

## **An Investigation of the Impact of an Intervention to Reduce Academic Procrastination Using Short Message Service (SMS) Technology**

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### **Abstract**

This mixed-method pilot study investigated the impact of a custom Short Message Service (SMS) reminder system developed to help students reduce procrastination and increase performance on weekly content-related quizzes in a high-enrollment hybrid online course. Text message reminders were sent to three students with high procrastination and low performance levels on a schedule based on free-operant avoidance principles, where messages would be terminated upon completion of the weekly quiz. The results suggest that there was sufficient evidence that the system had a positive effect on procrastination levels, but less evidence for an effect on performance. Subsequent interviews with the participants confirmed the utility and potential of the system, and revealed areas for improvement in the implementation of the SMS reminder system as well as an understanding of the students' response to the intervention.

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The phenomenon of procrastination is widespread in society, but it is particularly prevalent and potentially detrimental in the academic setting. It has been defined on several occasions (Lay, 1986; Milgram, Mey-Tal, & Levison, 1998; Solomon & Rothblum, 1984), but Schraw, Wadkins, and Olafson (2007) provided a useful working definition that captured the essence of the phenomenon. They defined procrastination as "intentionally deferring or delaying work that must be completed" (2007, p. 13). Within an academic institution, Steel (2007) reported that more than 80% of students procrastinated, and up to 50% were chronic procrastinators. The consequences of procrastination have been documented as largely negative in terms of emotional issues such as stress (Tice & Baumeister, 1997), self-esteem (Steel, 2007), and anxiety (Lay & Schouwenburg, 1993). The theme remains consistent within the academic setting, where procrastination has been linked to reduced academic performance (Perrin et al., 2011; Rakes & Dunn, 2010; Tuckman, 2005).

Although most researchers present procrastination as a detrimental trait and the result of a failure of self-regulation (Rabin, Fogel, & Nutter-Upham, 2011), some researchers have suggested that it may be advantageous under certain conditions. Chu and Choi (2005) delineated between traditional "passive" procrastinators and a new group termed "active" procrastinators. They concluded that active procrastinators "are more likely to accomplish tasks with satisfactory outcomes than passive procrastinators, who are often paralyzed by indecision regarding action and haunted by past failure to complete tasks" (2005, p. 260). Other scholars who have

commented on the positive aspects of procrastination have noted that delays are not necessarily negative if they are the result of, for example, planning or data collection (Knaus, 2000). Other positive effects may be a heightened sense of challenge just before an examination (Lay, Edwards, Parker, & Endler, 1989), or increased efficiency in performing easy tasks (van Eerde, 2003).

A significant amount of research has been done on this topic, and most focus on the causes or factors influencing procrastination. For example, Rabin et al. (2011) conceptualized academic procrastination as a problem of executive functioning, and suggested that improvement in higher order executive processing requires both cognitive and behavioral strategies in addition to general confidence building strategies. Rakes and Dunn (2010) examined motivation and demonstrated the inverse relationship between procrastination and both intrinsic motivation and effort regulation. Similarly, van Eerde's (2003) meta-analysis examined the processes involved in procrastination, focusing on variables such as personality traits, motives, affect, and performance. One significant finding was that "procrastination appears be related to a higher extent to one's self- image than to the threat of receiving negative performance feedback" (2003, p. 1409). Most of the research into the factors leading to procrastination have used self-report inventories, such as the Lay's Procrastination Scale (Lay, 1986) and the Tuckman Procrastination Scale (Tuckman, 2005), to determine the presence or extent of procrastination. However, others have used more direct methods to measure procrastination. For example, Rotenstein, Davis, and Tatum (2009) used start and submissions times of online homework as objective measures of student procrastination.

Although there is a wealth of research on procrastination, few studies focus on reducing procrastination, and even fewer use technology to achieve their goals. Early examples of applied research include Reiser (1984) and Lamwers and Jazwinski (1989) both of which examined course contingencies with the Personalized System of Instruction context. A more recent example of applied research is a study by Ariely and Wertenbroch (2002) who examined procrastination reduction via self-imposed deadlines and found that externally imposed deadlines enhanced performance more so than self-imposed deadlines. Likewise, Perrin et al. (2011) used schedules of online practice quiz to demonstrate that procrastination decreased when the availability of study material was contingent upon completing prior study material, as opposed to when the material were available without a completion requirement. Building on previous applied research, the current study will help to fill the current research gap by taking an applied look at reducing procrastination using currently available technological tools.

This study used Short Message Service (SMS) technology, or text messaging, to send frequent reminders to students' mobile phones in an effort to reduce academic procrastination. The SMS technology was chosen because it has become commonplace amongst students (Battestini, Setlur, & Sohn, 2010), and it is projected to increase in use (Omar, Sanchez, & Bhutta, 2009). The technology also has the potential to influence students' self-regulation as evidenced by Goh, Seet, and Chen (2012) who demonstrated that persuasive SMS messages can lead to improvements in students' performance and self-regulated learning effort. SMS technology has been successfully deployed for different purposes in many disciplines, most notably in the area of health. Although the healthcare system is arguably more advanced than the education system in the way technology is implemented, it does provide a suitable point of comparison. Based on their systematic review of literature, Cole-Lewis and Kershaw (2010) recommended that SMS research be treated with urgency because "text messaging may be an important tool to reduce the global burden on health care by providing more effective disease

prevention and management support ” (2010, p. 67). The technology can also be used in the area of education, for example Bull and McCormick's (2011) successful integration of SMS into a pre-algebra course. Similarly, Safie (2004) integrated SMS at the course level and reported that students overwhelmingly preferred to receive SMS reminders for deadlines and exam notifications. They also introduced SMS quizzing into their pedagogy and reported that a significant majority of students found the system to be beneficial, easy to use, and intuitive. At the institutional level, Richardson's (2009) SMS implementation involved six courses and focused on student support services. They reported benefits such as the ability to communicate outside the normal boundaries, but questioned the value of the technology in terms of improving student learning. They also noted the sociolinguistic issues that emerged when the type of communication, for example official or formal, was constrained by the technical limitations of the SMS technology. The prior examples highlight successful SMS implementation, and they provide support for Riordan and Traxler's (2005) suggestion that with careful consideration and planning in terms of technology and pedagogy, SMS technology could be successful in the academic environment. One possible contribution that SMS technology could have in the academic setting is in the area of reducing procrastination. The potential of the technology has been demonstrated in the area of health where Stockwell et al. (2012) showed the efficacy of SMS reminders in improving immunization coverage within a population. Although the potential of the technology, in terms of reminders, has been acknowledged within the academic context (Bull & McCormick, 2011; Riordan & Traxler, 2005), there is still a need for applied research that implement SMS strategies and evaluates the potential of the technology. The current study aims to help facilitate the discussion on the utility of implementing SMS technology to reduce procrastination in the academic setting.

The theoretical framework of the study, outside the applied aspect of reducing procrastination, is visible via the scheduling algorithm used to control message delivery. SMS messages can be sent at any time and in varying quantities, thus it is important to consider the schedule at which messages are sent. Both Stockwell et al. (2012) and Goh et al. (2012) used a specific schedule to determine when messages were sent, underlining the value of a purposeful schedule. In response to the call by Rabin et al. (2011) for a combination of behavioral and cognitive strategies to reduce procrastination, the current study employed a theory-based approach, negative reinforcement, to change academic behavior. Specifically, this study employed free-operant avoidance, which Cooper, Heron, and Heward (2007) described as an arrangement where avoidance behavior is free to occur at any time to delay aversive stimuli. In the case of this study, completing the required tasks would terminate the delivery of SMS messages.

The purpose of the study was to examine the utility and feasibility of implementing an intervention based on SMS technology to reduce procrastination within the academic environment using free-operant avoidance principles. The study focused on students who were consistent procrastinators, and who were performing below average. The intervention was not designed to specifically target performance, but performance was included as a variable in this study because it is of critical importance within the academic environment. As supported by the literature, procrastination may have an important effect on performance.

The following questions guided the current study:

1. What are the effects of the implemented SMS system on student procrastination levels?
2. What are the effects of the implemented SMS system on student performance levels?
3. What are the reactions of student to the implemented SMS system?

## **Method**

### **Setting**

The study was a pilot investigation conducted during the Fall 2012 semester within the context of a large-enrollment hybrid online undergraduate educational psychology course at a large mid-western university. Student participation was voluntary and the study procedures were reviewed and approved by the university's Institutional Review Board (IRB). The researcher was not the course instructor. The course was offered in a hybrid model in which one weekly class session was replaced by online activities. The weekly online activities included quizzes that were designed to ensure content mastery before face-to-face class discussions. There were ten total content related quizzes, and they were due on the same day and at the same time each week. Each quiz contained between 15 and 20 items, and a time limit of 30 minutes was enforced using the features of the university's learning management system.

### **Sampling Procedure and Participants**

There were 124 students enrolled in the course, and they were all eligible for selection into the study. Data from all students in the course over the first four quizzes were examined and students were identified as candidates and invited to participate in the study if they met three criteria: (1) they completed the first four quizzes, (2) they completed three of the first four quizzes with less than five hours before the deadline, and (3) the average percent score on the first four quizzes was less than 80%. Students who did not complete all of the first four quizzes were excluded because there was no method of determining the cause of the missing quiz or quizzes. The five-hour marker was chosen because it was the estimated amount of time required to complete the readings for class preparation. The 80% performance threshold was chosen because it was the minimum score students were expected to earn on each quiz. Of the 124 enrolled students, five met the selection criteria, and they were invited to participate in the study. Students were informed that participation required the following: their phone number, confirmation of a cellular phone plan with unlimited text messaging, and a willingness to receive text message reminders between 10am and 10pm inclusive. Three students accepted the invitation and two declined. The resulting three participants were all female first year students, and they each had different declared majors.

### **Measures**

Three sources were used to collect data on procrastination, performance, and reactions. Firstly, participants' procrastination for a specific quiz was calculated by subtracting the deadline time for the quiz from the time the quiz was started, and then representing the difference as hours. Secondly, performance was obtained from the results of each quiz, and it was recorded as a percent score. Quizzes consisted of 15 to 20 multiple-choice items, and students had 30 minutes to complete a quiz. All quizzes were delivered via the university's learning management system, Sakai CLE 2.8. Finally, participant reactions were obtained via the semi-structured interviews conducted at the end of the study.

## Materials and Procedure

The researcher developed a system to automatically initiate and manage outgoing SMS text messages. An account was created at an online SMS gateway provider that supported server-based communication to their gateway using an application programming interface (API). A Linux, Apache, Python, Postgresql (LAPP) server was setup to initiate and manage the outgoing text messages. The Linux Cron job scheduler was used to automate the text messaging procedure based the message distribution schedule shown in Table 1.

Table 1

*The schedule showing the number of SMS messages sent each day*

Day	Number of Messages Delivered
1	0
2	0
3	1
4	2
5	4
6	7
7 (deadline)	13

The SMS prompt intervention plan was based on the principle of free-operant avoidance, a form of negative reinforcement, where the participant could terminate the messages for each week by completing the weekly quiz. The schedule was based on an algorithm that increased the frequency of text messages sent per day as a deadline approached. The messages were sent at time intervals that were distributed evenly in a 12-hour time span from 10am and 10pm. The deadline for each quiz was the same, Tuesdays at midnight.

The frequency pattern for the SMS message delivery schedule was created using an algorithm based on a maximum frequency of 13 messages on the day of the quiz deadline (1 message per hour + 1 message at the end of the 12th hour). For each day before the day of the quiz deadline, the number of messages was reduced by 50% and rounded up to the nearest integer. As shown in Table 1, the first day in which a participant would receive a message was on Day 3 of the weekly schedule.

All participants received the same message with a unique salutation that was personalized with her or his first name. Specifically, the message read “[STUDENT], please do not forget to read the chapter and complete the upcoming quiz.” There was no communication, SMS or otherwise, between the researcher and the participants until after the final quiz was completed.

Participants were provided with a web-based form through which they could terminate the messages. The form had two options through which participants could make one of two selections: (1) they had completed their quiz and wished to skip all subsequent messages for the week, or (2) the participant wished to terminate their involvement in the study, thereby stopping all future messages.

## Data Collection Procedure

Data related to procrastination and performance were collected in the Sakai Collaboration and Learning Environment (Sakai CLE 2.8) system through which the course was delivered. The data collected for each quiz included a timestamp indicating completion time for a quiz and also a score for the quiz that indicate the percentage of correct answers on the quiz.

### **Post-Intervention Interview Procedures**

The researcher interviewed the three participants after the final quiz was completed. The interview sessions were semi-structured, and they were focused on participants' attitudes and perceptions of the task. Participants were informed that there were no correct or incorrect answers, and they were encouraged to provide as many details as possible. The interviews between the researcher and the participants were recorded (audio) and then transcribed by a graduate student who was not a part of the study. The participants were asked to reflect on their attitudes and perceptions at three discrete time periods: prior to the study, during the study, and at the end of the study. Questions in the first time period focused on participants' rationale and expectation, questions in the second time period focused on what actually transpired, and questions in the third and last time period focused on participants' reflections and analyses. Finally, the participants were asked to make general recommendations. The general outline for the interview questions are presented in Appendix A.

### **Design and Variables**

This study used an AB single-subject design, fully described by Cooper et al. (2007), with two primary goals. With respect to the technical feasibility and practical aspects of the intervention, this research design presented an opportunity to introduce a potentially vital intervention to the at-risk sample, without the ethical concerns such as delayed exposure or early withdrawal that is required with other designs. Also, this research design served the need for piloting the intervention in order to determine the suitability of the set of measurements as an indicator of effectiveness.

The study evaluated the effect of SMS text prompts on academic procrastination and performance. The baseline phase included the first four quizzes of the academic term during which students did not receive any SMS text prompts regarding the course. The experimental phase of the study began with the fifth quiz and continued until the participants had completed a total of ten quizzes. During the experimental phase of the study, participants received SMS text messages that contained reminders about the quiz deadline. The frequency of the SMS text message increased each day as the deadline approached.

**Procrastination.** Procrastination was operationally defined as the difference, in hours, between the deadline for a quiz and the time that a participant started the quiz. Larger differences in time indicated that a student had started a quiz earlier in advance of a deadline, thus indicating less procrastination. Conversely, smaller time differences indicated later quiz start times and greater procrastination.

**Performance.** Performance was measured using the score on the quiz and reported as the percentage of items that were correctly answered on the quiz.

### **Analysis**

Although there is no universally accepted method for analyzing the type of single-subject data gathered in this study, a multifaceted approach was implemented in order to provide a platform to discuss the utility of the intervention. The quantitative data were analyzed using

multiple procedures, including the Conservative Dual-Criteria (CDC) procedure, effect sizes, and visual analysis. The narrative data from the interviews was used to contextualize and further interpret the results of the quantitative analysis.

**CDC.** The CDC procedure, outlined by Fisher, Kelley, and Lomas (2003), is a method for visually inspecting and interpreting data from studies using single-subject design. In studies using this design, typically each participant represents a subject, but in some circumstances, a single subject is represented by a cluster of participants. In this study, each participant represented a single subject. In the CDC method, adjusted (0.25 of standard deviation) baseline level and trend lines are extended into the intervention, and intervention data points examined with respect to the adjusted baseline lines. In the case of this study, all six intervention points must be above both adjusted lines before it can be concluded that a systematic change occurred from baseline to intervention. The procedure, described by the authors as having “the potential to be a useful first step” (Fisher et al., 2003, p. 405), can only determine whether systematic change occurred from the baseline phase to the intervention phase, and not whether the change was caused by the intervention.

**Effect size.** The effect size for each case in this study was calculated using the Nonoverlap of All Pairs (NAP) procedure (Parker & Vannest, 2009). The effect size is an estimate of the magnitude of the relationship, and the NAP is a novel procedure that can indicate performance differences between the baseline and intervention phases. To interpret the NAP results, small, medium, and large effect sizes correspond to NAP values of .56, .63, and .70 respectively.

**Visual analysis.** The quantitative data were graphed and then interpreted using visual analysis. Visual analysis, as described in Cooper et al. (2007), is a systematic form of data examination intended to determine if meaningful change occurred from the baseline to intervention phases, and if those changes can be attributed to the independent variable, which is the SMS prompts in this study. The visual analysis focused on the five components that were examined within and between phases. The components examined within and between the baseline and intervention phases were as follows:

- Level, the value where data converge, was a function of the mean and median of the baseline and intervention data.
- Trend, the overall direction or rate of change of the data (slope), was determined using the ordinary least-squares (OLS) linear regression equation, and the trend lines are included on each graph.
- Variability, the variation in data range and the stability of the data, focused on the low-high data range, the standard deviation from the mean, and a stability criterion of data falling within 50% of the mean.

The components examined between the baseline and intervention phases were as follows:

- Immediacy, the immediacy of the intervention's effect, was a comparison of the last baseline data point and the first intervention data point.
- Overlap, the overlap between the baseline and intervention data, was an examination of the Percentage of Nonoverlapping Data (PND) with a minimum acceptable criterion of 80%.

The visual analysis components are more fully discussed in Cooper et al. (2007), Kazdin (1982), and Riley-Tillman and Burns (2009). For this study, the determination of meaningful change relied on whether or not a majority of the components demonstrated favorable change or outcomes.

**Interviews.** The qualitative data collected during this study were based on the interviews. The interviews were recorded and then transcribed verbatim by a graduate student. The researcher then copied the data into a spreadsheet and organized them such that the responses for each participant were located in separate columns and the responses to individual questions were aligned in rows. Consequently, each row contained all participants' responses for a single question, although each participant's response was in a separate cell within the row. The researcher used the resulting grid format to analyze the responses of each participant. Unique observations, reactions, and recommendation were recorded separately and then cross-checked against the responses of the other participants. This method was used to identify unique insights and common themes amongst the participants.

## Results

This section reports the procrastination and performance results for each participant, as well as the qualitative results based on the interviews conducted at the end of the study. The summary data and findings are initially presented for all three participants and then discussed for each participant in greater detail. Additional statistics related to the quantitative analysis are also included in Appendix B and C.

### Effect of Intervention on Procrastination

Figure 1 and Table 2 are summaries of the findings and they show the mixed results of the effectiveness of the intervention on procrastination levels. Figure 1 shows the procrastination results for all three participants in graph format while Table 2 shows a summary of the three main indicators of change in procrastination for each participant.



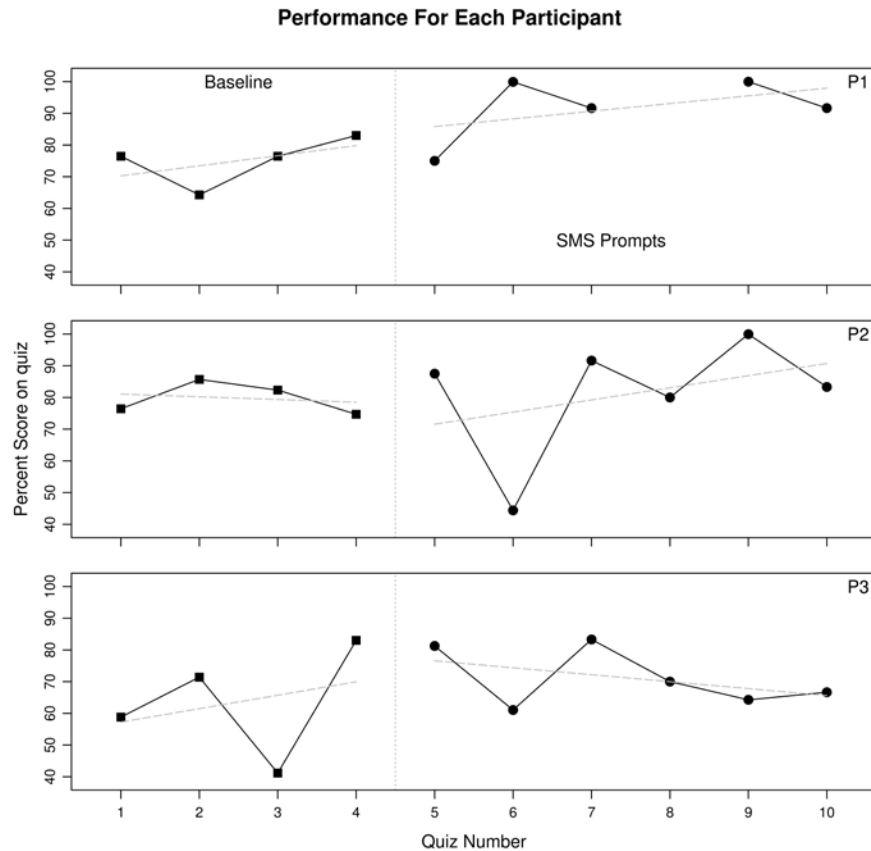


Figure 1. The performance results for participants one, two, and three (P1, P2, P3).

Table 2

*Summary of the assessment of multiple indicators of change in procrastination*

Participant	CDC	Visual Analysis	
	(Systematic Change)	Effect Size	(Within and Between)
1	No Evidence	Large	Some evidence of meaningful change
2	No Evidence	Small	Minimum evidence of meaningful change
3	No Evidence	Small	Minimum evidence of meaningful change

**Participant one.** Figure 1 shows the procrastination results for participant one in graph format, and Table 4 shows the procrastination data results (Level, Trend, Variability) during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant one.

**CDC.** Of the five intervention data points, four were above the adjusted baseline mean line, and three were above the adjusted baseline trend line. Although the intervention results were very close to the acceptable range, the conclusion is that there was not adequate evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .85, as computed using the NAP procedure. This indicated a large magnitude of effect and suggested an effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the Level was very low indicating very high initial procrastination. There was an overall slightly increasing Trend in the baseline, indicating that procrastination was slightly decreasing. The baseline had very low Variability, and it was very stable with all data falling within the 50% of mean criterion range. Looking next at the intervention data, the Level was low indicating high procrastination during intervention, that is, when receiving SMS prompts. There was an overall decreasing Trend in the intervention, indicating that procrastination generally increased over the course of the intervention. The intervention had low Variability, and it was unstable with 40% of the data falling outside the 50% of mean criterion range.

*Between phases.* Examining the differences between the baseline and intervention phases, there was a large increase in Level as evidenced by a 4.25-hour increase in mean and a 4.66-hour increase in median. The large increase in Level reflected a large decrease in procrastination from baseline to intervention. There was also a difference in Trend, where the slightly increasing baseline Trend preceded the slightly decreasing intervention Trend. The Trend results indicated that procrastination was initially decreasing during the baseline but increasing during the intervention. Variability increased from baseline to intervention as evidenced by large increases in both data range and standard deviation, and there was a large decrease in stability. In terms of Immediacy, there was a large 5.58-hour reduction in procrastination immediately at the start of the intervention. Finally, the Overlap between baseline and intervention, as measure using the PND procedure, was 80%. This was within the minimum acceptable criterion of 80%.

**Participant two.** Figure 1 shows the procrastination results for participant two in graph format, including the presence of significant outliers. Table 4 shows the procrastination results (Level, Trend, Variability) for participant two during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant two.

**CDC.** Of the six intervention data points, only one was above the adjusted baseline mean line, but all were above the adjusted baseline trend line. The conclusion is that there was no evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .50, indicating a small magnitude of effect and suggesting a minimally effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the Level was very low indicating high initial procrastination. In this case, the median was the more appropriate measure of Level because of the presence of the outlier. There was an overall decreasing Trend in the baseline, indicating that procrastination was increasing. The baseline had high Variability, and it was very unstable with all data falling outside the 50% of mean criterion range. Much of the Variability in the baseline can be attributed to the presence of the outlier. Looking next at the intervention data, the Level was low, indicating high procrastination during the intervention. Similar to the baseline results, the median was a better indicator of Level because of the outlier. There was an

overall increasing Trend during the intervention, indicating that procrastination generally decreased over the course of the intervention. The intervention had high Variability, and it was very unstable with 80% of the data falling outside the 50% of mean criterion range. Much of the Variability in the intervention can be attributed to the presence of the outlier.

*Between phases.* Examining the differences between the baseline and intervention phases, there was a small overall decrease in Level as evidenced by a 1.04-hour decrease in mean and a 0.85 hour increase in median. The change in Level reflected a small increase (using the median) in procrastination from baseline to intervention. There was a large difference in Trend, where the greatly decreasing baseline Trend preceded the increasing intervention Trend. The Trend results indicated that procrastination was greatly decreasing during the baseline, but increasing during the intervention. Variability slightly decreased from baseline to intervention as evidenced by small decreases in both data range and standard deviation, and there was a small increase in stability. In terms of Immediacy, there was a very small increase (0.74 hours) in procrastination immediately at the start of the intervention. Finally, the Overlap between baseline and intervention was 0% and outside the minimum acceptable criterion of 80%.

**Participant three.** Figure 1 shows the procrastination results for participant three in graph format, and table 4 shows the procrastination results (Level, Trend, Variability) for participant three during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant three.

**CDC.** Of the six intervention data points, only two were above the adjusted baseline mean line, but all were above the adjusted baseline trend line. The conclusion is that there was no evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .50, indicating a small magnitude of effect and suggesting a minimally effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the Level was very low, indicating high initial procrastination. There was an overall slightly decreasing Trend in the baseline, indicating that procrastination was increasing. The baseline had very low Variability, and it was very stable with all data falling within the 50% of mean criterion range. Looking next at the intervention data, the Level was very low, indicating very high procrastination during the intervention. There was an overall slightly decreasing Trend in the intervention, indicating that procrastination generally increased over the course of the intervention. The intervention had low Variability, and it was very unstable with 60% of the data falling outside the 50% of mean criterion range.

*Between phases.* Examining the differences between the baseline and intervention phases, there was a very small overall increase in Level as evidenced by a 1.05-hour increase in mean and a 0.15-hour decrease in median. The change in Level reflected a small increase (using the mean) in procrastination from baseline to intervention. There was a small difference in Trend, where the intervention Trend decreased at a slightly higher rate than the baseline Trend. The Trend results indicated that procrastination was increasing slightly from baseline to intervention. Variability increased from baseline to intervention as evidenced by large increases in both data range and standard deviation, and there was a large decrease in stability. In terms of Immediacy, there was a very large increase (6.55 hours) in procrastination immediately at the start of the intervention. Finally, the Overlap between baseline and intervention was 33% and outside the minimum acceptable criterion of 80%.

### Effect of Intervention on Performance

Figure 2 and Table 3 are summaries of the findings and they show the mixed results of the effectiveness of the intervention on performance levels. Figure 2 shows the performance results and trends for all three participants. Table 3 shows a summary of the three main indicators of change in performance for each participant.

**Procrastination For Each Participant**

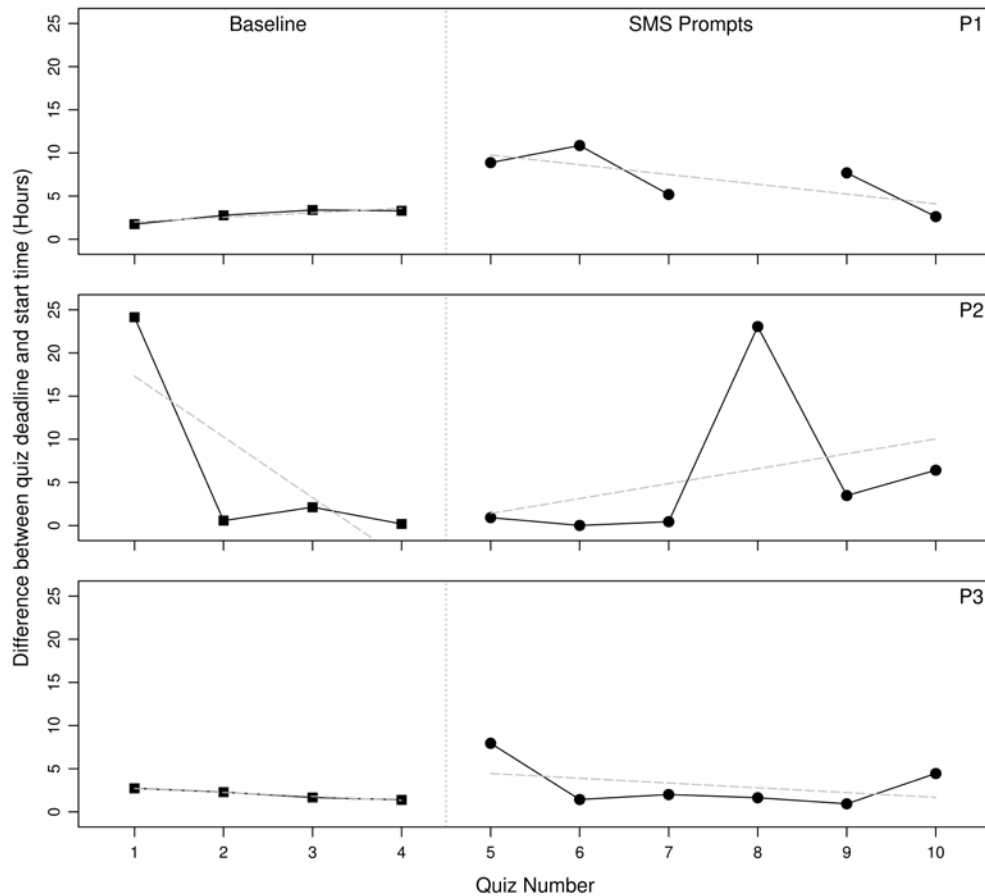


Figure 2. The procrastination results for participants one, two, and three (P1, P2, P3).

Table 3

*Summary of the assessment of multiple indicators of change in performance*

Participant	CDC (Systematic Change)	Effect Size	Visual Analysis (Within and Between)
1	No Evidence	Large	Moderate evidence of meaningful change
2	No Evidence	Large	Minimum evidence of meaningful change
3	No Evidence	Medium	Minimum evidence of meaningful change

**Participant one.** Figure 2 shows the performance results for participant one in graph format, and Table 5 shows the performance results (Level, Trend, Variability) for participant one during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant one.

**CDC.** Of the five intervention data points, four were above the adjusted baseline mean line, and three were above the adjusted baseline trend line. The conclusion is that there was no evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .85, indicating a large magnitude of effect and suggesting an effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the Level was moderate, indicating average performance over the first four quizzes. There was an overall increasing Trend in the baseline, indicating that performance was increasing. The baseline had low Variability, and it was very stable with all data falling within the 50% of mean criterion range. Looking next at the intervention data, the Level was very high, indicating high performance when receiving SMS prompts. There was an overall increasing Trend in the intervention, indicating that performance increased over the course of the intervention. The intervention had moderate Variability, and it was very stable with all data falling within the 50% of mean criterion range.

*Between phases.* Examining the differences between the baseline and intervention phases, there was a very large increase in Level as evidenced by a 16.59-point increase in mean and a 15.19-point increase in median. There was also a small difference in Trend, where the intervention Trend increased at a slightly higher rate than the baseline Trend. Variability increased from baseline to intervention as evidenced by increases in both data range and standard deviation, but there was no change in stability. In terms of Immediacy, there was a large reduction (8 points) in performance immediately at the start of the intervention. Finally, the Overlap between baseline and intervention was 80% and within the minimum acceptable criterion of 80%.

**Participant two.** Figure 2 shows the performance results for participant two in graph format, including the presence of an outlier. Table 5 shows the performance results (Level, Trend, Variability) for participant two during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant two.

**CDC.** Of the six intervention data points, four were above the adjusted baseline mean line, and five were above the adjusted baseline trend line. The conclusion is that there was no evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .71, indicating a large magnitude of effect and suggesting an effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the level was moderate, indicating average performance over the first four quizzes. There was an overall slightly decreasing Trend in the baseline, indicating that performance was decreasing. The baseline had low Variability, and it was very stable with all data falling within the 50% of mean criterion range. Looking next at the intervention data, the Level was moderate, indicating moderate performance when receiving SMS prompts. In this case, the median was the more appropriate measure of level because of the presence of the outlier. There was an overall increasing Trend in the intervention, indicating that performance increased over the course of the intervention. The intervention had

high Variability, and it was very stable with all data falling within the 50% of mean criterion range. Much of the Variability in the intervention can be attributed to the presence of the outlier.

*Between phases.* Examining the differences between the baseline and intervention phases, there was a small increase in Level as evidenced by a 1.35-point increase in mean and a 6.02-point increase in median. There was a large difference in Trend, where the slightly decreasing baseline Trend preceded the increasing intervention Trend. Variability increased from baseline to intervention as evidenced by large increases in both data range and standard deviation, but there was no change in stability. In terms of Immediacy, there was a large increase (12.80 points) in performance immediately at the start of the intervention. Finally, the Overlap between baseline and intervention was 50% and outside the minimum acceptable criterion of 80%.

**Participant three.** Figure 2 shows the performance results for participant three in graph format, and Table 5 shows the performance results (Level, Trend, Variability) for participant three during the baseline and intervention phases. The results of the three methods of analyses: CDC, effect size, and visual analysis are presented for participant three.

**CDC.** Of the six intervention data points, three were above the adjusted baseline mean line, but only one was above the adjusted baseline trend line. The conclusion is that there was no evidence of a systematic change from the baseline to the intervention phase.

**Effect size.** The effect size for this case was .63, indicating a medium magnitude of effect and suggesting a moderately effective intervention.

**Visual analysis.**

*Within phases.* Looking first at the baseline data, the Level was low, indicating below average performance over the first four quizzes. There was an overall increasing Trend in the baseline, indicating that performance was increasing. The baseline had high Variability, and it was very stable with all data falling within the 50% of mean criterion range. Looking next at the intervention data, the Level was low, indicating below-average performance when receiving SMS prompts. There was an overall decreasing Trend in the intervention, indicating that performance decreased over the course of the intervention. The intervention had moderate Variability, and it was very stable with all data falling within the 50% of mean criterion range.

*Between phases.* Examining the differences between the baseline and intervention phases, there was an increase in Level as evidenced by a 7.49-point increase in mean and a 3.22-point increase in median. There was a large difference in Trend, where the increasing baseline Trend preceded the decreasing intervention Trend. Variability decreased from baseline to intervention as evidenced by large decreases in both data range and standard deviation, but there was no change in stability. In terms of Immediacy, there was a small decrease (1.75 points) in performance immediately at the start of the intervention. Finally, the Overlap between baseline and intervention was 16.67% and outside the minimum acceptable criterion of 80%.

### Post-Intervention Interview Results

The interviews yielded insights into participants' attitudes and perceptions prior to, during, and after the study. They also provided valuable information regarding the general functionality of the SMS reminder system. The interviews lasted between 15 and 20 minutes for each participant.

**Attitude prior to the study.** The first section of the interview focused on attitudes and perception prior to the starting the study, and it included prior exposure, rationale, and expectations. In terms of prior exposure, none of the participants had experienced any type of reminder system similar to what they experienced during this study. The rationales for

participation were similar. All participants acknowledged their early poor performance, and cited this as the primary reason for agreeing to participate in the study. All participants also acknowledged the issue of procrastination, and each thought that the reminders would help reduce procrastination. Beyond the issue of procrastination and performance, one common theme was the perception that the study would not be detrimental, as suggested by participant three, "Well it can't hurt. Even if it doesn't help, it can't hurt." All participants expressed similar outcome expectations that their procrastination would decrease, with participant one expressing the hope that performance would subsequently increase. Surprisingly, participant two and three's expectations centered on procrastination related to reading the content material as opposed to simply taking the quiz. For them, the greater issue was being reminded to start reading as opposed to remembering to take the quiz.

**Experiences during the study.** The second section of the interview focused on what the participants actually experienced, and it included impressions of the system, actions taken, effects of the schedule, explanations of use, and problems encountered. Impressions of receiving reminders via SMS were somewhat mixed, but all participants characterized the experience as something good, in that it was an attempt by the instructor to help them succeed. Unlike participant one and three, participant two thought that the messages were sometimes annoying stating that "even though I would be kind of annoyed, I would still remember, like okay let me take this so I can turn this off." Participants' actions upon receipt of a reminder were consistent, in that they attended to the first few reminders in the study by opening then reading the message. After receiving a few messages, they generally saw the reminder but did not open the message. All participants expressed that after receiving a few reminders, they recognized the message, knew its content, and subsequently did not need to open or read the entire message. Interestingly, participant one used the SMS reminder as a prompt for another reminder, stating that after receiving a reminder, "I got on my laptop and left myself a sticky note to remember to do the quiz that night." Reactions to the schedule used for reminders were mostly consistent, but there were some subtle differences. Generally, participants had no issue with the schedule, and it was largely ignored. Participant one and three appreciated the repetitive nature of the reminders, and participant one commented that "I appreciated that they were like repetitive reminders, 'cause sometimes I'd like see it when I'm in another class and I'm like okay I'll do this later, and then I forget about it. And then I get the next reminder, and I'd be like oh my goodness, and like I would've forgotten all about this again." Participant two particularly appreciated that the number of reminders increased as the deadline got closer. Interestingly, when the participants estimated the average number of messages they received per day, they reported 30 to 40, 50, and more than 100, for participants one, two, and three respectively. Participants' reactions to the technological aspects of the study were overwhelmingly positive. There were no reports of technological issues, and all participants found the system, especially the stopping web page, easy to use. All participants used the stopping web page at least once, but only participant two used it on every occasion. Participant two commented that she used the stopping web page because "sometimes I would forget to turn the text message off. So it would be closer to the day, and I'm like wait, I already took it. So I would go turn it like, um go to my email." Participant two also wished for an option to stop the reminders via SMS, eliminating the need to use the stopping web page. She understood the capabilities of the SMS technology, and knew that two-way communication was possible. However, she understood why the SMS reply was not included as an option, and correctly stated that the option to stop via SMS was not ideal because

participants could terminate reminders even when they had no intention of working, or were not in a position to work.

**Reflections after the study.** The third section of the interview required participants to reflect on their experience, and it included effects on procrastination, performance, and self-regulation, future participation, and overall value of the system. In terms of perceptions of effects, all participants believed that the reminders had a positive effect on procrastination, performance, and overall self-regulation skills. Participant one acknowledged that she continued to delay starting her quizzes, however, she commented that she began reading the content much earlier, thus the quizzes took less time, and consequently she felt that she had a better grasp of the material. For her, the SMS reminders were a good prompt to read, even if she did not take her quizzes early. Participant two and three felt that the reminders helped, but they both expressed the sentiment that the effect was great in the beginning but diminished over time. Participant three commented that “It was effective, very effective, in the beginning. I think it died down a little bit, but it still worked.” However, she added that she was not a strong reader and consequently had issues motivating herself to read the course material. All participants indicated that if given the choice, they would use this or a similar system. All participants thought that the system had significant potential for students in general. Participant one thought the value of the system hinged in the fact that students attended to SMS messages more than email. Participant three thought that it was a good idea in general, but it should be optional because “some people pay for texts. I don’t know anybody who does in college, but it happens. They’re out there somewhere.” Interestingly, participant two thought the system was valuable because of what it would trigger within the student. She thought that:

“People who are procrastinators like myself, like I mean, it makes you start thinking like okay, well what time – when was I actually planning on doing this? Was I planning on doing it, or like, and then I start like evaluating like okay, how much homework do I have this weekend? So can I just do it now and get it over with? Or like, should I just wait anyway ‘cause I don’t have any homework, you know, or like I have so much to do.”

**General recommendations.** The fourth and final section of the interview focused on recommendations, and it included message content, number of messages, schedule, and stopping procedure. Participants felt that the content of the message should remain the same, and that there was no need for more personalized messages nor was it necessary to give students the option to customize the messages. Participants felt that the message schedule was effective. Participant one did not see a need to change the schedule, while participant two thought that it might be a good idea to allow some form of personal customization of the schedule. Participant three thought that customization might be good, but that it might be a detriment to some students in that they would choose reminders close to deadlines. Participants gave positive feedback about the stopping procedure, but participants two and three suggested that it would be useful if there were alternate ways of stopping the messages. Participant three was especially concerned about this issue because she felt that it might be necessary to stop the messages at certain times, for example at the doctor's office.



## Discussion

This pilot study provided insights into the utility and feasibility of implementing an intervention based on SMS technology to reduce academic procrastination using free-operant avoidance principles. For these participants, there is some evidence that reminders sent via SMS technology may have an effect on academic procrastination and performance. Although the intervention was specifically designed to target procrastination and not performance, the results provided some support for the relationship between procrastination and performance as suggested Perrin et al. (2011). For example, participant two's Trend indicated that performance scores increased in parallel with a decrease in procrastination. In the case of participant three, the Trend indicated that performance scores decreased in parallel with an increase in procrastination. In both cases, performance scores were trending in the opposite direction during their respective baselines.

Focusing on the first research question, there was some evidence that the intervention had a positive effect on procrastination for these participants. The strength of the relationship between the intervention and procrastination results differed across participants. For participant one, the large effect size, the large increase in Level, the large Immediacy increase, and the large Overlap value suggested that the intervention may have had the intended effect of reducing procrastination. However, the CDC results did not provide adequate evidence of a systematic change from the baseline to the intervention phase. Also, the change in Trend from positive to negative suggested that the intervention may have had negative effects. One possible interpretation of participant one's results is the Novelty effect, which was identified as a possibility during the interviews with participants. The large Immediacy increase at the start of the intervention followed a decreasing Trend, suggested that any immediate effects may have diminished over time. The interview with this participant, however, offered another interpretation. Although participant one's procrastination increased during the intervention, she reported reading the chapters earlier and consequently she had a better understanding of the content. This coupled with her increase in performance during the intervention suggested that she was less concerned with procrastination because of her increased performance.

The procrastination results for participant two were more difficult to interpret due to the outliers present in both the baseline and the intervention data. Although the results were complicated by the outliers, some conclusions can be drawn from the data. The CDC results indicated that there were no systematic changes from the baseline to the intervention phase. The small overall effect size suggested a minimally effective intervention, but the increase in Level, and the large change in Trend, suggested that the intervention may have had the intended effect. It is, however, difficult to interpret the Trend change in the absence of an associated immediate effect at the start of the intervention, and given the presence of the outlier. If there was an effect for participant two, it was most likely minimal at best.

The effect of the intervention on participant three appeared to be minimal in all aspects. There were minimal changes in Level and Trend, and the Overlap value was small. The effect size was small, and the CDC results indicated that there were no systematic changes from the baseline to the intervention phase. The only interesting note was the large immediate effect present at the beginning of the intervention. This possible effect, however, quickly diminished, and procrastination levels returned to previous baseline levels.

There was some evidence that the intervention may have had an effect on the performance of these participants, which was the focus of the second research question. For

participant one, the large effect size, the large Overlap value, and the large increase in Level suggested an effective intervention. However, the CDC results indicated no systematic change from baseline to intervention, the consistent Trend from baseline to intervention suggested minimal to no effect, and the large immediate decrease at the start of the intervention suggested a negative effect. Overall, the intervention appeared to have minimal to no effect on participant one's performance. For participant two, there was some evidence to suggest that the intervention may have had an effect on performance, but the possible effects were somewhat difficult to interpret because of the presence of the outlier in the intervention. The large effect size, the large change in Trend from baseline to intervention, the small increase in Level, and the large Immediacy increase in performance at the start of the intervention, all suggested an effective intervention. However, the Overlap value was small, and the CDC results did not provide evidence of a systematic change from the baseline to the intervention phase. For participant three, the medium effect size and the moderate increase in Level, suggested an effective intervention. However, the small Overlap value, the lack of an immediate effect at the start of the intervention, and the change from a positive to a negative Trend, suggested that the intervention had minimal or negative effects.

In terms of the third research question, participant reactions, the interviews provided a wealth of information that helped contextualize the quantitative results, provide support for some phenomena expressed in the literature, and identify key areas for improvement. All participants reported that they fully attended to the messages at the beginning intervention, but less so as it continued. The possible Novelty effect identified in the interviews could be interpreted from especially participants one and three's resulting procrastination levels. The participants' reactions also supported some findings in the literature such as Goh et al's. (2012) examination of the effect of SMS on self-regulation. In this study, participant one started leaving herself additional reminder notes, and participant two began questioning her academic habits. The messages, in these cases, appear to have prompted participants to examine their self-regulatory strategies. Participants also provided valuable information regarding strengths and weaknesses of the system. Overall, they found the system useful, and they thought that it could be something significant if a few changes were made. They had no technology issues and found the system intuitive and easy to use. Participants did not see the need for more persuasive messages, as indicated by Goh et al. (2012), because the participants perceived each message as a simple prompt, and they understood the meaning and purpose of the message upon receipt. Similarly, they did not think that it was necessary to allow users to compose custom messages. Participants recommended adding multiple methods of stopping the messages, but they acknowledged the potential for this feature to undermine the entire purpose of the system, that is, users might stop messages before completing the actual work. The scheduling of the messages was the most controversial aspect of the system, and two participants suggested that the ability to customize the schedule was an important but missing feature. Ariely and Wertenbroch (2002) demonstrated that self-imposed deadlines, customized schedules in this case, were less optimal than externally-imposed deadlines. However, it is possible that self-imposed deadlines would work within this setting. The scheduling algorithm was based on the principle of free-operant avoidance, which means that the messages should have been increasingly "annoying" as the participants delayed completing their quizzes. However, this was not the case. Participant two reported being sometimes annoyed, but the messages appeared to be only a minor irritant for her. It is very probable that the intended effect of the SMS system was negated by the large number of messages these participants received on an average day. The system, therefore, would need to

be configured to send considerably more messages to sufficiently motivate participants to complete their quizzes earlier. Given the participants' recommendations, in lieu of increasing the annoyance factor via increasing the messages, one strategy is to use a less punitive approach to decrease procrastination. Specifically, it is less punitive and possibly more effective, to allow participants the opportunity to select appropriate deadlines, and then adjust the number of messages based on the self-imposed deadline. The principles of free-operant avoidance would therefore not be in effect until after the self-imposed deadline. This strategy would give participants the opportunity to self-regulate before more punitive contingencies become active.

### **Conclusion and Limitations**

This pilot study begins to answer the call from Rabin et al. (2011) for more research into behavioral and cognitive strategies for reducing procrastination. It provides some evidence of the utility of a custom SMS system to reduce the academic procrastination and increase the performance of these select students on weekly content-related quizzes. The system appeared to be most effective during the initial stages of its implementation, but it is conceivable that these effects could be maintained by optimizing, at minimum, the scheduling component of the system. The scheduling algorithm was based on the principle of free-operant avoidance, but this study cannot parse the effects of the technology from the effects of the scheduling scheme. It is possible that better other algorithms could lead to better results, and future research should include this option.

This study was not designed to demonstrate the experimental effectiveness of the SMS system, rather, it provides an opportunity to examine the potential of the system and begin the investigation into possible relationships between the system and subsequent procrastination and performance changes. Subsequent research could examine optimized versions of the system, and they should be designed to experimentally determine the effectiveness of the system.

This study has several limitations that may have impacted the results. In terms of the participants, the Novelty effect, the Hawthorne effect, participant history, or maturation over the course of the semester, may have affected participants' procrastination levels and performance. Also, this study was limited to three participants, and cannot be generalized beyond this scope.

Although this study used a customized implementation of an SMS system, the implications of the results may offer insight into the effective use of commercially and freely available texting services.

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## Appendix A

### General outline for interview on attitudes and perceptions

- Prior to the study
  - Prior experience in a similar study or with a similar intervention
  - Rationale for agreeing to participate in the study
  - Perception of what would happen
- During the study
  - Impression of the weekly reminders
  - Actions upon receipt of message
  - Effect of the message schedule
  - Explanation of the use of the Stopping web page
  - Description of technology problems
  - Description of problem using the stopping web page
- At the end of the study
  - Perceived effect of the messaging on procrastination and performance
  - Perceived effect on self-regulatory skills
  - Probability of future participation in a similar intervention
  - Overall value of the system
- General suggestions or recommendations in terms of
  - message content
  - number of messages per day
  - message schedule and stopping procedure

## Appendix B

*The Procrastination results for each participant during the baseline and intervention phases*

Participant	Level		Trend			Variability		
	<i>M</i> (hr)	<i>Mdn</i> (hr)	Intercept $\alpha$ (hr)	Slope $\beta$	$R^2$	Low (hr)	High (hr)	<i>SD</i>
Participant One								
Baseline	2.80	3.03	1.49	0.53	.81	1.75	3.39	0.65
Intervention	7.05	7.69	15.42	-1.13	.53	2.62	10.86	2.88
Participant Two								
Baseline	6.76	1.35	24.34	-7.03	.61	0.19	24.15	10.07
Intervention	5.72	2.20	-7.23	1.73	.13	0.02	23.05	8.06
Participant Three								
Baseline	2.02	1.97	3.17	-0.46	.98	1.39	2.73	.52
Intervention	3.07	1.82	7.22	-0.55	.15	0.93	7.95	2.45



### Appendix C

*The Performance results for each participant during the baseline and intervention phases*

Participant	Level		Trend			Variability		
	<i>M (%)</i>	<i>Mdn (%)</i>	Intercept $\alpha$ (%)	Slope $\beta$	$R^2$	Low (%)	High (%)	<i>SD</i>
Participant One								
Baseline	75.04	76.44	67.07	3.19	.28	64.26	83.00	6.77
Intervention	91.62	91.63	73.70	2.42	.24	75.00	99.96	9.10
Participant Two								
Baseline	79.79	79.38	81.93	-0.86	.05	74.70	85.68	4.42
Intervention	81.13	85.40	52.41	3.83	.14	44.40	99.96	17.61
Participant Three								
Baseline	63.59	65.10	53.00	4.24	.09	41.16	83.00	15.52
Intervention	71.08	68.32	87.52	-2.19	.20	61.05	83.30	8.37