastination may not have any impact on performance. Active procrastinators are described as

individuals who accurately or efficiently manage their time and assess their own ability to complete a task. Active procrastinators may acquire reinforcement in the form of adrenaline in working under pressure or may encounter greater reinforcement during their lifespan by allocating as much possible time to preferred activities and intentionally delaying aversive tasks. However, little research supports Chu and Choi (2005) and critics argue that intentional delay is not procrastination, but rather prioritization (Chowdhury & Pychyl, 2018; Wessel, et al., 2019). Further, critics have also stated active procrastination does not meet the definition of resulting in a negative outcome (Steel, 2010). Procrastinators and non-procrastinators have been shown to equally assess their available time and duration a task takes to complete (Pychyl et al., 2000) suggesting procrastination is not a time management problem.

Self-handicapping

Individuals who procrastinate may do so to create an excuse for performing inadequately in the future (Ferrari, 1991). Ferrari (1991) described this as protecting one's self-esteem. Ferrari and Tice (2000) conducted a two-part study with adult men and women. In Study 1, participants were tasked with completing a math test but were offered the opportunity to practice the math problem or play video games for 15 min before the test. Participants who reported as procrastinators spent less time practicing before the actual math test. In Study 2, participants were given an identical math test to complete, but this time some participants were told that the math test was designed to be a fun game while others were told the test measured intelligence. Results of the study showed that participants who reported as procrastinators only reduced practicing when the math test was presented as a fun game. These results suggest that procrastination may be a form of self-handicapping, but it does not rule out alternative and more parsimonious explanations, such as avoiding aversive tasks.

Personality traits

Several studies note personality traits as causal mechanisms for procrastination. Ferrari (1991) reported students who procrastinate have low self-esteem, low-confidence, self-doubt, and anxiety. Van eerde (2003) discussed procrastination and associations to pessimism and neuroticism. Steel and Klingsieck (2016) reported conscientiousness is at the core of all types of procrastination. Although it is unclear if this is in addition to or in replacement of self-efficacy, impulsiveness, and distractibility discussed in Steel (2007).

Research on procrastination from mainstream scholars have primarily based their findings on personality theories and surveys. A notable number of these studies have produced weak or contradicting correlations, yet authors claim strong conclusions about the profile of a procrastinator. The usefulness of these studies is limited in terms of interventions or a behavior analysis of procrastination.

Measurement of Procrastination

One shared limitation in most research on procrastination is an almost exclusive reliance on questionnaires. Past researchers may have found it difficult to capture behavior that indicates procrastination directly. It may still prove difficult, if not impossible, to know what a student may be doing outside the classroom despite academic settings offering both a convenient sample and more controlled environment. Numerous procrastination scales and impulsivity questionnaires to assess procrastination have been developed. The Procrastination Assessment Scale-Students (PASS; Solomon & Rothblum, 1984) is the most used scale to measure academic procrastination (Harrington, 2005). The scale attempts to identify the prevalence and rationale students have for procrastinating. A feature of the questionnaire is that specific questions are geared towards distinct academic activities, such as writing, studying, and attending class. Thus,

results of the PASS provide some evidence that procrastination differs depending on the task given. A limitation of the PASS is that questions are framed as procrastination being inherently problematic. For example, students are asked to indicate their level of procrastination *and* the degree to which procrastination effects their performance. However, students may procrastinate without perceiving of negative consequences.

The Tuckman Procrastination Scale (TPS; Tuckman, 1991) attempts to identify more general academic procrastination, asking respondents to answer how well they match a descriptor of procrastination on a 1-4 Likert-type scale (i.e., 1 = that's not me, 4 = that's me). Tuckman (1991) reported achieving high reliability measures of .86 ($n = 50$) and .90 ($n = 183$) for two groups of students. However, no known study to date has evaluated the reliability of the TPS independently.

Kim and Seo (2015) and Rotenstein et al. (2009) have suggested that a lack of consistency and small effect sizes (i.e., slight negative correlations between academic procrastination and performance) in several studies on academic procrastination stem from the use of “contaminated” self-report data. Indeed, self-report questionnaires feature several disadvantages. Respondents may not provide accurate answers due to inaccurate recollection or intentionally falsifying answers. Others may respond in a way they presume the experimenter desires (Demetriou et al., 2015). For example, some respondents may answer questions with positive attributes more favorably and vice versa. Overall, answering questions about procrastination may not accurately equate to actual procrastination. In contrast, a behavior analytic approach with direct measures of procrastination may prove more accurate.

In addition to the study by Elvers et al. (2003) discussed above, Rotenstein et al. (2009) conducted a study measuring assignment access, submission, and due dates as measures of

procrastination. The students evaluated during this study were enrolled in a traditional classroom setting however assignments were administered online. To measure academic performance, assignment and overall course grade were recorded. Two-hundred ninety-seven graduate students were split into two groups. Students who submitted early were labeled Early Birds and students who submitted temporally closer to the assignment deadline were labeled Just-in-Timers. Results of the study showed over 50% of students had initial contact with assignments with less than 80 hr (3.3 days) prior to the deadline. Less than 20% of students accessed assignments more than a week in advance. Several other findings of the study are notable. First, significant negative correlations between academic performance and submission times were revealed ($r = 0.072, p = <0.002$). This indicated students who submitted assignments earlier tended to perform better. Second, significant positive correlations between start date and performance were revealed ($r = 0.142, p = <0.001$). This indicated students who accessed assignments earlier tended to perform better. Overall, Early Birds outperformed Just-in-Timers on individual assignments and overall course grade.

Elvers et al. (2003) and Rotenstein et al. (2009) provide a guiding example of the use of technology to record traditionally unobservable behavior. Adoption of and advances in learning management systems (e.g, Canvas) allow researchers to track the frequency, duration, and latency associated with interacting with academic content. Submission times as a behavioral indicator of procrastination represents substantial progress in research on academic procrastination.

Chapter 3: Behavioral Accounts of Procrastination

Task-aversion

Procrastination may occur when tasks are aversive, boring, or without meaning (i.e., no clear purpose for an assignment; Blunt & Pychyl, 2000). This is unsurprising given the literature on preference assessment and reinforcer efficacy (e.g., Lee et al., 2010). In contrast to preference assessments, demand assessments have been developed to identify academic tasks that evoke maladaptive behavior or low levels of engagement with the task (e.g., Roscoe et al., 2009). Using functional analysis methodology, aversive tasks are used to confirm that negative reinforcement in the form of task avoidance or escape maintains maladaptive behavior (e.g., Roscoe et al., 2009). Although studies using preference or demand assessments have primarily involved individuals with disabilities, college students may also engage in behavior that leads to an avoidance of aversive tasks. Although no known study has directly evaluated aversiveness of academic tasks for college students, several survey-based studies suggest task aversion may play a role in procrastination. In response to Solomon and Rothblum (1984), students reported task aversiveness as the primary reason why they procrastinate and tasks that were considered more difficult (e.g., writing assignment) produced higher levels of procrastination. A key difference between procrastination by college students and task avoidance by individuals with disabilities is that students eventually complete the task whereas participants undergoing demand assessments attempt to avoid tasks indefinitely. There is little research to suggest task avoidance causes procrastination despite many publications suggesting academic tasks are aversive. Ackerman and

Gross (2005) evaluated measures of procrastination and several task related measures, such as difficulty, interest, clarity, and scope (time required to complete a task). The results of the study provided some evidence that students prefer clear instructions, small assignments, and incentives for initiating work (rather than completing). Notably, no differences were found between self-reported high and low procrastination groups on perceived difficulty or how time consuming an assignment was. It may be the case that all students find academic tasks aversive to some degree.

History of Procrastination

A student may wait until the final day to study, stay up all night, and pass a test the same morning. If a positive grade is received, a student may be more likely to repeat this pattern in the future. Indeed, students who procrastinate are likely to have a history of receiving reinforcement following procrastination (Bijou, et al., 1976). This is in line with research suggesting some students may procrastinate and still perform adequately (e.g., Seo, 2011). All studies on procrastination discussed thus far employ group designs that mask individual differences. It is likely that studies demonstrating academic performance is hindered by procrastination mask the effects of students who are not affected. Morris et al. (1978) compared the number of weekly units completed between students enrolled in either a self- or instructor-paced course. The results of the study demonstrated that self-paced students procrastinated more, completing more units toward the end of the semester. However, no differences in academic performance, course evaluations, or course withdrawal were found between courses.

Delayed Reinforcement

The literature indicates reinforcers lose value when they are delayed (Lattal, 2010; Skinner, 1938). The temporal distance between studying and a subsequent consequence is less

when studying occurs closer to a deadline. Response strength (cf. Killeen & Hall, 2001) will likely become greater when followed by more immediate consequences, such that procrastination will occur again in the future.

Mazur (1996) conducted two experimental studies on procrastination with pigeons. In Experiment 1, pigeons were presented a concurrent choice paradigm with differing fixed ratio (FR) requirements across a fixed and adjusting key. Pecks on a fixed key resulted in a 6 s delay followed by a FR 5 schedule requirement. Pecks on an adjusting key varied in delay and schedule requirements across conditions. Completion of the FR requirement regardless of initial choice did not result in an immediate reinforcer, instead a variable time 20 s schedule was initiated. An aim of the study was to identify indifference points between smaller-sooner and larger-later work requirements, similar to indifference points produced by discounting. Results of this experiment demonstrated that as the delay to the onset of the FR requirement increased, so did the FR schedule increase. That is, as the delay to initiate work increased the amount of work required increased.

In a second experiment both fixed and adjusting keys were programmed with identical FR requirements and differing delays. The onset of the FR schedule was delayed by 2 s on fixed key and 15 s on the adjusting key. Reinforcement was provided at the end of each link such that the total time between reinforcer delivery and choice responses were constant. Results of this experiment demonstrated pigeons selected the delayed FR schedule in 75% of trials. Together, these experiments demonstrated a preference for larger, more delayed work requirements. Similar findings were found with fixed interval schedules (Mazur, 1998) that may be more analogous to academic settings. Jarmolowicz et al. (2010) observed the patterns of weekly test-takers in undergraduate courses aggregating the cumulative number of tests taken over the course

of week. Their results show that group-level aggregates also result in Fixed Interval (FI) patterns of responding. This suggests that FI-like responding is common enough across student populations that group level analysis is similar to within-subject analysis.

Negative and Positive Reinforcement

The type of reinforcement following procrastination may be of some relevance. For some students, reinforcement may be subtractive in that an aversive task is removed or delayed. For others, it may be additive in that positive feedback is received. Procrastination is likely to be reinforced by receiving a grade that is sufficient to pass an assignment, even if the grade is lower than what the student is capable of achieving. Passing grades despite procrastination is likely to lead to procrastination in the future. Of course, there may be a combination of reinforcing effects (complexities of negative and positive reinforcement have been discussed elsewhere, see Baron & Galizio, 2005). McCown and Johnson (1989) assessed students daily by recording their level of anxiety and number of hours spent studying. Procrastinators reported high anxiety when an exam was announced that decreased within a couple of days. Notably, for all students, anxiety increased and decreased in proportion to study time. Results of the study demonstrated that as the exam neared procrastinators' anxiety increased and studying decreased in proportion, a reversal of the pattern onset of the course. It is not currently clear whether negative or positive reinforcement have differential effects on procrastination and some scholars have suggested the distinction is moot at the level of identifying causality (Baron & Galizio, 2005). Several studies have demonstrated delayed aversive events produce similar choice responding as delayed positive reinforcement (Deluty, 1978). That is, organisms will choose a smaller-sooner punisher over a larger-later punisher. This is analogous to discounting of positive reinforcers (Green &

Myerson, 2004). However, there may be practical utility in distinguishing negative versus positive reinforcement effects in designing treatments for procrastination.

Schedules of Reinforcement

Examining concurrent schedules (i.e., competing activities) outside of laboratory settings can prove daunting. Students face competing behavior under concurrent schedules of reinforcement that are likely to be more temporally close and of higher magnitude than academic related tasks. It is also unclear what discriminative stimuli may be present (or absent) that signals studying should occur. One possible explanation is that the passage of time can function as a discriminative stimulus. Although there is evidence to suggest some physical stimulus must be associated with the passage of time for a response to occur (Deibel et al., 2014).

When discussing fixed interval (FI) schedules to students in introductory behavior analysis courses, procrastination serves as a fine example. Mawhinney et al. (1971) evaluated study habits of students when quizzes were administered daily versus a large exam every three weeks. Study time per day was stable when daily quizzes were being administered but decreased sharply when quizzes were withdrawn. During the 3-week exam period daily study time slowly increased until a peak was reached immediately prior to the day of exams. However, this may not be a perfect representation of behavior under FI schedules considering all studying is reinforced following the exam. Traditionally, FI schedules have no programmed effects on responding prior to the interval criterion (Ferster & Skinner, 1957).

Chapter 4: Impulsivity and Delay Discounting as Procrastination

Impulsivity and procrastination from a cognitive standpoint have been interpreted as opposite ends of the same spectrum. Impulsiveness can be described as spending too little time before action whereas procrastination is spending too much time before action. However, several studies have found significant positive correlations between both constructs (Bennett & Bacon, 2019; Ferrari, 2004; Steel, 2007). Both are described as involving the misjudgment of the time required for tasks (Lay, 1986), failure to self-regulate (self-monitor), have positive and negative outcomes (i.e., active procrastination is akin to functional impulsivity), inhibit optimal responding, are self-defeating, and associated with anxiety (Steel, 2007). There is even some supporting evidence that procrastination and impulsivity are genetically linked (Gustavson et al., 2014). Ferrari (2004) posed the question is “procrastination and impulsivity two sides of the same coin?” and ultimately concluded that they are not opposites but one in the same. Although scholars share similar definitions of what constitutes impulsivity, measures of impulsivity, like procrastination, have heavily relied on self-report and correlational assertions.

Procrastination as defined by Mazur (1996), the choice of a larger-delayed work over a smaller-sooner work requirement, parallels a behavioral framework of impulsivity (e.g., Neef et al., 2005). Research on impulsivity within behavioral models is discussed as delay discounting, a tendency to discount outcomes that are further away in time. Delay discounting provides a behavioral measure of impulsivity based on choice responding rather than self-report.

A large body of research on impulsivity as discounting has proven more utilitarian than notions of impulsivity as cognitive failure. To study discounting, researchers typically arrange a series of concurrent choices between a smaller-sooner reward and a delayed but larger reward. The delay and magnitude of the larger reward varies until an indifference point is identified. For example, a participant may be asked to choose between receiving \$100 now or \$500 in six months. Selecting \$100 would be considered impulsive whereas selecting \$500 would be considered a demonstration of self-control.

Impulsive choice via discounting assessment has been shown to be predictive of a multitude of maladaptive behavior. Compared to controls, for example, gamblers have been shown to discount more steeply than non-gamblers (Dixon et al., 2003). Individuals who text-and-drive also discount more than those who do not (Hayashi et al., 2018). Smokers have higher discounting rates than non-smokers (Odum et al., 1999). Drug abusers also discount more steeply than matched controls (Johnson et al., 2010; Kirby et al., 1999) and may discount more steeply with more severe addiction (Kirby & Petry, 2004). Moreira and Barbosa (2019) recently conducted a systematic review consisting of 32 studies on delay discounting as a measure of impulsivity and found a strong association between trait impulsivity and discounting in addition to the predictive validity of discounting and maladaptive behavior. Three studies have compared procrastination as measured by personality scales to delay discounting finding that procrastinators discount hypothetical rewards more steeply than peers (de Groot & Dom, 2005; Yesilkayali, 2014; Youzhi & Jing, 2009). However, no study has assessed delay discounting to behavioral measures of procrastination.

Steel and König (2006) created a framework described as temporal motivation theory (TMT) that suggests procrastinators are impulsive and sensitive to delay to reinforcement. Steel

and König (2006) suggest the following mathematical expression can be used to account for procrastination.

$$\text{motivation} = (\text{expectancy} \cdot \text{value}) / (\text{impulsiveness} \cdot \text{delay})$$

The equation reads that motivation to perform a task is a function of the expected value of the task, probability of reward, and immediacy of reward. Additionally, satisfaction and need fulfillment are also variables that influence procrastination. Delay discounting serves as a more parsimonious explanation than TMT with actual rather than hypothetical mathematical models (Mazur, 1987).

Studies on delay discounting have shown that humans tend to shift their preference from a larger delayed reward to a smaller immediate reward as the amount of time to receive the

$$V = \frac{A}{1 + kD}$$

delayed reward increases (Rachlin & Green, 1972; Rachlin et al., 1991). Several studies have demonstrated this relation using the following hyperbolic model (Mazur, 1987; Myerson & Green, 1995).

In this equation V represents the subjective value of the optimal reward, A represents the objective amount of the optimal reward, D represents the delay before the optimal reward will be contacted, and k represents a free parameter which provides a quantitative value of the degree to which an individual discounts delayed rewards (i.e., discount rate). Using this model, there is always a point at which an individual will prefer the optimal choice, suboptimal, or demonstrate indifference between choices. The indifference point is identified as the point at which an individual will switch their preference from the optimal choice to the suboptimal choice. That is, the point at which a smaller-sooner reward is preferred over a larger-later reward.

Delay discounting in tandem with behavioral measures of procrastination (e.g., submission times) may provide more robust findings on the relationship between procrastination and impulsivity. Additionally, given the predictive validity of discounting and a variety of maladaptive behavior, discounting may serve as a tool to identify students who may be prone to procrastinate.

However, discounting tasks come with some possible limitations. Discounting tasks typically involve hypothetical monetary rewards. Thus, choices about monetary rewards may not be representative of other real-world decisions. However, numerous studies have found no significant differences between the use of actual or hypothetical rewards to assess discount rate (e.g., Madden et al., 2003).

Another limitation of discounting task is that they only assess two concurrent options, which typically do not resemble real-world scenarios. This is problematic conceptually. For example, Goldfield and Epstein (2002) had participants choose between an immediate healthy food versus a delayed unhealthy food. However, choosing to eat unhealthy food later does not prevent one from also eating healthy food now. That is, choices in natural settings are not mutually exclusive. This may not be as concerning on the assessment of procrastination because engagement in work substantially prior to a deadline would not constitute procrastination. That is, procrastination is more similar to mutually exclusive concurrent choice arrangements rather than free operant conditions.

Chapter 5: Interventions of Academic Procrastination

Interventions for academic procrastination are scarce (Zacks & Hen, 2018) with most interventions focusing on self-management (e.g., goal setting, planning,) and counseling to manage negative affect and cognition (Klingsieck, 2013). Cognitive interventions have focused on changing self-doubt, fear of failure, and personal beliefs about procrastination (Rozenthal & Carlbring, 2014) despite little evidence these variables are related (Steel, 2007). McDermott (2004) describes treating anxiety and altering irrational thoughts such as “I’m not motivated therefore I can’t work” that interfere with task completion. Cognitive behavior therapy (CBT) has been reported to be more effective (Balkis & Duru, 2007) and this may be due to a focus on specific thoughts about procrastination and the inclusion of techniques, such as self-monitoring, goal settings, and time-management (van Eerde & Klingsieck, 2018). For example, Özer et al. (2013) required participants to attend five 90 min sessions that covered how to identify personal patterns of procrastination, engage in productive thoughts, and assess their progress in managing their procrastination. Pre- and post-test measures of procrastination via self-report demonstrated students significantly decreased their procrastination. However, the use of self-report may limit the validity of these findings.

Several studies have aimed to use behavioral interventions that change environmental stimuli, prompt engagement, or impose additional contingencies on assignment completion. One study (Ziesat et al., 1978) restricted students study time to an empty session room on campus for 4 hr per day. Students were told they could not study at any other time or place. Although students could choose not to study during designated times there were no other

available activities in in the session room. Results demonstrated students study time increased compared to students who were able to schedule their own study time and place. Davis and Abbitt (2013) used Short Message Service (SMS, texts) to prompt students to complete quizzes each week. A SMS would be sent to the students' phone starting on the third day a quiz was available and the number of messages would increase exponentially each day after. To stop receiving SMS, students had to complete the quiz for the week. Davis and Abbit (2013) theorized that completing a quiz would function as negative reinforcement for escape of SMS notifications. Results of the study demonstrated slight decreases in procrastination and no effect on academic performance.

Extra credit and point dedications are common strategies to influence timely submissions. Powers et al. (1973) compared two groups of students either assigned to a test condition during which bonus points could be earned for early assignment submissions or a control group. The number of bonus points available decreased the closer students submitted to a deadline. Students in the test condition submitted more assignments early compared to the control condition. However, an adverse effect of receiving bonus points was evident in the performance of students on final exams. Students in the test-condition performed worse likely because they had accumulated enough extra credit to still pass the course despite not earning a high grade on the final. However, most studies on the use of point contingencies have shown no significant detriment to performance while producing lower levels of procrastination (Glick & Semb, 1978; Lu, 1976; Reiser, 1984; Ross & McBean, 1995). In one of the few behavior analytic interventions on procrastination, Johnson et al. (2011) informed students that the due date of a final exam would come two days sooner for each late submission. The authors suggested that a

reduction in the delay to an aversive stimulus reduced procrastination. Students also demonstrated higher quality work.

Self-monitoring has been demonstrated to be effective at managing weight loss (Burke et al., 2011), workplace productivity (Olson & Winchester, 2008), smoking cessation (Schmitz et al., 2005), and athletic performance (Lan & Morgan, 2003). Several studies have shown self-monitoring to improve academic performance (Blick & Test, 1987; Carr & Punzo, 1993; Crabtree et al., 2010) and homework accuracy (Falkenberg & Barbetta, 2013) for individuals with disabilities. Although self-regulatory failure is often cited as a cause of procrastination, it is surprising that self-monitoring is rarely an approach to reduce procrastination. However, several studies have shown that self-monitoring has positive effects on academic performance (Fabriz et al., 2014; Lan et al., 1993).

Chapter 6: Toward Behavioral Measures and Interventions for Procrastination

Current research on academic procrastination has focused on traditional education settings and primarily relied on the use of self-report measures, which have been shown to be highly inaccurate (Bernard et al., 1984). A growing population of distance learners warrants further research in online environments. The proposed study aims to add to the existing literature on prevalence of procrastination among online graduate students while using behavioral measures of academic performance and procrastination.

Although procrastination is often viewed as such, there is little support that procrastination is caused by personality traits or cognitive deficits (Steel, 2010). Rozenhal and Carlbring (2014) suggest procrastination is dominantly a behavioral problem that can differ in topography but shares the same underlying mechanism. In other words, procrastination involves a large class of responses with a shared function. Impulsivity as a form of temporal discounting has consistently been associated with procrastination from both cognitive and behavioral models of procrastination. While there have been attempts to evaluate the relation between impulsivity, procrastination, and discounting, no study has done so by relying exclusively on behavioral measures. The proposed study aims to bridge the gap in the current literature by evaluating the association between measures of discounting and procrastination. The study also aims to extend the current literature by evaluating the predictive validity of discounting on academic procrastination and performance.

A shared gap in the literature of both procrastination and impulsivity is a lack of interventions following measures of either behavior (or construct depending on the discipline).

The proposed study aims to evaluate the effectiveness of a multi-component intervention designed to reduce academic procrastination for online graduate students. Because courses in the current study are eight weeks in duration, it is not feasible to test one component of the intervention at a time. The rationale of using a packaged intervention is to increase the probability of producing a therapeutic effect. Additionally, while many psychological interventions require expertise in CBT, the current study aims to evaluate an intervention that can be readily administered by any instructor.

Chapter 7: Method

Overview

The following experiments reported here encompass distinct methods to evaluate factors of prevalence, prediction, and intervention for academic procrastination. In Study 1, the relationship between delays to complete assignments, an indicator of academic procrastination and academic performance was examined. Next, correspondence between assignment delays and impulsiveness as measured by delay discounting was evaluated as part of Study 2. Lastly, Study 3 involved an assessment of an intervention to decrease assignment delays.

General Procedures

Participants. All participants in the following studies were graduate students enrolled in distance learning courses in behavior analysis. All students were over the age of 18.

Dependent Measures

Latency to Submission. The latency between assignment availability (i.e., the time in which an assignment was accessible to a student) and submission was used as an indicator of procrastination. To derive a latency datum for each assignment submission, the date and time of an assignment submission was subtracted from the date and time of the assignment due date. These calculations were automatically programmed using Microsoft Excel® to limit human error using the following formula:

$$= ((\text{Deadline Date} + \text{Deadline Time}) - (\text{Open Date} + \text{Open Time})) * 24$$

The formula provides the exact amount of time (in minutes) an assignment was submitted prior to a deadline. All assignments had a 168 hr window to be completed from the moment an assignment was made available. The latency to submission was derived by subtracting the number of hours-prior-to-deadline from 168. This measure is accurate to the nearest minute with hours reported as a decimal number. For example, student submitting an assignment 8.43 hr prior to a deadline was equivalent to a latency of 159.56 hr.

Assignment Grades and Canvas. Individual assignment grades for each participant were extracted from Canvas learning management system (LMS) as part of a retrospective review of the data. Canvas is an online learning platform used by 50% of R1 designated universities in North America (Canvas LMS, n.d.). Canvas facilitates the administration of online courses and interaction between students and instructors. Canvas captures analytics on student engagement with course content, such as page views, view duration, and submission times.

Course Structure. All courses were 8-weeks in duration and covered behavior analytic content as part of a graduate program designed to prepare students for certification in the field. Each course was designed similarly with identical assignment due dates and availability. The type of assignments (e.g., writing, presentation, test) administered across each course were also identical. Each course required students to submit discussion posts, article summaries or presentations, and end the week with a quiz. Each course contained the following late work policy within their respective syllabi: No late work will be accepted for any reason unless arrangements are made with the instructor 24 business hours prior to the assignment due date.

Chapter 8: Prevalence of Procrastination on Academic Performance

The purpose of Study 1 was to assess the prevalence of late submissions and evaluate correlation between latency to submit assignments and academic performance.

Participants and Exclusionary Criteria

Twenty-six students participated in Study 1, three males and 23 females. Students were enrolled in an 8-week course covering foundational content in behavior analysis. Students were excluded from analysis if they withdrew from the course or required an accommodation as identified by Student Disability Services. Based on these criteria no student was excluded from Study 1.

Psychometric Measure

Pearson Correlation Analyses were calculated to determine the strength of correlations between submission time and grades. Analyses were conducted at the class level and within subgroups of the class.

Interrater Agreement

All data collected for Study 1 were extracted from Canvas. Thus, a permanent record of the data was accessible during and beyond the completion of the course. A primary and secondary observer with independent access to the course extracted submission time, submission date, due date, due time, and quiz grade for each submitted assignment in the course. Each observer had access to the course via their affiliation with the graduate program and neither observer was the instructor of the course. Each observer recorded 100% of data into separate Microsoft Excel® files. Data were compared across each file in two ways. First, a visual

inspection of each data cell was conducted to identify differences. Second, average and sum formulas were used across both files across each data set. Identical outputs from each formula indicated 100% agreement. Initial agreement scores were 99% across all measures. However, because Canvas provided a permanent record of the data, if the average or sum output did not match each observer extracted the data from Canvas into their individual file again and the formulas were reassessed. This process resulted in 100% agreement.

Procedure

Students and instructors were not provided information regarding the study and instructors were expected to teach as usual. The instructor of the course was aware of the research team and the measures being collected. Additionally, researchers were listed in the course roster with the label of teaching assistant. Researchers extracted data from Canvas for each student's quiz submission time and grade each week of the course. No differentiation was made between late versus on-time submissions. However, if a student did not submit a quiz the datum was omitted from the week's analysis rather than input a zero for the grade or latency. Because a quiz was administered each week, a total of eight sets of submissions (one for each week) were analyzed separately and cumulatively.

Results

The course provided 208 opportunities for the class as whole to submit a quiz. Five quizzes were excluded from the analysis due to two being excused by the instructor and three not submitted by students. In total, 203 submissions were included in the following analyses. Figure 1 displays the number of quizzes submitted within a given number of hours prior to the deadline. As time elapsed the number of quizzes submitted increased across subsequent time ranges. Overall, 148 (74%) quizzes were submitted with less than 24 hours to the deadline. Fifty-two

submissions (25%) were submitted within the last two hours of a deadline and three submissions (0.01%) were submitted after a deadline. The three late submissions are included within the 168 hr column in Figure 1.

The right panel of Figure 1 displays 148 submissions within the 24 hr prior to the deadline. A similar submission pattern occurs within the final 24 hr as was observed across the 168 hr time range.

Pearson’s correlation coefficients between latency and grade for each assignment are shown in Table 1. These data include the submission of all students ($n = 26$) with individual correlations calculated across each quiz and as a total. Four quizzes resulted in weak negative correlations (1, 6, 7, 8). Four quizzes demonstrated near zero correspondence between the measures.

Table 1

Overall Class Analysis

Quiz	Avg. Latency	Avg. Grade	r	p
Quiz 1	150.30	84.20	-0.31	.129
Quiz 2	155.64	82.29	0.01	.943
Quiz 3	145.29	86.12	0.06	.785
Quiz 4	150.34	93.95	-0.04	.844
Quiz 5	151.73	85.04	0.08	.691
Quiz 6	152.32	92.36	-0.22	.299
Quiz 7	145.61	84.42	-0.18	.392
Quiz 8	142.67	91.94	-0.32	.127
All	149.24	87.54	-0.08	.236

Note. All correlations were non-significant ($p > 0.05$).

Table 2 demonstrates Pearson’s correlation coefficient for students ranked the highest and lowest 15% ($n = 8$) based on latency to submit quizzes. This analysis aims to account for

students whose academic performance may not be affected by their level of latency to submit assignments.

Table 2

High Versus Low Performers Class Analysis

Quiz	Low Latency		High Latency		All		<i>r</i>	<i>p</i>
	Avg. Latency	Avg. Grade	Avg. Latency	Avg. Grade	Avg. Latency	Avg. Grade		
Quiz 1	98.61	86.50	167.18	81.75	132.89	84.20	-0.28	.504
Quiz 2	113.30	90.75	167.75	72.88	155.64	82.29	-0.06	.895
Quiz 3	84.73	81.88	167.48	85.50	145.29	86.12	-0.11	.791
Quiz 4	89.66	93.70	167.82	88.25	150.34	93.95	-0.35	.392
Quiz 5	94.60	80.25	167.73	70.38	151.73	85.04	-0.24	.569
Quiz 6	100.33	96.25	167.42	86.88	152.32	92.36	-0.34	.417
Quiz 7	95.85	88.38	167.24	85.38	145.61	84.42	-0.18	.671
Quiz 8	73.45	96.00	167.83	87.75	142.67	91.94	-0.40	.324
All	93.82	89.21	170.60	81.91	132.21	85.56	-0.22	0.07
All (10%)	84.65	91.02	171.74	79.58	128.20	85.30	-0.31	0.03

Note. All correlations were non-significant ($p > 0.05$) for analyses involving highest and lowest 15% of students based on average latency to submit. The bottom row includes results of overall analysis of highest and lowest 10% of students ($p > 0.03$)

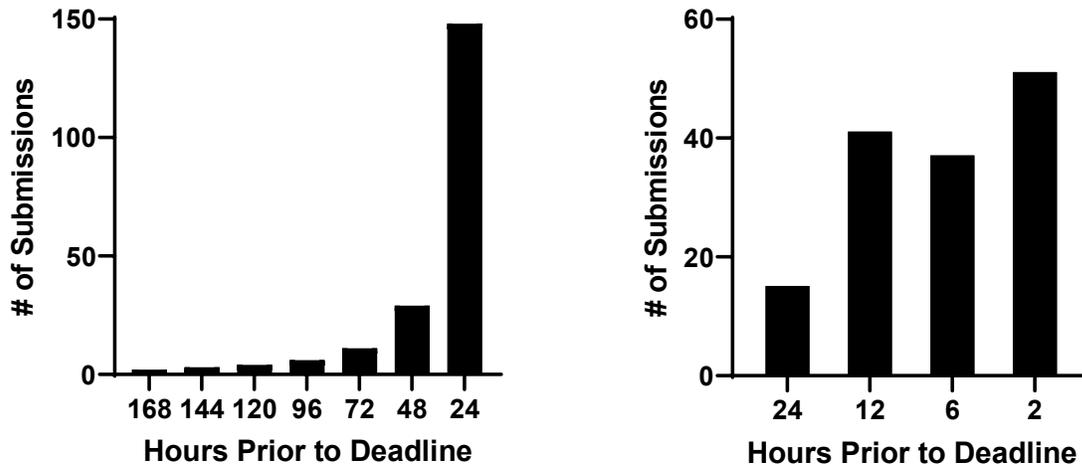


Figure 1. The left panel displays the number of submissions in the hours prior to the deadline. For example, 148 quizzes were submitted within the final 24 hours a quiz was due. The right panel displays the number of submissions during the final 24 hours to assignment deadline.

The correlations between grade and latency in Table 2 are derived from students who ranked as either the highest or lowest 15th percentile of their class based on latency to submit assignments. A weak correlation is considered to be $r < 0.20$, moderate correlations are considered to vary around $r = 0.30$, and strong correlations are considered to vary at $r = 0.50$ and above (Cohen, 1988). Weak to moderate negative correlations were identified across all quizzes. While week-by-week statistical analyses did not result in significant findings overall analysis demonstrated a suggestive trend ($p = 0.07$). Thus, further stratifying the population to include only the highest and lowest 10th of students ($n = 6$) is also reported. The purpose of including the 10% group is not to demonstrate a statistical significance is possible, but to show the extent of deviation required to demonstrate a significant p -value.

Figure 2 displays graphical representations of Quiz 1, 3, 5, and 6 from Table 1. These quizzes were selected as representative samples of the graphical patterns produced by all quizzes. Linear regression lines are plotted to demonstrate the relationship between grade and submission time, plotted as hours prior to deadline. Residual plots for each graph on the left column are plotted on the right column. The mean hours prior to deadline was 17.70, 22.71, 16.27, and 15.68 for Quiz 1, 3, 5, and 6 respectively. The standard deviation of the residuals was 32.55, 29.41, 34.08, 34.67 respectively for Quiz 1, 3, 5, and 6.

Within-subject analyses were conducted to evaluate if submission latency influenced performance on a weekly basis for individual students. The variance of all submission times for each student was used to rank each student's level of variability between weeks. The average variance per student was 570.23 (range = 0.99 – 3072.50).

Figure 3 displays data demonstrating correspondence between student's average submission latency and variability of their submissions. Variability was determined as the variance of each student's data set (standard deviation is an equivalent measure and plotted on the x-axis of Figure 3). Latency and variability were found to be highly correlated $r(24) = .72, p = < .001$.

Discussion

The clearest finding of Study 1 corroborates the notion that students, in general, tend to submit assignments the closer in time they reach a deadline, producing scalloped pattern of group responses. This finding is consistent with previous literature (Levy & Ramim, 2012). Figure 1 also displayed submission times within the final 24 hr prior to a deadline that did not demonstrate a common scallop pattern. However, given the limited data available it is difficult to make any assertions about how submission patterns may change daily. Overall, findings of Study

I suggest a weak to moderate negative association exists between latency to submit and academic performance. These results are in line with previous studies that suggest strong relationships between academic performance and submission delays (Elvers et al., 2003). However, it cannot be concluded that a statistically significant relationship exists based on the data presented. Selecting the highest and lowest 10% of students revealed a strong relationship between latency and grades however this analysis involved a sample of only 48 submission across six students. Furthermore, only half these students would appear to have high latencies. Although statistically significant findings were not consistently demonstrated these results do not eliminate the social significance of improving academic performance and reducing procrastination and related behavior when detrimental to the student. Future research is warranted to evaluate methods that can more efficiently identify students who may engage in later submissions and could benefit from support from instructors.

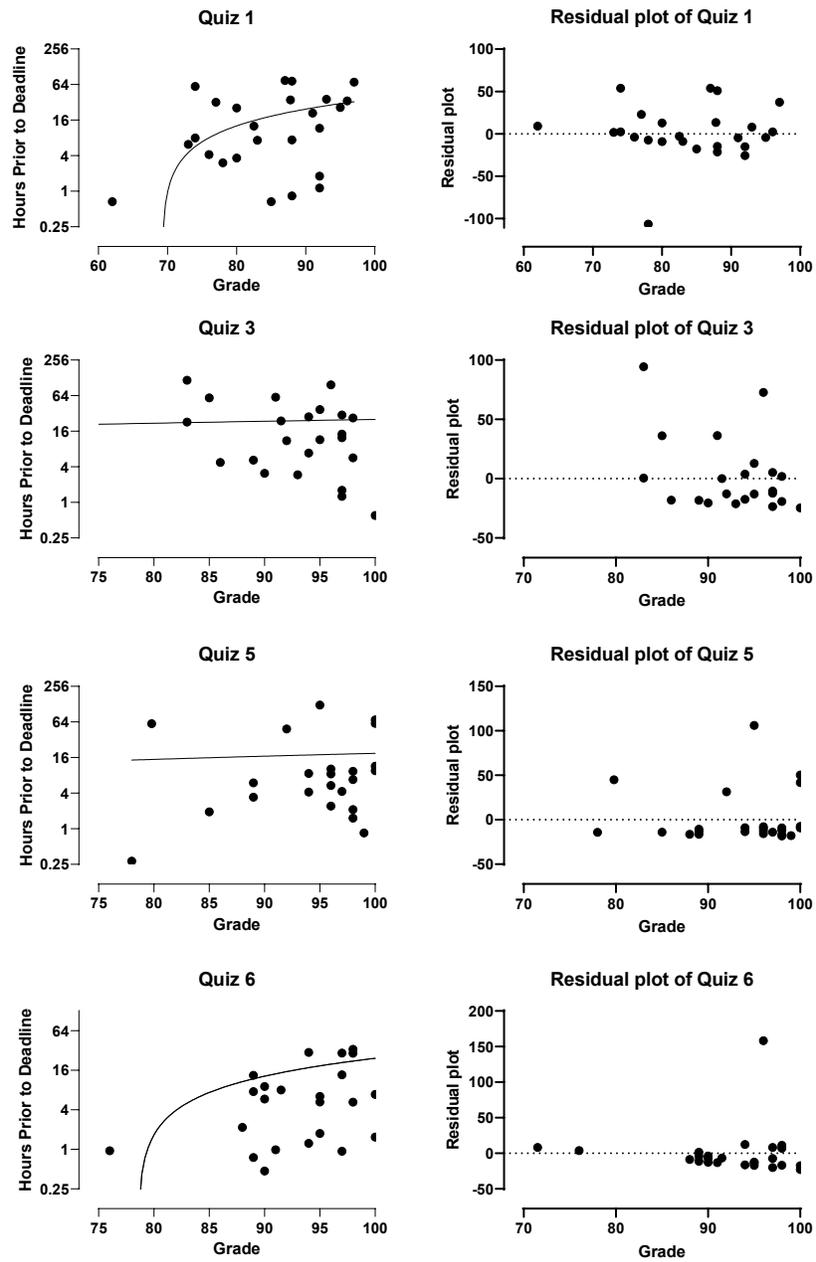


Figure 2. Linear regression lines are plotted to demonstrate the overall relationship between submissions and grades.

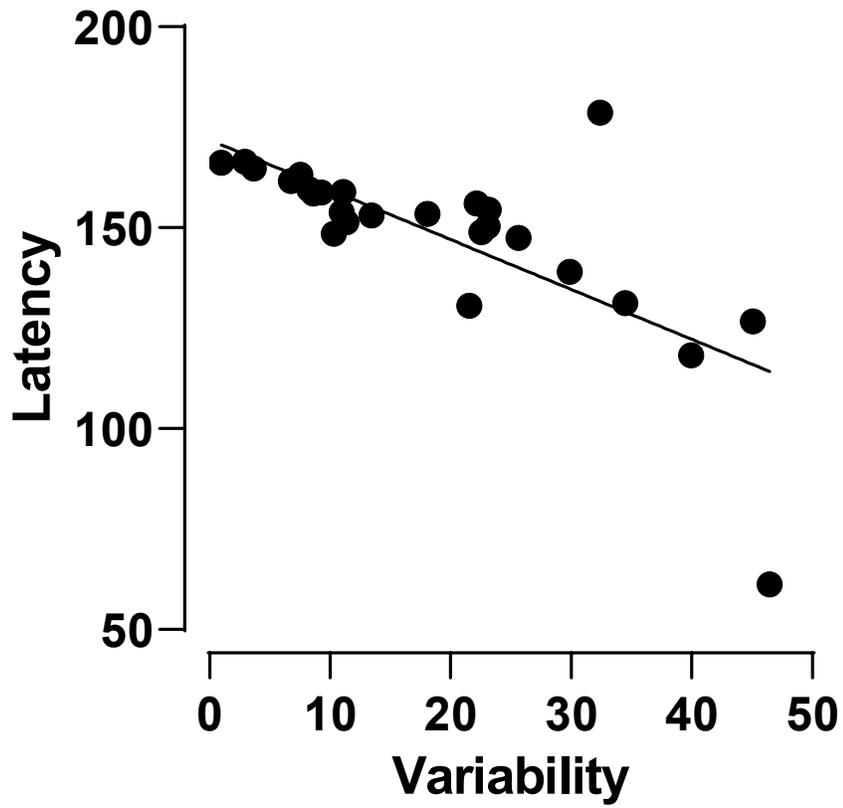


Figure 3. Variability measured by calculating the standard deviation of each students' latencies of quiz submissions.

Despite the analyses conducted in Study 1 a direction of causality remains unclear. That is, do students who submit earlier perform better or do high performers simply submit earlier? One potential way to answer this question is to rank students by grade rather than latency. Ranking students by grade emphasizes grade as a predictor of submission latency. However, a similar statistical output of $r = -0.20$, $p = .11$ was found in comparison to ranking students by latency ($r = -0.22$, $p = .07$, see Table 2) despite a vastly different set of students serving as inputs. Future studies may warrant more translational, human-laboratory approaches to investigating direction of causality. For example, Ziesat et al. (1978) required students to attend study sessions on-campus during designated hours of the week. Students did not have access to study materials elsewhere. This arrangement allowed the researchers more control in their experiment than is typically allotted in educational settings. Similar arrangements could be made in online settings.

An unintentional finding of this study was that of the role of variability and submission delays. Students who submitted assignments with a greater degree of variable delays across weeks tended to have greater average latencies to submit assignments overall. Inversely, students who submit assignments on a consistent schedule each week tend to consistently submit earlier than their peers. Such variability may also have contributed to the variability in weak positive and negative correlations demonstrated across each quiz as seen in Table 1. It is possible that student's tendency to have low and high latencies correspond with the direction of the correlational outputs. One potential strategy to reduce submission delays may be to help students establish routines that involve academic tasks. Related to academic procrastination, these findings suggest procrastinators are erratic, submitting early one week and late the next, whereas non-procrastinators tend to submit at the same time each week. Furthermore, if students with

high latencies are presumed as procrastinators, they do not procrastinate consistently. Variability may serve as an important dependent variable in future studies involving detecting students at risk for procrastination or poor academic performance.

Limitations

It is unknown the extent to which quiz difficulty or other course requirements impacted assignment submissions. It is possible that some quizzes may have required more reading, some content was more difficult, or the instructor failed to prepare the students adequately. However, these potential differences were likely experienced by all students. Individual within-subject differences likely play a larger factor. For example, some students have more clinical experience or education within the field, such as holding entry-level certifications (e.g., Registered Behavior Technician, Board Certified Assistant Behavior Analyst) while others may not. Some students may be more familiar with course content or have access to external resources (e.g., clinical supervisors willing to help their studies). These students may be better positioned to complete assignments earlier and therefore submit quizzes earlier. Secondary analyses with only the highest and lowest 15th and 10th percentile of students were conducted to attempt to account for students who may not have engaged in high latencies (or performed poorly). This analysis revealed more moderate effect sizes similar to previous research (e.g., Elvers et al., 2003). Further studies are warranted to determine more efficient methods to identify students with high latencies to submit assignments that impact performance and if such measures fit well with a concept of academic procrastination.

The choice of selecting to measure latency of quiz submissions over alternative assignments was made because a quiz was the most consistent available assignment when considering task difficulty. Additionally, quizzes are beneficial because it allows more direct

comparisons to students who may be enrolled in the course in the future or other courses with similarly designed quizzes (e.g., difficulty, number of questions, allotted time). The quiz was the final assignment students were required to complete prior to advancing to the next weeks content. Thus, finishing the quiz meant the student had also completed all other academic tasks. This is beneficial in that students could delay completing a writing assignment to complete a discussion post or vice-versa, however both were required to be completed prior to the quiz.

There are numerous uncontrolled variables in education and online research that likely contribute heavily to the findings of Study 1. For example, online students vary widely in age, socioeconomic status, job requirements, and family commitments. Anecdotally, online instructors may meet with a father of two and then a recent high-school graduate the next. It is unknown to what extent extraneous variables impacted the results of the study.

Finally, the duration allotted to students, 168 hr, may not be conducive to a study on latency and grades. That is, 168 hr may not be an ample amount of time to detect significant effects. Previous research has not been restricted to 8-week courses as was the case in the present study. No known study has conducted a parametric analysis on academic delays and assignments. Such a study may reveal larger later deadlines effect behavior differentially. Despite the short duration of the course the students were exposed to consistent patterns that is in line with previous research suggesting small effect sizes and high *p*-values are common when comparing latency to grade (Rotenstein et al., 2009).

Chapter 9: Delay Discounting and Procrastination

The purpose of Study 2 was to evaluate correspondence between submission delays and outcomes of a delay discounting task.

Participants and Exclusionary Criteria

Twenty-six students participated in Study 2, four males and twenty-two females. Participant characteristics and course enrollment status were identical to Study 1. Students were excluded from the analysis if they withdrew from the course or required an accommodation as identified by Student Disability Services. Additionally, unsystematic responses to the delay discounting task resulted in withdrawal of the student's data from analysis. Unsystematic responses were defined as a) failing to switch between smaller-sooner to larger-later within a delay value (e.g., selecting the same response for the entire task), b) switching multiple times between smaller and larger rewards within a given delay value, c) failing to complete the task (cf. Johnson & Bickel, 2008). Six students, 26%, met these criteria and were withdrawn from further analysis. This percentage is consistent with previous literature on nonsystematic responding for discounting tasks (Rung et al., 2018).

Interrater Agreement

Procedures for IOA were identical to Study 1. A secondary observer independently extracted responses to the discounting tasks into a Microsoft Excel® file. Primary and secondary files were evaluated for correspondence for 100% of the data similarly to Study 1. Interrater agreement was 100%.

Procedure

A discounting task was developed based on procedures described by Rachlin et al. (1991). The task was then computerized using Qualtrics software and based on the procedures described by Rung et al. (2018) and via personal communication (J. Rung, personal communication, November 30, 2019). The discounting task was administered to students via an in-class extra credit assignment with a link provided to the discounting task. The task could be completed in a web browser on a desktop computer or mobile device. Students were offered five extra credit points towards their overall course grade for completing the task. Students who did not want to complete the task had an opportunity to engage in an alternative activity for extra credit upon the students request, but no student requested this alternative option.

The discounting task was divided into nine sections with a total of 177 questions. The average time to complete the task was about three minutes. The first section asked respondents to provide their gender, ethnicity, and monthly salary. The second section provided instructions on how to complete the task and specified that all questions and decisions made were hypothetical. The final seven sections required participants to make choices between a smaller, but sooner monetary reward or a larger delayed monetary reward. For example, the first question in section three asked “Would you rather have \$1000 now or \$1000 in 1 week.” The following question asked, “Would you rather have \$990 now or \$1000 in 1 week.” The monetary values assessed included \$1000, \$990, \$920, \$850, \$800, \$750, \$700, \$650, \$650, \$550, \$500, \$450, \$400, \$350, \$300, \$250, \$200, \$150, \$100, \$80, \$60, \$40, \$20, \$10, \$5, and \$1. Sections four through nine were identical to section three except that the delay value (i.e., week) assessed changed across sections. The delays assessed were 1 Week, 1 Month, 6 Months, 1 Year, 3 Years, and 10 Years. Discounting assessments are either conducted in a titrating (random) or fixed sequence, however,

researchers have shown no systematic difference between discounting curves produced by either sequence (Rodzon et al., 2011). All questions in the present study were presented in a fixed sequence (e.g., Dixon et al., 2018; Rachlin et al., 1991) to reduce duration of the task and potential attrition (i.e., incomplete tasks)

The latency of each student's quiz submission was recorded identically to Study 1. Following the end of the course students were categorized into high and low latency groups based on individual average assignment submission latencies ($n = 6$). Discounting curves between groups were compared in addition to correlational analyses between pAUC scores, latency, and grades.

Results

On average students completed the discounting task within 6.87 min (range = 3.16 – 11.78 min). Figure 4 displays individual discounting curves for students in the high and low latency groups. A steeper curve is representative of a higher degree of discounting (i.e., impulsivity) and tendency to select smaller-sooner rewards over larger-later rewards. The high latency group demonstrated steeper discounting curves and overall smaller k values than the low latency group. Figure 5 displays group comparisons for both students stratified into high and low latency groups on the left panel. This graph reflects individual data of the high and low latency groups with the high latency group demonstrating steeper discounting curves. The right panel of Figure 5 displays data across all students split evenly across both high and low latency groups ($n = 20$). The group aggregated data displays smaller differences between groups despite the high latency group producing a slightly steeper discounting curve.

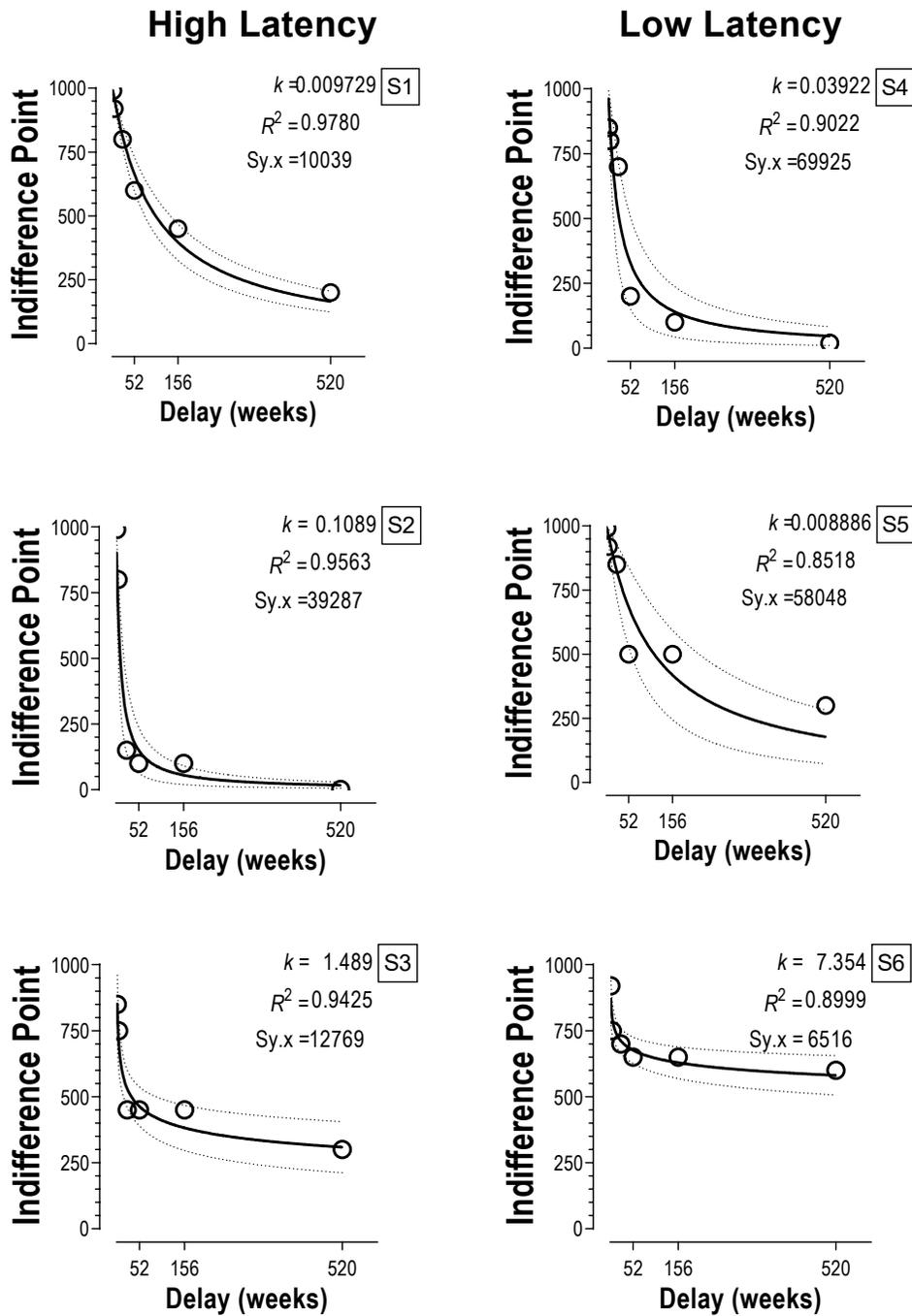


Figure 4. The left column displays data of three students, representative of the high latency group. The right column displays data of three students, representative of the low latency.

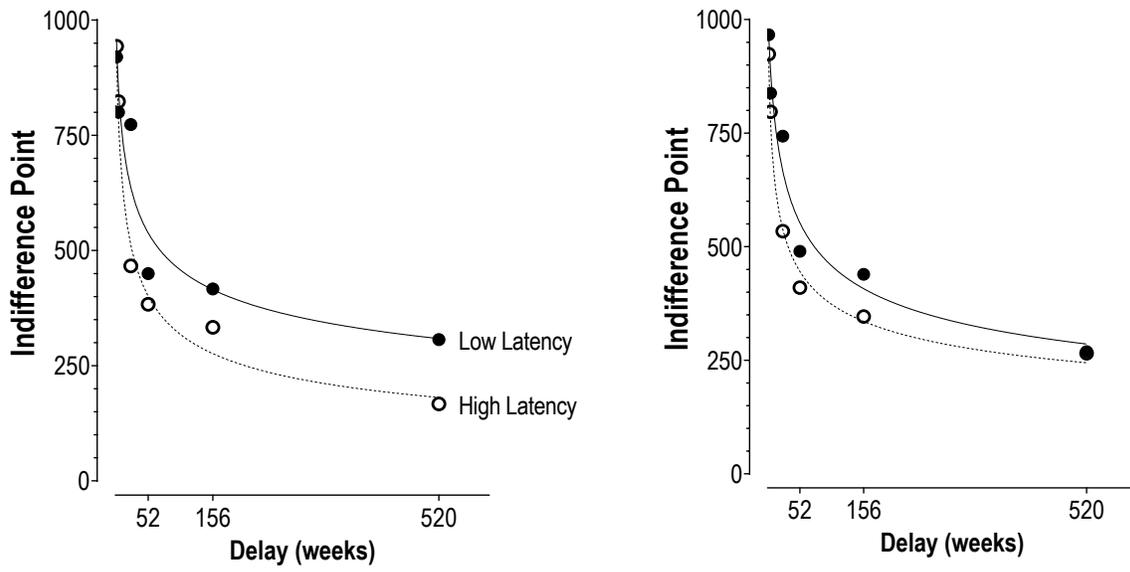


Figure 5. These graphs are discounting curves for high and low latency groups. The left panel demonstrates data for the top and bottom 15% of students ranked by their average latency to submit assignments. The right panel displays data for all students.

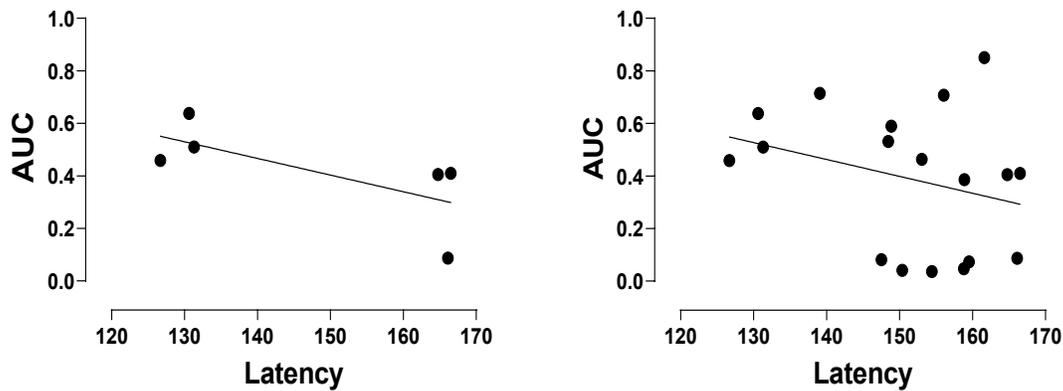


Figure 6. These graphs demonstrate correspondence between discounting as proportion of AUC and latency to submit assignments.

Correspondence between *p*AUC scores and latency to submit assignments is demonstrated in Figure 6. Each datum is an individual student’s average latency to submit an assignment plotted on the x-axis and AUC representative of individual discounting curves plotted on the y-axis. The left panel displays data representative of the highest and lowest 15% of students as ranked by latency. Student’s AUC scores were moderately negatively correlated with latency ($r = 0.69, p = .13$). Although common to not report the data for the group, the right panel displays data for all students in the course that completed the discounting task successfully. The slope of the linear regression model remains fairly stable across both panels. Correspondence between AUC and latency for all students was weakly negatively correlated ($r = 0.29, p = .23$).

Discussion

The purpose of Study 2 was to assess the role of discounting and submission delays given that discounting is a measure of impulsivity, a trait that has been previously highly correlated with academic procrastination. The results of Study 2 suggest students who submit assignments later in the week tend to discount more steeply. This finding is consistent with previous research

suggesting academic procrastination is associated with measures of temporal discounting (Yesilkayali, 2014). Closer examination of student discounting curves in low and high latency groups demonstrate two exceptions for each group. S3 in the high latency group demonstrated a discounting curve in-line with that of the low latency group. One possible explanation is the difference in salaries among members of the high latency group. S3 reported a salary triple of S1 and double of S2. Green et al. (1996) have demonstrated that income may influence how individuals respond to monetary-based discounting tasks. Future research may benefit from equalizing income across participants or developing discounting tasks with questions based on academic scenarios rather than money. For example, Manwaring et al. (2011) developed a series of discounting tasks where units of food or activities were presented rather than money. A discounting task that requires selection between units of academic tasks may be more relevant to a study on academic behavior and remove income as an uncontrolled variable. There is some evidence to suggest non-monetary outcomes may be discounted more than monetary given the high degree of liquidity (generalized condition reinforcers, in general) associated with money. Thus, it is possible that a discounting task associated with grades as outcomes and engagement in academic tasks (i.e., now versus later) may produce more predictive and discriminated outcomes among students.

A secondary aim of Study 2 was to evaluate if a discounting task would be useful for instructors to use to identify students who tend to submit assignments later rather than sooner. Considering the small sample size in this study, further research is warranted to assess the utility of discounting on a wider scale. In tandem with the results of Study 1, it is plausible that instructors can be alerted earlier in the semester to provide more attention to a select few students by examining submission times or administering discounting tasks early in a semester (or prior

to). The discounting task used in the present study was programmed and distributed by a research team rather than instructors. Programming, distribution, and analysis of student responses are skills likely outside the scope of many instructors practice. Additionally, even with highly trained instructors, many forms of distribution require costly software (e.g., Qualtrics, Inquisit). Although free options may exist, they may not allow for quick data analysis or provide a user-friendly interface for respondents. Further research is warranted to develop ready-to-distribute discounting tasks that produce results in a format that is easy for an instructor or aid to interpret and are cost-effective.

Chapter 10: Intervention to Reduce Procrastination

The purpose of Study 3 was to evaluate an intervention to reduce submission delays with college students. A goal of this intervention was that it would be easy for instructors or teaching aids to administer

Participants and Exclusionary Criteria

Sixty-four students participated in Study 3, five males and 49 females. Participant characteristics and course enrollment status were similar to Study 1. Students were excluded from the analysis if they withdrew from a course or required an accommodation as identified by Student Disability Services.

Interrater Agreement and Procedural Fidelity

Procedures for IOA were identical to Study 1 and calculated for 50% of extracted data. Agreement scores were 100%. Procedural fidelity of the intervention was assessed for 38% of opportunities across each course (8 weeks of instruction for each course). Procedural fidelity scores for each component of the intervention was 100%.

Procedure

A multiple baseline design across cohorts was implemented to evaluate the effect of an intervention designed to decrease academic procrastination. Each cohort was enrolled in two consecutive eight-week courses such that students experienced baseline and intervention phases across courses. Like Study 2, instructors of the courses were aware of the research team and the measures being collected and researchers were listed in the course roster as teaching assistants.

Baseline

During baseline, no instructions were provided to instructors and the research team did not interact with students. Researchers continued to extract data from Canvas similarly to Study 2.

Intervention

The intervention consisted of three components, a) announcements, b) point-contingency, and c) a self-monitoring assignment. Prior to the intervention, students were provided instructions regarding the point-contingency and self-monitoring assignments.

Announcements. Instructors of each course were instructed to provide announcements to students regarding upcoming deadlines throughout the week. Instructors were provided templates and shown how to automate announcements. That is, instructors could create announcements in advance to be automatically delivered to students at a future date. Announcements were sent directly to students three times per week and were permanently displayed within the LMS (See Appendix A).

Point-contingency. A point contingency was described to students at the onset of the first intervention week. Students were told they would receive up to five extra percentage points on quizzes contingent on timely submissions. Students who submitted 48, 36, 24, and 12 hr prior to a deadline received 5, 4, 3, and 2 extra percentage points respectively for the submission. For example, if a student submitted an assignment 50 hr prior to a deadline and scored a 95% on the assignment, an additional 5% was applied to the assignment for a total score of 100%. The extra points were applied by a researcher serving as a teaching assistant and any concerns noted by students regarding extra points were directed to the teaching assistant.

Self-monitoring. A self-monitoring form (see Appendix B) was provided to students to log their interactions with course material throughout the week. Students were provided instructions on how to complete the form, descriptions on the benefits of self-monitoring, and deadlines to submit their forms twice per week. Using the self-monitoring form was optional as there were no programmed contingencies for failing to submit the form. A researcher serving as a teaching assistant marked submissions of the self-monitoring form as complete or incomplete each week and addressed questions from students about the self-monitoring form.

Social Validity Questionnaire

A social validity questionnaire was distributed to instructors and students to assess the acceptability and feasibility of the procedures (See Appendix C and D). The questionnaires presented 17 questions for instructors and 20 questions to students using a 7-point Likert-type scale. The questionnaires were created using Qualtrics and emailed directly to instructors and students. Social validity scores for the instructor questionnaire ranged from 3 to 7 (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree). Two of three instructors responded to the questionnaire. Instructors rated the intervention as easy to understand and effective, beneficial and appropriate for college students, and did not interfere with their teaching practice. The results of the questionnaire are presented in Table 3 below.

Table 3*Social Validity Scores - Instructors*

	Question	Average Score
1	The intervention would be acceptable for college aged students.	7
2	The intervention had a positive effect on submission times.	6
3	I would suggest the use of the intervention to other instructors.	6
4	The intervention would not result in negative side effects to students.	7
5	The intervention would be appropriate for a diverse group of students.	5.5
6	I like the procedures used in the intervention.	6.5
7	The intervention was easy to implement.	6
8	Overall the intervention would be beneficial to most students.	6.5
9	The intervention demonstrates a good way to address student procrastination.	6
10	The intervention improved overall student's timeliness with completing assignments.	5.5
11	Most instructors would find the procedures appropriate for college aged students.	6.5
12	The intervention was a fair way to address student timeliness.	6.5
13	The intervention interfered with my teaching.	1.5
14	The intervention was easy to understand.	7
15	I would continue using components of intervention in future courses.	6.5
16	Academic procrastination is an important issue to address.	5.5
17	The intervention lead to noticeable changes in submission times.	5

Note. Average social validity score for instructors who responded to the social validity questionnaire.

Results of the social validity survey for students are presented in Table 4. Only four of forty students who experienced both baseline and intervention phases responded to the student questionnaire. The low return rate may be due to the questionnaire being delivered after students had completed the courses rather than within the semester. Additionally, there was no incentive programmed for students to complete the questionnaire. Thus, responses to the social validity survey may not be representative of all students. Students reported each component of the intervention was appropriate for college-aged students and would suggest future instructors use

similar strategies. Students also rated the instructors for each component as easy to understand. The point-contingency and announcements components were as having a positive impact on performance whereas self-monitoring was rated as neither having a positive or negative impact on performance. Time management was rated as an important issue to address and anecdotally, students reported that the intervention improved their completion of assignments leading to reduced workloads during weekends.

Results

All results across cohorts are displayed in Figure 7 in a multiple baseline design. The hours prior to deadline are graphed on the y-axis rather than latency to magnify differentiation. The dashed lines represent a change in course content. The university closed on-campus courses and transitioned to fully remote courses during Week 10 due to the Covid-19 epidemic; this is noted on Figure 7 as CV19.

Cohort 1 displayed small intervals between submission time and deadline during baseline ($M = 10.72$ hr) followed by an immediate increase during intervention ($M = 28.90$ hr). On average, students in Cohort 1 submitted assignments 27.18 hr in advance during the final three weeks of the intervention, an increase of 16.46 hr. Cohort 2 initially displayed large intervals between submission time and deadline during baseline ($M = 37.10$) prior to a gradual decrease as the first course concluded and second course commenced (Week 9). Cohort 2 displayed a gradual increase during intervention ($M = 28.26$ hr) although overall displayed a decrease in interval between submission and deadline of 8.84 hr. The final four baseline weeks for Cohort 2 averaged 21.11 hr. In comparison to the final four intervention weeks, Cohort 2 averaged 32.88 hr, an increase of 11.77 hr. The intervention was not assessed with Cohort 3 however data for Cohort

Table 4*Social Validity Scores - Students*

	Question	Average Score
1	Time management is an important issue to address.	7
2	The extra credit opportunities were appropriate for the course.	6.5
3	The announcement reminders were appropriate for the course.	7
4	The self-monitoring tool was appropriate for the course.	5.5
5	The self-monitoring form had a positive impact on my performance in the course.	2
6	The extra credit opportunities had a positive impact on my performance in the course.	6
7	The announcement reminders had a positive impact on my performance in the course.	6.5
8	I like the instructional strategies used in the course.	6
9	The extra credit instructions were easy to understand.	7
10	The self-monitoring instructions were easy to understand.	6.5
11	The announcement reminders were easy to understand.	7
12	Overall, the strategies used in the course were beneficial.	6.5
13	The strategies used in this course helped me be more timely with my assignment submissions.	6
14	I would want to see the strategies used in the course in future courses.	6
15	The quiz extra credit opportunity is a good way to address timeliness.	7
16	The extra credit opportunities had a positive effect on my grades.	6.5
17	The strategies used in this course were a fair way to address student timeliness.	6.5
18	The extra credit opportunity had a negative effect on my performance in the course.	1
19	The announcement reminders had a negative effect on my performance in the course.	1
20	The self-monitoring form had a negative effect on my performance in the course.	2.5

Note. Average social validity score for students who responded to the social validity questionnaire.

3 were collected concurrently with Cohort 1 and 2. During the first 10 weeks of the semester Cohort 3 displayed stable baseline rates during the implementation of the intervention for Cohort 1 ($M = 27.65$ hr). Cohort 3 displayed gradual improvements in submission times during the final six weeks of the semester without any intervention components being implemented ($M = 37.17$ hr).

Figure 8 displays data for students who on average submitted assignments within 10 hr prior to deadlines during baseline. These students were identified as procrastinators. The number of students that met this criterion were 15, 4, and 5 for Cohorts 1, 2, and 3 respectively. Thus, Figure 8 excludes students who may have reached a ceiling regarding how quickly they could submit an assignment and therefore could not have feasibly improved during the intervention. Baseline performance for these students is notably lower across all Cohorts. On average, Cohort 1 submitted assignments 3.45 hr prior to deadlines during baseline and 20.30 hr during intervention (final four weeks), an increase of 16.85 hr. On average, Cohort 2 submitted assignments 3.02 hr prior to deadlines during baseline and 6.85 hr (final four weeks) during intervention, an increase of 3.83 hr.

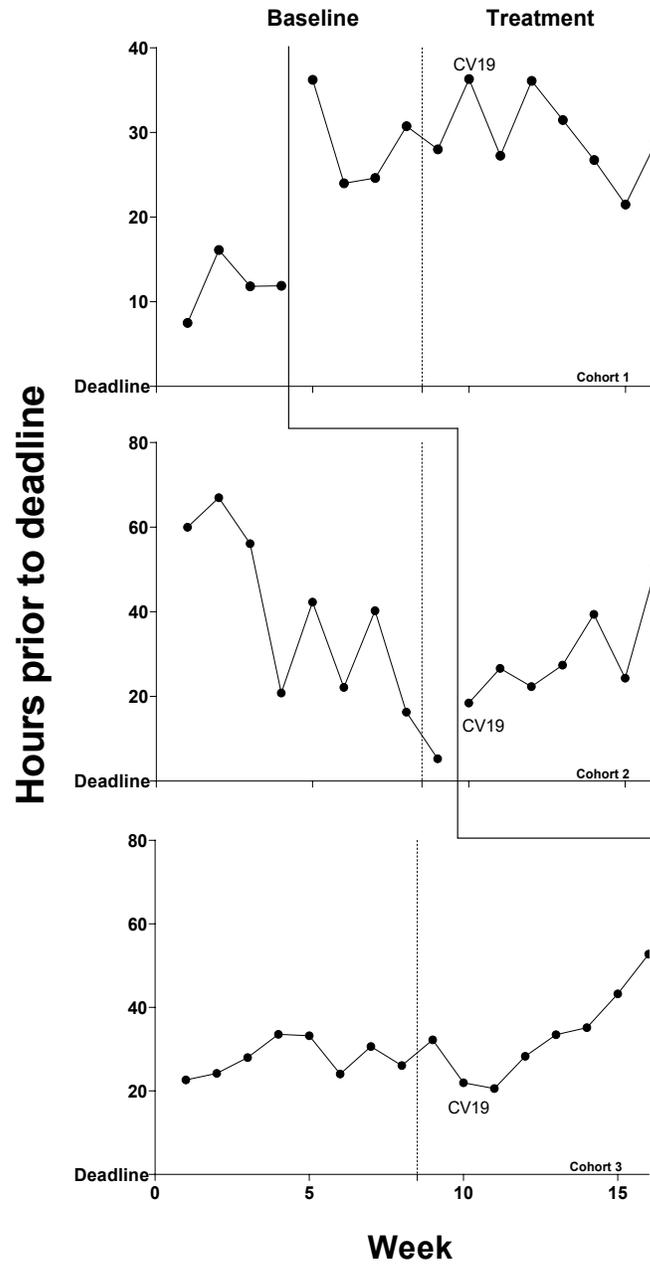


Figure 7. The y-axis displays the average time prior to a deadline to submit an assignment. The x-axis shows the current module (week) of the course. Dashed phase lines demonstrate a change in course.

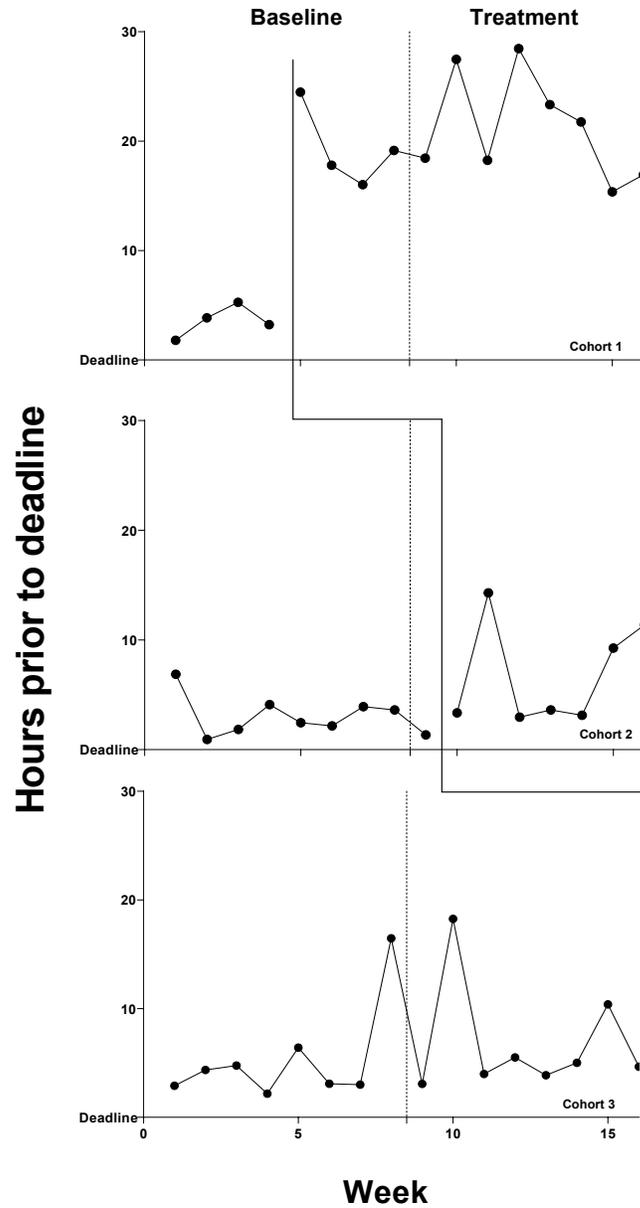


Figure 8. The y-axis displays the average time prior to a deadline to submit an assignment. The x-axis shows the current module (week) of the course. Dashed phase lines demonstrate a change in course. This graph only includes students who displayed high latencies to submit assignments during baseline.

Individual representative student data for Cohorts 1 and 2 are presented in Figures 9 and 10. Figure 9 displays students paired with their matched-ranked counterpart based on baseline latency to submit assignments. That is, the lowest ranked student from Cohort 1 was paired with the lowest ranked student from Cohort 2. It was not possible to pair each student from Cohort 1 with a student from Cohort 2 due to differing class sizes. Thus, the final eight panels in Figure 10 are presented in an AB design and include only students in Cohort 1.

An alternative view of the results of Study 3 is presented in Figure 11 as pre- and post-intervention performance. Twenty-five students across Cohorts 1 and 2 (left panels) were identified as procrastinators. Twenty-three of 25 (92%) students identified as procrastinators displayed at least marginal improvement during intervention and one student performed markedly worse. Thirteen students identified as non-procrastinators were identified across Cohorts 1 and 2. Four students performed worse during the intervention phase, six students performed better, and four students displayed little differentiation.

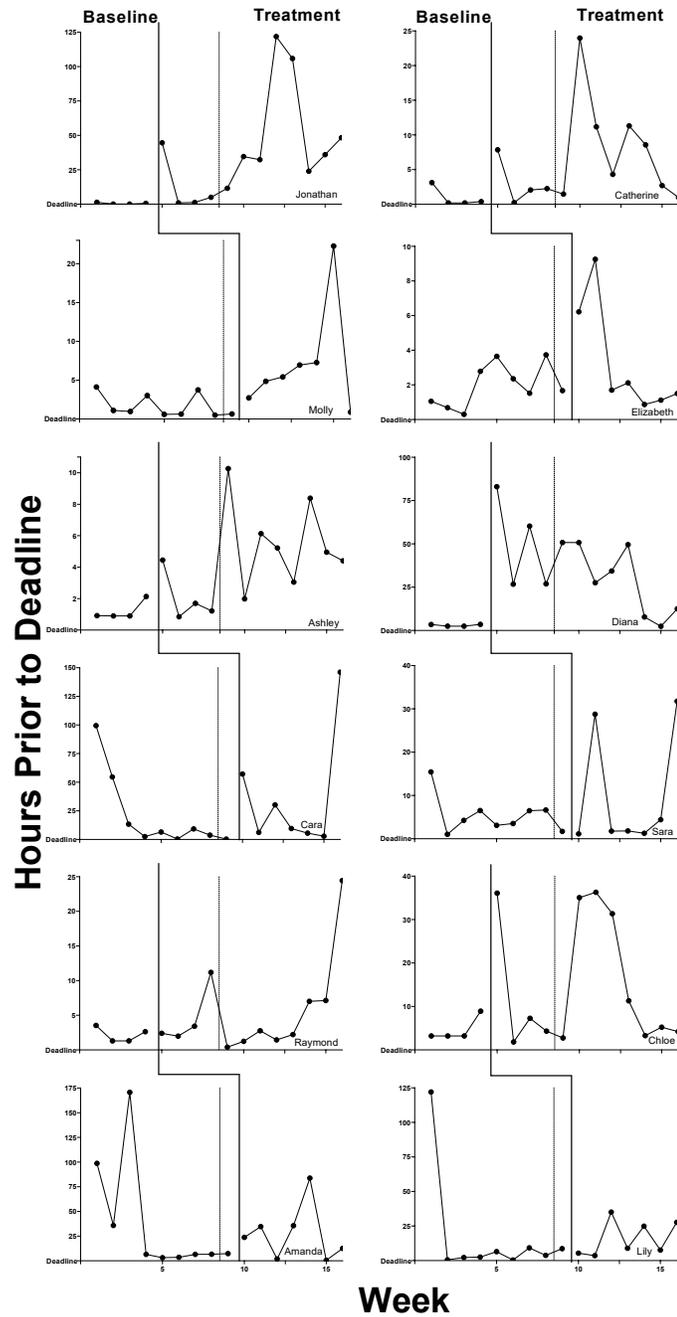


Figure 9. These graphs demonstrate individual student data across students from Cohorts 1 and 2. The y-axis displays the average time prior to a deadline to submit an assignment. The x-axis shows the current module (week) of the course. Dashed phase lines demonstrate a change in course.

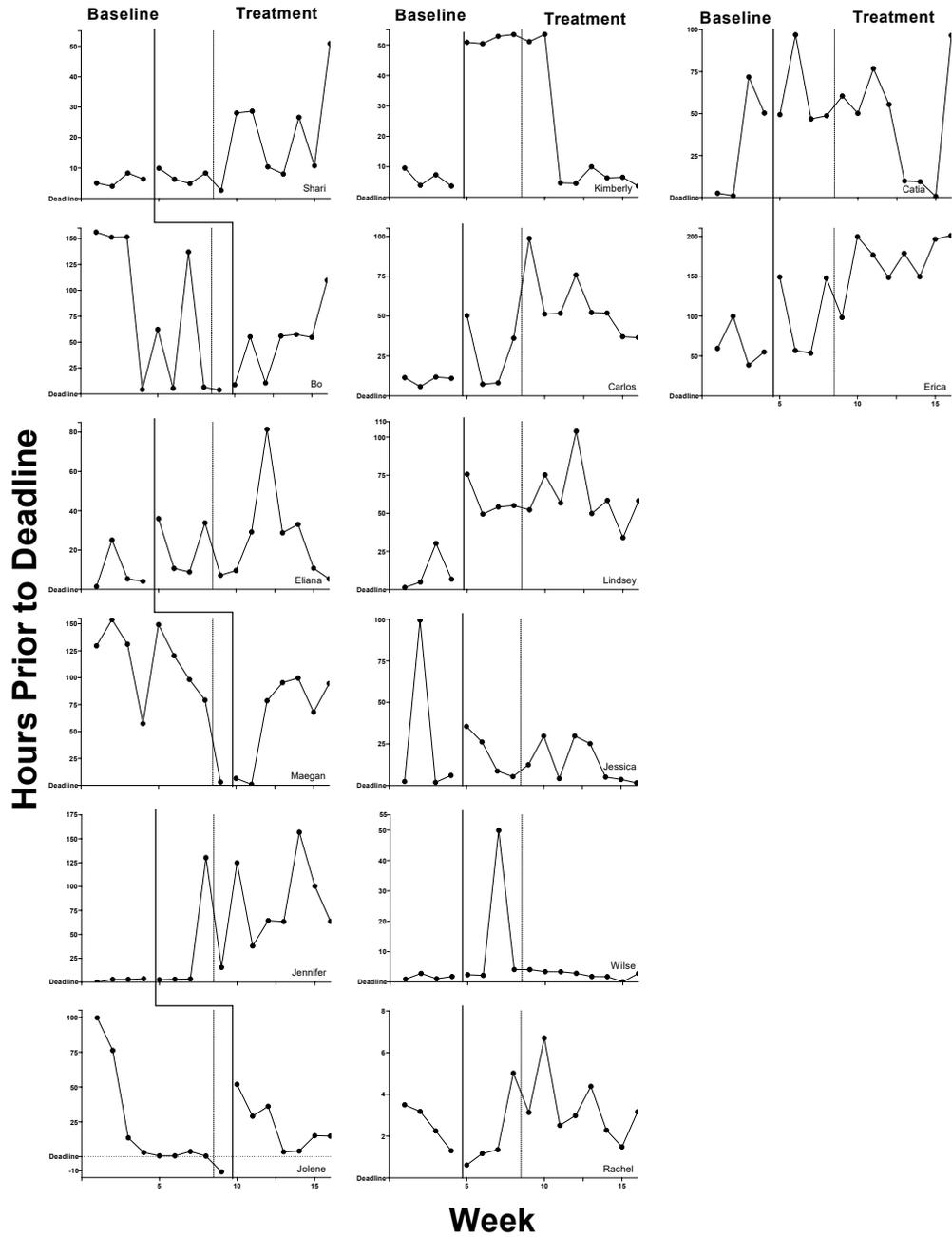


Figure 10. These graphs demonstrate individual student data across students from Cohorts 1 and 2 in the leftmost column of panels. The second and third column display data only for students from Cohort 1. The y-axis displays the average time prior to a deadline to submit an assignment. The x-axis shows the current module (week) of the course. Dashed phase lines demonstrate a change in course.

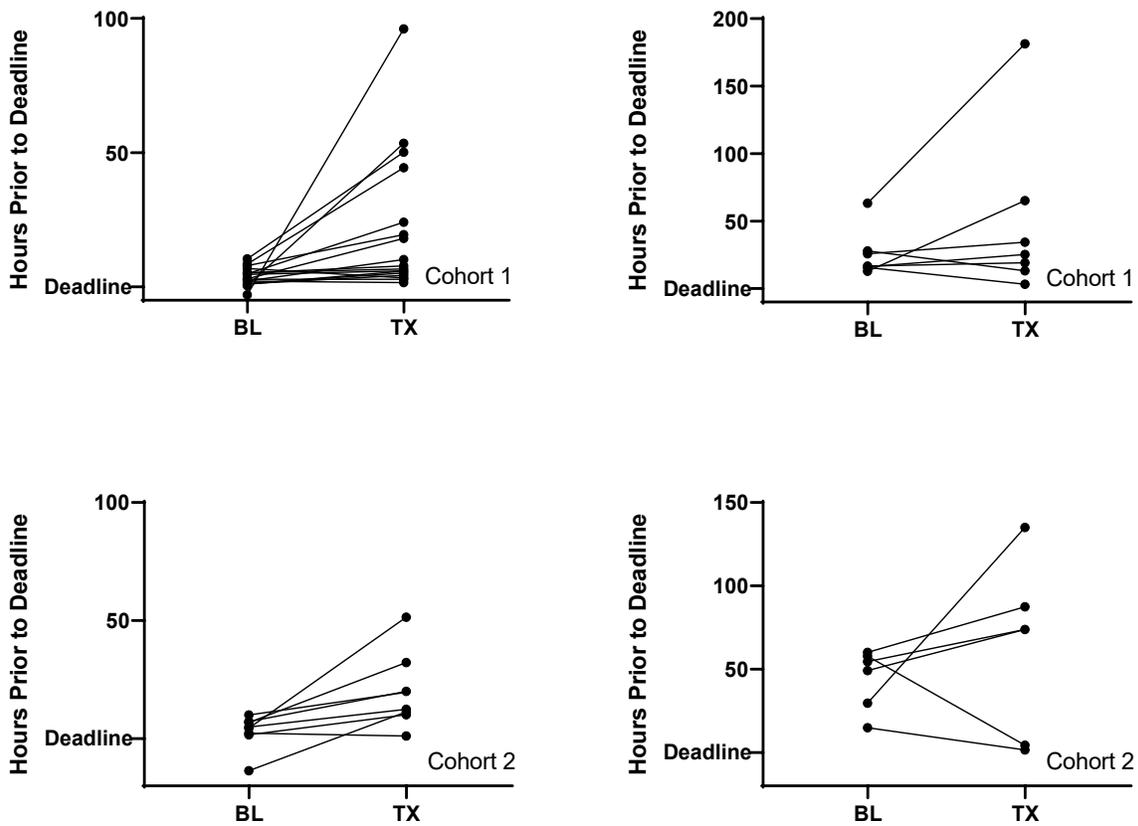


Figure 11. The left panels display data for students who on average submitted within 10 hr prior to deadlines during baseline. The right panels display data for students who submitted more than 10 hr prior to deadline. Each pair of data represent an individual student.

The top panels of Figure 12 and 13 display the number of submissions in 24-hr intervals after students were given access to complete the quiz for Cohorts 1 and 2 respectively. The bottom panels display the number of students whom would have earned extra credit during baseline phase if extra credit was provided and actual extra credit earned during intervention. Figure 12 displays data for Cohort 1. Cohort 1 submitted 62 quizzes during the final 24 hours of a deadline during intervention in comparison to 87 during baseline. The number of submissions across all 24-hour intervals increased during the intervention phase. During baseline, the total number of submissions that would have resulted in extra credit was 20 in comparison to 44 during intervention.

Figure 13 displays data for Cohort 2. Cohort 2 submitted 34 quizzes during the final 24 hours of a deadline during the intervention phase in comparison to 40 during baseline. During baseline, the total number of submissions that would have resulted in extra credit was 20 in comparison to 44 during intervention. During baseline, the total number of submissions that would have resulted in extra credit was 12 in comparison to 26 during intervention.

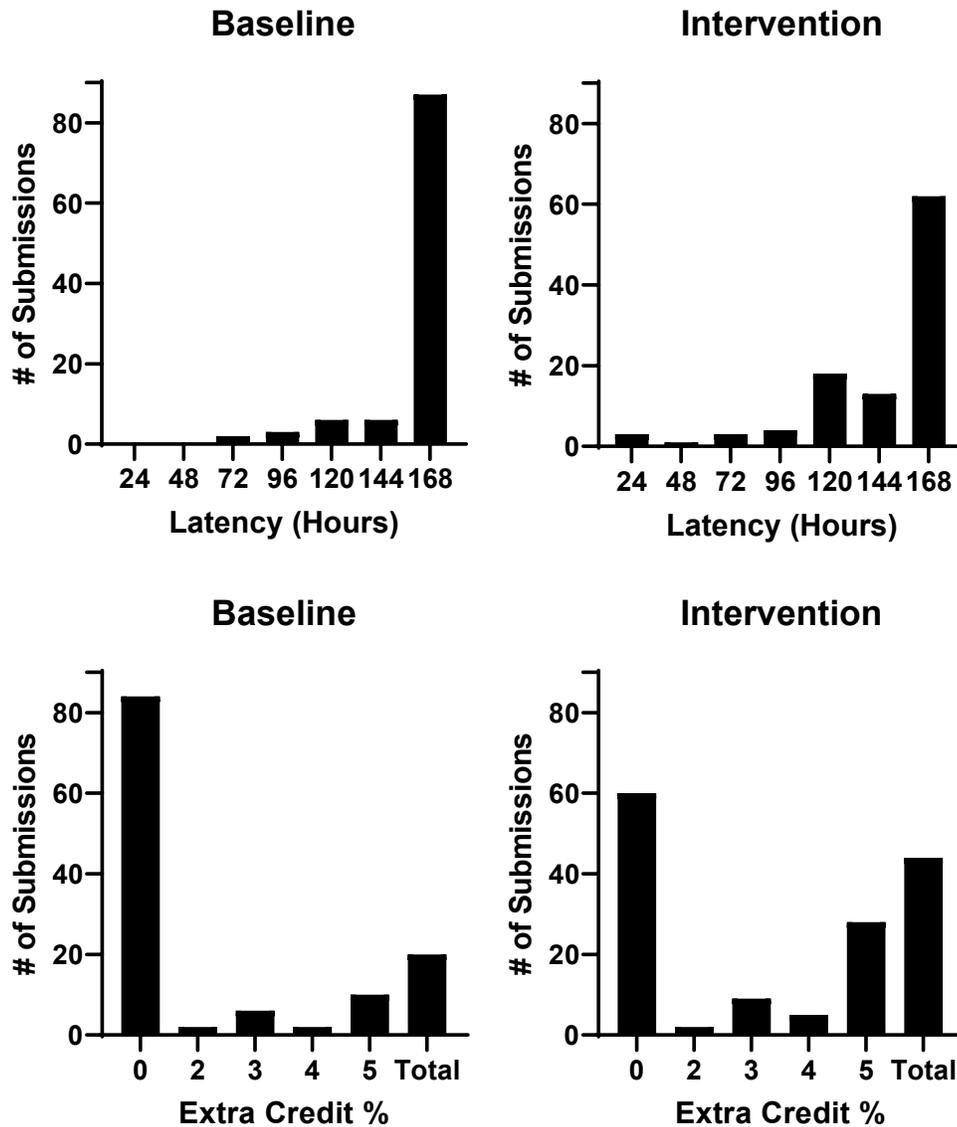


Figure 12. The top panels display the total number of submissions after a 24-hour interval with 168 hr being the maximum allotted number of hours to submit assignments. The bottom panels display the number of submissions that would have resulted in extra credit during baseline and were earned during intervention.

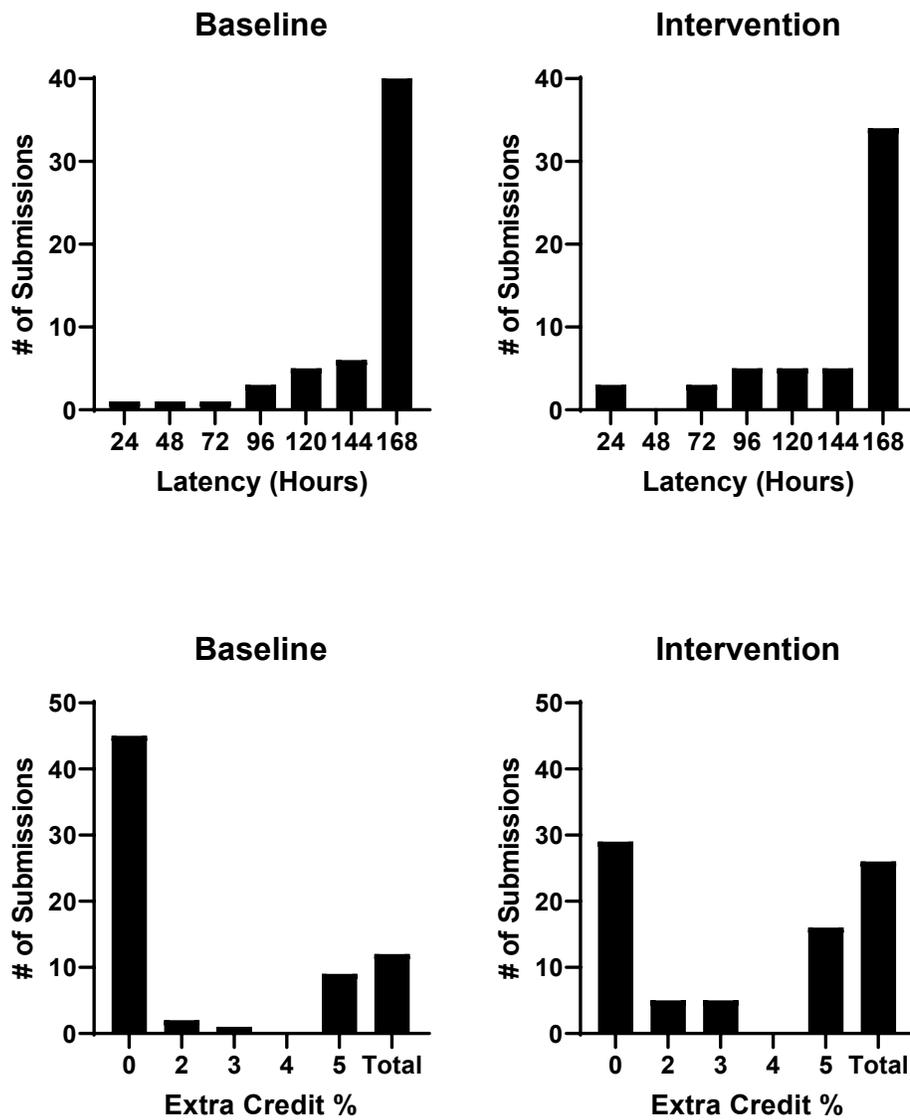


Figure 13. The top panels display the total number of submissions after a 24-hour interval with 168 hr being the maximum allotted number of hours to submit assignments. The bottom panels display the number of submissions that would have resulted in extra credit during baseline and were earned during intervention.

Discussion

The purpose of Study 3 was to evaluate an intervention to decrease latency to submit assignments. Although students were tasked with several types of assignments, quizzes were chosen for three reasons. First, quizzes were the final assignment students were required to complete prior to moving to the next week's module. Thus, it was theorized that targeting quiz submission times may also improve submission times of all prerequisite academic tasks. Second, quizzes were a common assignment across all courses and required of all students every week, providing a consistent measure throughout the semester. Lastly, quizzes allowed researchers to equate difficulty and point value more feasibly than alternative assignments. However, the current study did not measure completion of other assignments. Future research may examine how assignment deadlines influence engagement; in particular how response allocation of academic behavior changes with differing class contingencies.

The results of Study 3 suggest the intervention improved student submission times for most students. Cohort 1 immediately improved their submission times following the intervention. Concurrently, Cohort 2 regressed from an initial high baseline while the intervention was in effect for Cohort 1. This pattern of responding across cohorts suggest a strong intervention effect for Cohort 1. However, a multiple baseline design calls for replicability across staggered phases. Cohort 2 displayed a reversal in trend from baseline to intervention resulting in the total average submission time across both phases to be similar. Because Cohort 3 displayed a similar increase in submission times as Cohort 2, despite no intervention being in place, it is likely that extraneous variables may have influenced responding for Cohort 2 and 3. However, there are several anecdotal explanations for Cohort 3's performance. First, the instructor for the course used announcements similarly to the announcements programmed in the

intervention component without being directed to do so. The instructor was highly interactive and supportive of students and had research experience in improving student engagement. It is possible that the instructor employed other techniques that facilitated early submissions. This may be especially true given that the pattern of responding displayed by Cohort 3, improving each subsequent week, was unusual. Lastly, it was discovered post-hoc that students were provided choices in how to progress through the week's content. Previous research with children has demonstrated choice can increase adaptive behavior (e.g., Brandt, et al. 2015). Future researchers may be interested in assessing how allowing students to select their own assignments or learning modality may impact submission times. For example, McWilliams (2015) has described a democratic syllabus, giving students opportunities to select lessons, discussions, and deadlines of their choosing.

Research in education can be difficult given the number of potential extraneous variables. Research in online environments may be even more susceptible to uncontrolled circumstances. The present study is likely as flawed in this regard as those that have come before. There are several unknown factors that may have impacted students in the present study. Students naturally have differing experiences with the academic content, however, the students in Study 3 also had differing amounts of time as a graduate student. Students in Cohort 1 and 2 were second year students with only two and one semester remaining prior to graduation. Cohort 3 were currently in their first semester. Cohort 2's initial high baseline may have been due to their superior academic experience, but this was not the case. One may expect the freshman Cohort 3 to perform worse than their peers, but not only did they display higher baseline submission times, they also improved without experiencing the intervention. Courses were also different and the

range in difficulty, although subjectively similar, may have influenced submission times.

However, this is more likely an issue of validity within a cohort rather than across cohorts.

Not all students elected to complete the self-monitoring activity as it was optional. About half of students in each Cohort completed the self-monitoring activity. It is unclear whether students who completed the activity benefited from it or were students who performed well already. Anecdotally, one student reported that the self-monitoring activity was unnecessary for them and was time consuming although it may help others. The self-monitoring form was developed to be comprehensive and adaptable rather than quick, a possible oversight that may have caused a low number of students using the tool. However, it is unclear what the average duration of completion was. Further study of self-monitoring as an intervention in isolation may be beneficial to further refine tools that can facilitate student's academic engagement. If the self-monitoring tool was a burden it may have negatively affected submission times or imposed unnecessary stress for students who voluntarily used the tool given the other requirements for each module.

A global pandemic involving Covid-19 took place during the study that may have impacted student's abilities to complete academic tasks. It is unknown to what extent Covid-19 impacted student submissions. Although the university that hosted the courses did not close, students enrolled in the study may have been in any part of the United States. Some states enacted policies shutting down employment, healthcare facilities, and other resources that may have impacted students. It is possible that students who were unable to work during this time had more time to dedicate to school. Inversely, it is possible that stressors due to the pandemic may have negatively impacted students.

Latency to submit assignments was the primary measure and selected as a measure of procrastination. However, there are many different reasons why a student may delay submitting an assignment and submission time may not mean that an assignment was just completed. For example, students could wait to take the quiz later in the week to maximize their studying. Thus, initiation of an assignment, such as studying for a quiz, rather than submission may be a better measure of procrastination. However, in the present study, quizzes were completed shortly after they were initiated. That is, students could not pause the task and complete it later or complete the task and submit it later. Although this does not alleviate the question as to whether students may wait to study until the last minute, it may be closer in line with a measure of initiation. Further, waiting to study until the last minute is akin to theories of active procrastination which currently have little to no empirical support.

A class-wide intervention was used in this study to provide an exemplar of a real-world implementation of strategies to reduce submission times. However, precision may be lost when working with groups rather than individuals. The individual data sets presented in Figures 9 and 10 were extracted from initially aggregated data. Although most of these data demonstrate positive effects of the intervention it may be more beneficial to design interventions easily deployable to individual students. However, there are challenges in targeting individual students with certain interventions while not providing similar opportunities for all in the academic context. For example, universities may have restrictions in allowing one student to earn credit or receive extra prompts but not others. Ultimately, the results of Study 3 demonstrated that although not all students may have benefited substantially, it may be worth the effort to help students who do benefit.

Instructors may also benefit from the intervention. Early submissions allow instructors more time to grade assignments. Figures 12 and 13 demonstrated how submissions during intervention were allocated across days of the week. Instructors may be able to provide faster turn-around times, have less pressure to grade, and may provide more elaborate feedback. In turn, these behaviors may lead to higher student satisfaction with the instructor. However, further research is warranted to evaluate the impact of reducing grading latency may have on students' perceptions of the instructor. Grades and feedback may be the primary consequences associated with academic tasks, it may be of some importance to understand how delaying these consequences effect students' performance or perceptions of quality instruction. Anecdotally, the instructors noted that the intervention was easy to implement and had noticeable positive effects on students' submissions. The instructors also informed the research team that they learned about different features of the LMS that they will continue to use as a function of their participation. Although not recorded, the total training time on average for instructors was about 30 min and easily conducted over the phone.

Chapter 11: General Discussion

The present series of studies aimed to evaluate academic procrastination at large, how measures of discounting related to submission latencies, and if it were possible to influence submission latencies with an easily deployable intervention. The results of Study 1 suggest students tend to submit assignments close to deadlines. This finding corresponds with previous research suggesting scallop-like patterns of submissions are the norm (Howell et al., 2006). Study 1 also demonstrated some moderate correspondence between submission latencies and academic performance. Surprisingly, variability was found to be a predictor of submission latency. Although the sample size of Study 1 warrants a larger-scaled study on the predictive validity of variable submission times on procrastination. Further research is required to determine to what extent do submission times effect performance and what other stressors are related to late submissions (e.g., poor sleep).

The results of Study 2 demonstrated students who discounted more steeply tended to submit assignments later in the week. However, this finding was less prominent (but still present) when whole group comparisons were conducted rather than selecting the top and bottom 15% of students based on their average latency. While discounting tasks may reveal information about individuals, they remain less useful if unable to facilitate behavior change. Further research is warranted to refine discounting methodology as applied to college students to help instructors quickly identify students who may benefit from additional attention or other interventions.

The results of Study 3 suggest instructors may be able to influence students to submit assignments more quickly and that strategies to do so do not require much time or effort.

Additionally, submitting assignments earlier may be beneficial to the student's performance and the instructor's ability to provide feedback to students. The intervention consisted of a multi-component package which was selected to increase the likelihood of improving submission times. However, it is unknown which component of the intervention was most likely to be beneficial. A component analysis was not able to be conducted given the short duration of courses. Identifying which components of the intervention were most beneficial could lead to more effective strategies in increasing the latency between submission and the deadline as a way of treating academic procrastination.

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Appendices

Appendix A: Sample Announcements

Monday Announcement

Hello Class,

This week you have the following readings and assignments to complete.

[Introduction Video Link]

Readings

Reading one – [Link to assignment]

Reading two – [Link to assignment]

Lecture Videos

Lecture 1 – [Link to assignment]

Lecture 2 – [Link to assignment]

Assignments

Assignment – Due Date – [Link to assignment]

Assignment – Due Date – [Link to assignment]

Other Notes/Tips

[Notes/Tips]

Wednesday Announcement

Hello Class,

Just a friendly reminder that your **Initial Discussion Post** for the week is due today by 11:59PM!

Remember to do your best in providing thoughtful discourse and responding to peers.

[link to assignment]

Your **self-monitoring form is due today** by 11:59PM with sections Monday through Wednesday completed.

[link to assignment]

Saturday Announcement

Hello Class,

Just a reminder that your Quiz is due Sunday at 11:59PM. Don't try and crunch to the end!

Students who submit and take exams earlier tend to perform better!

[link to assignment 1]

Appendix B: Sample Daily Monitoring Self-Monitoring Task

Monday		
Studying	Yes No	Comments
I viewed the week's introductory video	Yes	Your dog was really funny!
I spent 30 min reviewing instructions for assignments due this week	Yes	Same assignments from last week, it's all good.
I spent 30 min viewing lecture presentations	No	I totally forgot! My friend from Arkansas came to visit and well. Yeah.
I asked the instructor any questions I had about assignments	N/A	I didn't have any questions this week.
<i>*You may create your own goal here.</i>	N/A	
Organization	Yes No	Comments
I checked Canvas for new announcements	Yes	They go straight to my phone with the Canvas App!
I added due dates for assignments to my calendar/agenda	Yes	I'm using an app to schedule my due dates now.
I asked the instructor any questions I had about assignments	Yes	
I found a quiet distraction-free area to study this week.	Yes	I found a cute little coffee shop nearby.
Health	Yes No	Comments
I interacted with friends and family today.	Yes	I took my kids to the park.
I went to sleep by 11:30 pm today.	No	I watched too much TV.
Time	Minutes	Comments
I spent _____ minutes on school-related work today.	45	
<i>*You may create your own goal here.</i>		
All assignments submitted? (If yes, all points automatically awarded)	Yes No	
I viewed, reviewed, and submitted all assignments this week!	No	
If all assignments are completed today, you may override the score on the right with 11 for today and the remainder of the week.	Total Yes	7
	Total	10
	Score	70.00

Appendix C: Social Validity Questionnaire – Instructor

		Strongly Disagree	Disagree	Somewhat Disagree	Neight Agree nor	Somewhat Agree	Agree	Strongly Agree
1	The intervention would be acceptable for college aged students.	1	2	3	4	5	6	7
2	The intervention had a positive effect on submission times.	1	2	3	4	5	6	7
3	I would suggest the use of the intervention to other instructors.	1	2	3	4	5	6	7
4	The intervention would not result in negative side effects to students.	1	2	3	4	5	6	7
5	The intervention would be appropriate for a diverse group of students.	1	2	3	4	5	6	7
6	I like the procedures used in the intervention.	1	2	3	4	5	6	7
7	The intervention was easy to implement.	1	2	3	4	5	6	7
8	Overall the intervention would be beneficial to most students.	1	2	3	4	5	6	7
9	The intervention demonstrates a good way to address student procrastination.	1	2	3	4	5	6	7
10	The intervention improved overall student's timeliness with completing assignments.	1	2	3	4	5	6	7
11	Most instructors would find the procedures appropriate for college aged students.	1	2	3	4	5	6	7
12	The intervention was a fair way to address student timeliness.	1	2	3	4	5	6	7
13	The intervention interfered with my teaching.	1	2	3	4	5	6	7
14	The intervention was easy to understand.	1	2	3	4	5	6	7
15	I would continue using components of intervention in future courses.	1	2	3	4	5	6	7
16	Academic procrastination is an important issue to address.	1	2	3	4	5	6	7
17	The intervention lead to noticeable changes in submission times.	1	2	3	4	5	6	7

Appendix D: Social Validity Questionnaire - Student

	Question	Strongly Disagree	Dissagree	Somewhat Disagree	Neight Agree nor	Somewhat Agree	Agree	Strongly Agree
1	Time management is an important issue to address.	1	2	3	4	5	6	7
2	The extra credit opportunities were appropriate for the course.	1	2	3	4	5	6	7
3	The announcement reminders were appropriate for the course.	1	2	3	4	5	6	7
4	The self-monitoring tool was appropriate for the course.	1	2	3	4	5	6	7
5	The self-monitoring form had a positive impact on my performance in the course.	1	2	3	4	5	6	7
6	The extra credit opportunities had a positive impact on my performance in the course.	1	2	3	4	5	6	7
7	The announcement reminders had a positive impact on my performance in the course.	1	2	3	4	5	6	7
8	I like the instructional strategies used in the course.	1	2	3	4	5	6	7
9	The extra credit instructions were easy to understand.	1	2	3	4	5	6	7
10	The self-monitoring instructions were easy to understand.	1	2	3	4	5	6	7
11	The announcement reminders were easy to understand.	1	2	3	4	5	6	7
12	Overall, the strategies used in the course were beneficial.	1	2	3	4	5	6	7
13	The strategies used in this course helped me be more timely with my assignment submissions.	1	2	3	4	5	6	7
14	I would want to see the strategies used in the course in future courses.	1	2	3	4	5	6	7
15	The quiz extra credit opportunity is a good way to address timeliness.	1	2	3	4	5	6	7
16	The extra credit opportunities had a positive effect on my grades.	1	2	3	4	5	6	7
17	The strategies used in this course were a fair way to address student timeliness.	1	2	3	4	5	6	7

18	The extra credit opportunity had a negative effect on my performance in the course.	1	2	3	4	5	6	7
19	The announcement reminders had a negative effect on my performance in the course.	1	2	3	4	5	6	7
20	The self-monitoring form had a negative effect on my performance in the course.	1	2	3	4	5	6	7