Running Head: PROCRASTINATION IN A CAPSI COURSE

A Study of Procrastination in a Computer-Aided Personalized System of Instruction Course

By

Gabriel J. Schnerch

A thesis submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfillment of the requirements of the degree of

MASTER OF ARTS

Department of Psychology

University of Manitoba

Winnipeg

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

*****

COPYRIGHT PERMISSION

A Study of Procrastination in a

Computer-Aided Personalized System of Instruction Course

BY

Gabriel J. Schnerch

A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of

Manitoba in partial fulfillment of the requirement of the degree

MASTER OF ARTS

Abstract

Excessive procrastination is a problem that besets self-paced and non-self-paced courses alike. This study examined data from a CAPSI-taught course section in which the instructor introduced a self-pacing chart to reduce academic procrastination, and compared it with data from a comparable CAPSI-taught section in which the chart was not added. Regression analyses demonstrated a relationship between procrastination and academic performance similar to that found in prior research in the section not containing the intervention. Analysis of covariance revealed no differences in rate of progress or final exam scores between the two sections. There was, however, a significant difference in dropout rates between the two sections suggesting that the addition of the chart may have increased dropouts. Finally, a positive relationship between peer-reviewing and final exam performance was suggested by some of the data, supporting findings from prior CAPSI research.

Acknowledgements

I thank my advisor, Dr. Joseph Pear for his guidance on this project, and the members of my thesis committee, Dr. Dickie C.T. Yu of the Department of Psychology and Dr. James Hare of the Department of Zoology. I also give special thanks to Sherise Devine and Ronni Molinski for their hard work and effort on this project.

Dedication

This thesis is dedicated to Elizabeth Sharpe, my grandmother and number one supporter.

Table of Contents

List of Tables

A Study of Procrastination in a Computer-Aided Personalized System of Instruction Course

Academic procrastination has long been considered a behavioural problem displayed by many people. Considerable research in the areas of psychology and education has been devoted to examining some of the psychological and emotional correlates of academic procrastination, especially in post-secondary education. Findings have been mixed, with some inconsistency among studies in terms of proposed psychological events that are related to procrastination, such as low self-esteem, extraversion, positive affect, and impulsivity, while more consistent behaviour correlates have included time management skills, goal-setting skills, and organization skills (Steel, Brothen, & Wambach, 2001). Although research has suggested some of the personality characteristics that relate to procrastination, much of the problem with procrastination lies in the consequences, both short- and long-term, on individuals who procrastinate.

In post-secondary institutions there is often less prompting by instructors to induce students to study on a consistent basis than their prior learning history, developed in high school, has prepared them for (Bijou, Morris, & Parsons, 1976). Although the standard or traditional lecture and testing procedures for post-secondary course delivery typically include examinations with set dates and times and/or written assignments and papers with strict deadlines, students vary considerably as to when they begin work on meeting course requirements. They also differ as to whether they evenly distribute the work evenly over an extended period or concentrate it into a shorter period (Springer, 2005).

Researchers typically define and measure academic procrastination as either beginning studying or writing close to the deadline for an examination or assignment or massing the majority of the work near the deadline for its completion (Born & Moore, 1978). Much of the research in this area has documented deleterious correlates of academic procrastination, most pointing to outcomes that may be at least mediated by the procrastination behaviours. For example, Tice and Baumeister (1997) gathered information about students' behaviour from daily inventories and found that while students who engaged in more procrastination experienced less stress early in the term than students who did not procrastinate, the procrastinators experienced more stress as the deadline approached. Tice and Baumeister (1997) also reported that procrastination correlated significantly with lower exam scores, lower grades on written papers, and a higher incidence of illness. This was a strictly correlational study, however, and thus any causal inferences should be made with caution. It is quite possible that factors which lead to students putting off their work until later in the semester also tend to lead these students to obtain lower grades overall. Similarly, increased reported illness may be either a cause or effect of greater procrastination (and, could even be a major factor leading to both procrastination behaviour and lower grades).

It has been suggested that procrastination in online courses can be especially problematic relative to traditional courses because the latter force even the most problematic procrastinators to be exposed (e.g., through lectures) to some of the material earlier than they might otherwise be (Elvers, Polzella, & Graetz, 2003).

Personalized System of Instruction (PSI)

As an alternative to the traditional lecture-based method of instruction, Fred S. Keller (1968) developed a method of course delivery now commonly referred to as either the Keller Plan or Personalized System of Instruction (PSI). PSI contains a number of components based on behaviour analytic methods to enhance the learning process. These components include: clear specification of the learning objectives, usually in the form of study questions; small units of course material; frequent unit tests in which students demonstrate their knowledge; mastery criteria requiring demonstration of mastery of the material on one unit before moving on to the next unit; nonpunitive procedures in that there is no penalty for not demonstrating mastery at a given unit; the use of student helpers (often called "student proctors") who have demonstrated mastery of the material that assist with marking tests and providing feedback to test writers; rapid feedback on unit tests; a self-paced format; and minimal use of lectures (Martin & Pear, 2003, p.16-17).

Considerable research has demonstrated that PSI is generally more effective than traditional teaching methods (Buskist, Cush, & DeGrandpre, 1991; Kulik, Kulik, & Cohen, 1979). However, it also tends to be more labour intensive in terms of preparing multiple tests for each unit, scheduling unit tests, and training student proctors, which has tended to discourage its use (Buskist, Cush, & DeGrandpre, 1991; Lloyd & Lloyd, 1986).

Computer-Aided Personalized System of Instruction (CAPSI)

Advances in computer technology led to the capability of computerizing much of the more labour-intensive aspects of the system, thereby allowing for a more cost-effective method of managing a PSI-taught course. A computerized version of PSI, the Computer-Aided Personalized System of Instruction (CAPSI), originated at the University of Manitoba as a mainframe-computer based program (Kinsner & Pear, 1988; Pear & Kinsner, 1988). The system progressed to a DOS-based program on the university's local server that could be accessed from campus computers or online via telnet; and finally to a full Web-based application program. Each version of CAPSI has become user-friendlier and more accessible.

Incorporating many of the aspects of PSI noted above, CAPSI has been able to expand on the original idea in several ways (Pear & Crone-Todd, 1999). These include permitting students, the instructor, and teaching assistants to access the systems at any time (24-hours-per-day, seven-days a week, including holidays) rather than only during regularly scheduled class times, and allowing students to act as peer reviewers for units they have passed as soon as they have passed those units.

Unit tests are marked on a pass/restudy basis, where pass means that the student has demonstrated mastery and restudy indicates that the student must restudy and take another test on the unit. At the beginning of a course the instructor specifies the number of peer reviewers required to mark and pass each unit test (typically two) in order for the test to be registered as a pass. Tests marked by the instructor or teaching assistant require only one marker to assign a pass for the test to be recorded as a pass. Unit tests are only assigned to the instructor or teaching assistant for marking when there are not two students within the course who are available and qualified to mark the test. If a test is marked by peer reviewers, both peer reviewers must assign a pass in order for the system to record a passing mark for the test; if one or both peer reviewers assign a restudy, then the mark recorded for that test is a restudy. Because unit tests are unsupervised, CAPSI-taught courses typically include a closed-book, supervised final examination that uses a marking scheme in which partial credit may be obtained. The CAPSI program includes a built-in appeal function for students who wish to argue their assigned mark on unit tests or exams. As well, while students are encouraged to complete all 10 unit tests according the CAPSI General Manual, there is no actual requirement for students to complete all 10 unit tests in order to pass the course.

Research on the peer-reviewer aspect of CAPSI has shown that the use of two peer-reviewers as markers of unit tests produces assignment of marks and peer-reviewers providing feedback with a reasonable degree of accuracy relative to that of an instructor, ranging from error rates of 7%-46% when compared with expert markers (Martin, Pear, & Martin, 2002a; Martin, Pear, & Martin, 2002b). Moreover, students rate CAPSI-taught courses as highly as traditional lecture-based courses in terms of how well they enjoyed the course material, how much they feel they learned in the course, and whether or not they would take another course using CAPSI in the future (Pear & Novak, 1996). This is not surprising because PSI-taught courses have typically been rated highly by students (Buskist, Cush, & DeGrandpre, 1991). This includes PSI-taught courses with some limited automation by computers (Eppler & Ironsmith, 2004).

Self-pacing in Personalized Courses

Although the mastery aspect of PSI requires self-pacing, some students do not pace themselves well. In other words, some students engage in procrastination to the extent that they may not complete their work on time (Lamwers & Jazwinski, 1989; Reiser, 1984; Roberts, Fulton, & Semb, 1988; Wesp, 1986).

To some extent, procrastination may be an artificial problem, or one that results from a system of arbitrary deadlines that exist mainly for administrative convenience. Born and Moore (1978) noted that the "pacing problem" is a product of the fact that the limited duration of a semester restricts the amount of self-pacing that is possible in a course. Bijou, Morris, and Parsons (1976) note that most university students' learning histories tend not to have provided them with much skill in navigating self-paced courses.

Springer (2005) examined the progress of students in a number of CAPSI-taught courses, and found that students varied widely on their rates of writing unit tests. Springer defined three categories of progress through a CAPSI-taught course or progress style: Early massing, in which students massed or concentrated their unit tests early in a course, late massing or procrastination in which students massed their unit tests late in a course, and no massing in which students distributed their unit tests fairly evenly across a courses. Many procrastinators completed all unit tests in the course, although some did not. Although the three categories of progress style did not appear to result in significant differences in terms of academic performance (measured in terms of researcher scored final exam scores) among those students who completed all the unit tests, there was a significant difference between those students who displayed an early massed progress style and completed all unit tests compared to those who did not complete all the unit tests. However, further research suggests that there may be a relationship between progress rate and final exam performance for more "challenging" courses (i.e. those in which there is already larger variability in final exam performance) but not for other courses (Schnerch, Dalzell, & Pear, 2006).

Early massed progress may be advantageous in a CAPSI-taught course because – since the procedure requires that students have passed units that they peer review – it is necessarily associated with a greater number of peer-review points earned. Moreover, Springer found that peer-review points were correlated with greater performance on final exams. Overall, getting started early on test taking and massing early in CAPSI-taught courses seems related to overall performance in the course.

Most attempts to gain control over students' pacing in PSI-taught courses have included instructor-imposed deadlines in addition to the end of semester deadline, often with aversive consequences associated with not meeting these deadlines. Interventions that have previously been reported in the literature as being effective in reducing procrastination in PSI courses include instructor-set deadlines with either a reward for meeting the deadlines or punishment for not meeting them (e.g., Reiser, 1984), instructor-set deadlines combined with contracting with students not meeting the deadlines specified (e.g., Lamwers & Jazwinski, 1989), student-set personal deadlines (e.g., Roberts, Fulton, & Semb, 1988), and procedures for shaping the time-management skills of the students (e.g., Keenan, Bono, & Hursh, 1978). It may be possible, however, to achieve effective control over progress rates without resorting to the aversive contingencies inherent in strictly-enforced deadlines.

Wirth (2004) examined the effect of instructor-delivered rules on student performance in a CAPSI-taught course. The CAPSI General Manual, provided to all students enrolled in a CAPSI-taught course, contained instructions encouraging students to carefully examine unit tests that they were reviewing to ensure both accurate marking and feedback. The General Manual also informed students that their reviewing might be monitored periodically. A question was also included in the pool of questions that could appear on the first unit test. This procedure increased the accuracy with which students reviewed unit tests (Wirth, 2004). The data from this study thus suggest that instructor delivered rules targeting specific student behaviours to increase a performance measure, even without explicit aversive consequences (that is, no aversive contingencies were specified by the instructor, although some students may believe there is implied aversive contingencies depending on their relative learning history and interactions with past instructor-delivered rules), can gain some control over students' behaviour, and it was speculated that instructor prompts during the course may enhance this effect.

The present study investigated the effects of adding to the structure of a "challenging" CAPSI-taught undergraduate course a series of prompts designed to exert control over students' pacing behaviour in order to reduce procrastination. It was hypothesized that this would reduce procrastination, which in turn would result in higher performance on the final exam than in a CAPSI-taught course that did not include these prompts.

Method

Participants

Participants were students enrolled in two sections of Learning Foundations (University of Manitoba Course No. 17.247) delivered by CAPSI in the Winter 2005 and Winter 2006 sections. There were 33 students initially enrolled in the Winter 2005 section, and 21 students initially enrolled in the Winter 2006 section. Most analyses, however, were performed only on those students who did not drop the course. The final enrolments were 26 students on the Winter 2005 section, and 11 students in the Winter 2006 section.

Procedure

Archived data were used for the analyses. The Winter 2005 section, which will be referred to as the No-Chart Section, was taught using CAPSI as described in the Introduction. In the Winter 2006 section, which will be referred to as the Chart Section, the instructor (who was the same instructor for both sections) added a "Suggested Self-Pacing Chart" to the General Manual for the course and a question relating to the chart on all unit 1 tests. There were also frequent reminders (see below) about suggested unit test deadlines sent to all students via the internal CAPSI messaging system. The "Suggested Self-Pacing Chart" was also available on the information website for the course. The chart included suggested completion dates for each unit test in the course, each spaced approximately one week apart. The question that appeared on each unit 1 test was "By what date does the 'Suggested Self-Pacing Chart' suggest that you should complete unit test 3?" A week before the suggested date for every second unit test (starting with unit test 2), the course instructor sent out the following message via the CAPSI messaging system: "This is just a reminder that you should try to complete unit test X by MONTH DAY" (where "X" was the unit the students should have been on, and "MONTH DAY" was the month and day that the students should complete the unit according to the chart).

The archived data collected for both sections for each student were as follows: number of unit tests completed, final exam answers, final exam scores assigned by the instructor, dates that each unit test was passed, and number of peer-review points earned.

Method of Analysis

Due to the nature of the different marking schemes used for unit tests and the final exam, for research purposes, final exams are typically the main measure of students' academic performance in a CAPSI-taught course. As well, to help ensure reliable scores for final exam are obtained, and since it is unclear after a course is over exactly what method was used by the instructor in marking the final exams or how closely he/she followed his/her marking scheme, final exam scores were derived by researchers independent of the original instructor. Two research assistants and I scored the final exams using an answer key prepared for this study, although only my scores were used for the final data analyses and the research assistants' scores were used only for determining the consistency of the marking with the answer key, thus providing an estimate of interobserver reliability (IOR). The answer key was created by two research assistants and I, in which each question that appeared on any of the examinations was analyzed as individual components, and a marking rubric was created with answers for each component. This took into account that different questions contained different numbers of discrete components. For example, one question may be "Define respondent stimulus generalization and give an example". This question would be considered to contain two components; one relating to the definition, and one relating to the example. Each question was marked out of 5, although various question components could be assigned different marks depending on how many components a question was determined to contain. For a question with only one component, that component was worth 5 marks; for a question with two components, each component was worth 2.5 marks; for a question with three components each question was worth 1.67 marks; and so on. Each component was marked as either completely correct or incorrect. For example, if a question contained two components, and the student's answer to component 1 was completely correct, but their answer to component 2 was lacking in some way, the markers would assign a mark of 2.5 for component 1, a mark of 0 for component 2, and the overall mark for the answer to that question would be 2.5 out of 5.

The research assistants involved in the answer key creation and revisions, and who provided IOR's, included a Master's student in Applied Behaviour Analysis with considerable experience as an ABA researcher and Behaviour Analyst, and a senior therapist in ABA with a Bachelor's degree in Psychology and who has served as a research assistant on a number of ABA-related projects. Randomly selected tests from both sections were chosen to be used for practice scoring by the author and at least one research assistant, and IOR scores were derived for these practice sessions. Following derivation of the IOR scores on practice tests, discussion of the discrepancies in marking were held, and revisions were made to increase the precision of the answer keys were made where deemed necessary. Once 3 tests in a row in each section had been independently scored with IORs of 80% or higher, "live" scoring began, in which the remaining final exams were scored by the author, and at least 30% of the overall tests in the course were independently scored by one of the two research assistants. While the scores determined by the author for the final exams used in the practice scoring sessions were used in the final data analyses, none of the IORs from the practice sessions were used in the final analysis. For those questions in which the answer key had been revised in the practice sessions, the author re-scored the practice exams on those questions only to maintain consistency with the final scoring scheme. For IOR purposes, each question component was treated as an interval of data, and IORs were calculated per exam using the interval method of IOR calculation. In the typical interval method of IOR calculation a period of time is divided into multiple intervals of equal lengths of time, and a behaviour is scored as occurring or not occurring per interval. Overall IOR is then calculated by taking the number of intervals in which two scorers agreed that the behaviour occurred, and dividing this by the agreements plus the number of intervals on which they disagreed as to whether the behaviour occurred or not (Martin & Pear, 2007).

In the No-Chart section 31% of the exams were scored in common, while in the Chart section 36% of the exams were scored in common. The average IOR for the No-Chart section was 89.3%, with a range of 81.8% to 97.1%. The average IOR for the Chart section was 92.6%, with a range of 85.2% to 100%.

A progress index, which was the same as that used by Springer (2005), provided a quantitative measure distribution of each student's unit tests throughout the course. The progress index for a student was calculated by first determining how many unit tests the student had completed (i.e., passed) by the end of each day of the course. Thus, if a student is in a course that began on Sept. 01, and he or she had completed 3 unit tests on Sept. 03, then for day 3 (which corresponds to Sept. 03) that student would be assigned a 3. The progress index was calculated by simple addition of all the scores for each day in the course for a given student (see Table 1), and then dividing this number (Progress Index Score) by the highest possible score (Progress Index Ratio). This ratio was used because of the differences in the total number of days in the different sections of the course. For those students who complete all ten unit tests, the progress index would be lower if they complete their unit tests later in the course (that is, the lower the score, the more the students "procrastinated"), while the larger the score the earlier they completed unit tests overall (Table 1). These analyses were performed on all students who completed the course (defined as having written the final exam), and on those students who both completed the course and completed all ten unit tests (referred to here as the "unit completion subset" of all students who completed the course). The rationale for conducting these separate analyses is that students who did not complete all the unit tests may represent a different population than those who did.

The researcher scored final exam scores were compared to the instructor-marked final exam scores using Pearson product-moment correlation to determine the approximate reliability of the instructor-marked final exam scores and whether or not they would be included in further analyses, or if only the research scored final exam scores would be used.

Correlation was used to evaluate whether or not the positive linear relationship previously found between progress indices and final exam scores in CAPSI research (Schnerch, Dalzell, and Pear, 2006) would be found between the two groups used in this study. Correlations between number of peer-review points earned and both progress indices and final exam scores were explored, and because of the possible relationships between peer-review points and both progress indices and final exam scores in each of the two course sections, it was decided to run partial correlations between progress indices and final exam scores for each section with peer-review points partialed out.

Comparisons were made between the sections to explore possible differences based on either or both of the progress indices or final exam scores as dependent variables. Due to the apparent relationship between peer-review points and both progress indices and final exam scores in each of the two course sections, it was decided to use an Analysis of Covariance (ANCOVA) to explore these differences while controlling for peer-review points earned.

Follow-up analyses were performed using Pearson product-moment correlation to further explore the relationships involving peer-review points and final exam scores. Analyses were also performed comparing the relative dropout rates of the two sections. For the drop-out rate analyses, data of all students who had attempted at least one unit test were examined. This ensured that students considered enrolled in the course for the purpose of this study were only those who had, to at least some extent, come into contact with the contingencies operating in the course, including the "suggested self-pacing chart" since a question relating to the chart appeared on unit test 1. Students who dropped the course were defined as those students who were enrolled in the course (as defined above) but did not complete it (which, as noted earlier was defined as writing the final exam). The dropout rate was defined as the proportion of enrolled students who dropped out. A Z-test of the difference of proportions was used to explore the difference in drop-out rates.

Results

Correlations between the researcher scored final exam scores and the instructor-marked final exam scores using Pearson product-moment correlation resulted in $r = 0.853$, $p < 0.001$ for the No-Chart section, and $r = 0.875$, $p < 0.001$ for the Chart section. For the No-Chart section instructor-marked final exam scores had ranged from 3 to 60 (range = 57) points, with a mean of 33.44 and standard deviation of 17.34, while the researcher scored final exam scores had a range of 2.38 to 45.25 (range = 42.87) points, with a mean of 17.92 and standard deviation of 12.64. For the Chart section instructor marked final exam scores had a range of 8 to 57 (range = 49) points, with a mean of 35.61 and standard deviation of 17.43, while the researcher scored final exam scores had a range of 0 to 31.68 points, with a mean of 18.01 and standard deviation of 10.02 (Table 2).

In the No-Chart section, progress indices had a range of 0 to 0.582 (range = 0.582), with a mean of 0.204, and a standard deviation of 0.161. In the Chart section, progress indices had a range of 0.067 to 0.772 (range = 0.705), with a mean of 0.310, and a standard deviation of 0.238.

For the No-Chart section the correlation between progress indices and final exam scores (researcher scored) was $r = 0.48$, $p = 0.012$, and between progress indices and final exam scores (instructor marked) was $r = 0.59$, $p = 0.002$. For the Chart section, the correlation between progress indices and final exam scores (researcher scored) was $r = 0.475$, $p = 0.140$, and between progress indices and final exam scores (instructor marked) was $r = 0.658$, $p = 0.028$ (Table 3).

For the No-Chart section, correlations between peer-review points and progress indices ($r = 0.79$, $p < 0.001$), instructor-marked final exams ($r = 0.69$, $p < 0.001$), and researcher scored final exams ($r = 0.53$, $p = 0.006$) were all significant at at least the 0.01 level. For the Chart section, of the relationships between peer-review points and progress indices ($r = 0.84$, $p = 0.001$), instructor marked final exams (r = 0.59, p = 0.058), and researcher scored final exams (r = 0.39, p = 0.238), only the correlation between peer-review points and progress indices was significant at the 0.01 level, although the relationship between peer-review points and instructor marked final exams was similar to that in the No-Chart section and approached significance (Table 4).

For the No-Chart section of the course, the correlation between progress indices and final exam scores (researcher scored) was $r = 0.128, p = 0.544$, and between progress indices and final exam scores (instructor-marked) was $r = 0.107, p = 0.612$, when partialing out peer-review points. For the Chart section of the course, the partial correlation between progress indices and final exam scores (researcher scored) was $r = 0.297, p = 0.405$, and between progress indices and final exam scores (instructor-marked) was $r = 0.375, p = 0.286$. While statistical significance was not reached, correlations consistently were positive (Table 5).

Analysis of Covariance (ANCOVA) was used to explore differences between the two sections based on either or both of the progress indices or final exam scores as dependent variables while controlling for peer-review points earned. For evaluating differences between progress indices, a preliminary analysis to evaluate the homogeneity of slopes assumption was performed, which indicated the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1,33) = 1.96, MSE = 0.024, p = 0.171$. The ANCOVA for progress indices was not significant, $F(1,34) = 3.21, MSE = 0.041, p = .082$. For evaluating differences between researcher scored final exam scores, a preliminary analysis to evaluate the homogeneity of slopes assumption was performed, which indicated the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1,33) = 0.693, MSE = 78.57, p = 0.411$. The ANCOVA for researcher scored final exam scores was not significant,

$F(1,34) = 0.096$, $MSE = 10.82$, $p = 0.758$. Finally, for evaluating differences between instructor marked final exam scores, a preliminary analysis to evaluate the homogeneity of slopes assumption was performed, which indicated the relationship between the covariate and the dependent variable did not differ significantly as a function of the independent variable, $F(1,33) = 0.292$, $MSE = 53.01$, $p = 0.592$. The ANCOVA for instructor marked final exam scores was not significant, $F(1,34) = 0.005$, MSE = 0.94, $p = 0.943$.

For the No-Chart section, of the relationships between peer-review points and instructor marked final exams ($r = 0.441$, $p = 0.027$), and researcher scored final exams ($r = 0.269$, $p = 0.194$) while partialing out progress indices, only the correlation between peer-review points and instructor marked final exam scores was significant. For the Chart section, of the relationships between peer-review points and instructor marked final exams ($r = 0.084$, $p = 0.818$), and researcher scored final exams ($r = -0.022$, $p = 0.952$) while partialing out progress indices, neither relationship was significant (Table 7).

Although at the outset of the study I intended to run the same analyses excluding students who did not complete all ten unit tests in the course, these analyses were not run due to the extremely low sample size, as this exclusion criteria would have left the Chart section with n = 3. Analyses were thus only performed using all students who completed the course overall.

The No-Chart section had 33 students who attempted at least one unit test, and of these 26 who completed the course. The Chart section had 21 students who attempted at least one unit test, and of these 11 who completed the course. The Z-test for the difference between proportions was performed based on the drop-out rates between the

No-Chart section and the Chart section, yielding a Z-score of -2.037, $p = 0.0417$, two-tailed (Table 8).

Discussion

High correlations were evident in both sections between the final exam scores derived using the researcher scoring method employed in this study and the final exam marks assigned by the instructor. This of course is a good sign that the instructor for this course marked the final exams reliably, and thus I was able to include those scores in my analyses. It was interesting to note, however, that the correlations may have been higher except that the researcher scored exams seemed to have a lower ceiling, which reduced variability both in terms of the ranges and standard deviations for both sections. This makes sense as the objective scoring was perhaps, by necessity, more "strict" than would be desired of the instructor's mark assignments, particularly for a second year undergraduate course. Thus both the researcher derived final exam scores and the instructor assigned final exam scores were seen as reliable and useful measures, and thus analyses were run using both.

Previous CAPSI research found a positive correlation between progress indices and final exam scores (Schnerch, Dalzell, and Pear, 2006). In the current study, while this relationship was observed for the No-Chart section when using both the objective final exam scores and the instructor assigned final exam scores, for the Chart section this pattern was only significant at the 0.05 level when using the instructor assigned scores. The correlation between the progress indices and the objective final exam scores in the Chart section was similar (positive linear) and nearing significance, but as significance was not reached, possibly due to the restricted variability in the objective final exam scores, conclusions drawn must be extremely tentative as the two sections cannot conclusively be said to represent the same data patterns.

Students in CAPSI courses receive bonus points for peer-reviewing other students' unit tests. However, students may only mark unit tests that they themselves passed. Thus, the number of peer-review points students receive are necessarily tied to their progress rate through the unit tests in the course (represented quantitatively here by the progress index). However, in theory each test they mark also provides them with the opportunity to review the course material, and in fact it may be argued that the critical analysis involved in marking someone else's answers provides an exceptional learning opportunity (Springer, 2005). Thus, the number of peer-review points, as a measure of how many times a person has marked other students' tests, may be related to academic performance in CAPSI courses (as measured here by the final exam scores). It was decided to explore what relationship, if any, might be present then between peer-review points and these other measures. All correlations were positive and significant in the No-Chart section, including between peer-review points and both measures of final exam performance, as well as with progress indices. However, in the Chart section, only the relationship between peer-review points and progress indices reached significance. Nonetheless, due to the possible contribution of peer-review points to the amount of variance observed in each of these measures, it was decided to re-run the initial correlations partialing out the contribution of the peer-review points. As suspected, this procedure reduced each of the correlations, and in fact for both sections, while the correlations remained positive in each case, none of the correlations between progress indices and final exam scores (either objective of instructor assigned) remained significant.

Differences were explored between the two sections in terms of progress indices, and final exam scores (both measures). However, no significant differences were observed for either of these, either when holding peer-review points constant or not. Thus, no appreciable difference could be detected between the two sections on any of the measures of interest. The Suggested Self-Pacing Chart appears not to have had a detectable effect either on the more direct target of the intervention (i.e. increasing student rates of unit test taking) nor upon the indirect target (student academic performance in the course).

It was decided as well to do additional follow-up analyses involving the peer-review points, as they are potentially important to the learning process in CAPSI courses. The positive linear relationship remained between peer-review points and final exam scores when partialing out the effect of the progress indices for the No-Chart section of the course, however, only when using the instructor assigned final exam scores. No significant relationship was found for the Chart section, although it should be noted again that the sample size for that section was substantially smaller.

A two-sided test between the dropout rates was performed which revealed that there was a difference between the two sections, with the Chart section (the one with the added intervention) having a much larger drop-out rate. This brings up a number of additional questions. Did the addition 'Suggested Self-Pacing Chart' cause more people to drop out than usual? All attempts were made to make it clear to students through the wording of the chart and the email reminders delivered that this chart only suggested dates by which students were encouraged to try and complete unit tests by. These were not strictly-imposed deadlines, and thus were not expected to discourage students. Whether or not the intervention caused the increase in drop-out rate, which is hard to say in light of the current research design employed, a more important question needs to be asked in terms of the remaining data. With such a relatively large dropout rate in the Chart section, how representative were the students who remained in the course? This makes comparisons between the two sections even more difficult, and any possible speculations based on the results involving the data from the Chart section, or the differences between the two sections, necessarily even more tentative.

There was some evidence that a relationship exists between peer-reviewing and academic performance in CAPSI courses, which is consistent with previous findings (Springer, 2005). This is an area that would be especially interesting to explore further, particularly the impact of interventions targeting aspects of peer-reviewing, such as increasing peer-review accuracy and quality of feedback, as well as exploring what effects these may have on academic performance.

Some additional limitations of this research should be noted. The participants in this study were not randomly selected from the larger population of university students. Participants included in this study were self-registered in a non-required psychology course offered through CAPSI. Many may have selected a CAPSI-delivered course specifically based on any one or more of its features that are not characteristic of other, traditionally taught courses at the university, including its self-pacing feature. The learning course especially, is often taken by students after having taken one or more courses on behaviour modification, which are also offered via CAPSI, thus they may have more experience with the self-paced system than the average mid-level undergraduate university student. Replication of these results, including whether or not the same patterns would be seen in other kinds of courses offered using CAPSI, would be necessary to draw stronger conclusions.

Future research could explore more intrusive interventions that may include methods previously demonstrated to be effective in reducing procrastination in PSI courses as discussed earlier, such as instructor-set deadlines with either a reward for meeting the deadlines or punishment for not meeting them (e.g., Reiser, 1984), instructor-set deadlines combined with contracting with students not meeting the deadlines specified (e.g., Lamwers & Jazwinski, 1989), student-set personal deadlines (e.g., Roberts, Fulton, & Semb, 1988), or procedures for shaping the time-management skills of the students (e.g., Keenan, Bono, & Hursh, 1978).

References

Bijou, S. W., Morris, E. K., & Parsons, J. A. (1976). A PSI course in child development with a procedure for reducing student procrastination. *Journal of Personalized Instruction, 1,* 36-40.

Born, D. G., & Moore, M. C. (1978). Some belated thoughts on pacing. *Journal of Personalized Instruction, 3,* 33-36.

Buskist, W., Cush, D., and DeGrandpre, R. J. (1991). The life and times of PSI. *Journal of Behavioral Education, 1,* 215-234.

Elvers, G. C., Polzella, D. J., & Graetz, K. (2003). Procrastination in online courses: Performance and attitudinal differences. *Teaching of Psychology, 30,* 159-162.

Eppler, M. A., & Ironsmith, M. (2004). PSI and distance learning in a developmental psychology course. *Teaching of Psychology, 31,* 131-134.

Keenan, J. B., Bono, S. F., & Hursh, D. E. (1978). Shaping time-management skills: Two examples in PSI. *Journal of Personalized Instruction, 3,* 46-49.

Keller, F. S. (1968). Good-bye, teacher… *Journal of Applied Behavior Analysis, 1,* 79-89.

Kinsner, W., & Pear, J. J. (1988). Computer-aided personalized system of instruction for the virtual classroom. *Canadian Journal of Educational Communication, 17,* 21-36.

Kulik, J. A., Kulik, C. C., & Cohen, P. A. (1979). A meta-analysis of outcome studies of Keller's personalized system of instruction. *American Psychologist, 34,* 307-318.

Lamwers, L. L., & Jazwinski, C. H. (1989). A comparison of three strategies to reduce student procrastination in PSI. *Teaching of Psychology, 16,* 8-12.

Lloyd, M. E., & Lloyd, K. E. (1986). Has lightning struck twice? Use of PSI in college classrooms. *Teaching of Psychology, 13,* 149-151.

Martin, G. L., & Pear, J. J. (2003). *Behavior Modification: What It Is and How to Do It* (7th ed.). Upper Saddle River, NJ: Prentice-Hall.

Martin, T. L., Pear, J. J., & Martin, G. L. (2002a). Analysis of proctor marking accuracy in a computer-aided personalized system of instruction course. *Journal of Applied Behavior Analysis, 35,* 309-312.

Martin, T. L., Pear, J. J., & Martin, G. L. (2002b). Feedback and its effectiveness in a computer-aided personalized system of instruction course. *Journal of Applied Behavior Analysis, 35,* 427-430.

Pear, J. J., & Crone-Todd, D. E. (1999). Personalized system of instruction in cyberspace. *Journal of Applied Behavior Analysis, 32,* 205-209.

Pear, J. J., & Kinsner, W. (1988). Computer-aided personalized system of instruction: A effective and economical method for short- and long-distance education. *Machine-Mediated Learning, 2,* 213-237.

Pear, J. J., & Novak, M. (1996). Computer-aided personalized system of instruction: A program evaluation. *Teaching of Psychology, 23,* 119-123.

Reiser, R. A. (1984). Reducing student procrastination in a personalized system of instruction course. *Educational Communication and Technology Journal, 32,* 41-49.

Roberts, M. S., Fulton, M, & Semb, G. (1988). Self-pacing in a personalized psychology course: Letting students set the deadlines. *Teaching of Psychology, 15,* 89-92.

Schnerch, G., Dalzell, K., & Pear, J. J. (2006, May). *The Relationship Between*

Procrastination and Academic Performance in a Computer-Aided PSI Course. Poster presented at the 32nd Annual Convention of the Association for Behavior Analysis, Atlanta, Georgia.

Springer, C. R. (2005). *The relationship between progress style and exam performance in computer-aided personalized system of instruction courses.* Unpublished Master's Thesis, University of Manitoba, Canada.

Steel, P., Brothen, T., & Wambach, C. (2001). Procrastination and personality, performance, and mood. *Personality and Individual Differences, 30,* 95-106.

Tice, D. M., & Baumeister, R. F. (1997). Longitudinal study of procrastination, performance, stress, and health: The costs and benefits of dawdling. *Psychological Science, 8,* 454-458.

Wesp (1986). Reducing procrastination through required course involvement. *Teaching of Psychology, 13,* 128-130.

Wirth, K. M. (2004). *A study of rules designed to increase peer-review accuracy in a computer aided personalized system of instruction course.* Unpublished Master's Thesis, University of Manitoba, Canada.

Table 1

Progress Indices for Three Hypothetical Students

	Day											
Participant	1	2	3	4	5	6	7	8	9	10	Progress index (sum)	Progress index (ratio)
Student 1 (Late massing)	0	0	0	0	0	0	1	3	3	5	12	1.2
Student 2 (Steady rate)	0	1	2	2	3	3	3	4	5	5	28	2.8
Student 3 (Early massing)	1	3	3	5	5	5	5	5	5	5	42	4.2

Table 2

Comparison of Final Exam Scores in Chart and No-Chart Sections

Sections	Means	Standard Deviations	Ranges	Correlations of scores
No-Chart (Instructor Scored)	33.44	17.34	60-3=57	0.853
No-Chart (Researcher Scored)	17.92	12.64	45.25-2.38=42.87	
Chart (Instructor Scored)	35.61	17.43	57-8=49	0.875
Chart (Researcher Scored)	18.01	10.02	31.68-0=31.68	

Note. All correlations significant at the 0.001 level.

Table 3

Correlations Between Progress Indices and Final Exam Scores in Chart and No-Chart Sections

Final Exam Score Source	Progress Indices	Significance Level
No-Chart (Instructor Scored)	0.59[b]	0.002
No-Chart (Researcher Scored)	0.48[a]	0.012
Chart (Instructor Scored)	0.658[a]	0.028
Chart (Researcher Scored)	0.475	0.140

[a]Significant at the 0.05 level.

[b]Significant at the 0.01 level.

Table 4

Correlations Between Peer-Review Points and both Progress Indices and Final Exam Scores in Chart and No-Chart Sections

Measure	Peer-Review Points	Significance Level
No-Chart Instructor Scored Final Exams	0.69 [a]	<0.001
No-Chart Researcher Scored Final Exams	0.53 [a]	0.006
No-Chart Progress Indices	0.79 [a]	<0.001
Chart Instructor Scored Final Exams	0.59	0.058
Chart Researcher Scored Final Exams	0.39	0.238
Chart Progress Indices	0.84[a]	0.001

[a]Significant at the 0.01 level.

Table 5

Correlations Between Progress Indices and Final Exam Scores in Chart and No-Chart Sections While Partialing Out Peer-Review Points

Final Exam Score Source	Progress Indices	Significance Level
No-Chart (Instructor Scored)	0.107	0.612
No-Chart (Researcher Scored)	0.128	0.544
Chart (Instructor Scored)	0.375	0.286
Chart (Researcher Scored)	0.297	0.405

Table 6

Correlations Between Peer-Review Points and Final Exam Scores in Chart and No-Chart Sections While Partialing Out Progress Indices

Final Exam Score Source	Peer-Review Points	Significance Level
No-Chart (Instructor Scored)	0.441[a]	0.027
No-Chart (Researcher Scored)	0.269	0.194
Chart (Instructor Scored)	0.084	0.818
Chart (Researcher Scored)	-0.022	0.952

[a]Significant at the 0.05 level.

Table 7

Test of the Difference of Proportions Between Drop-Outs Rates of Chart and No-Chart Sections

Sections	Enrolled	Dropped	Drop-Out Proportion	Z-Score
No-Chart	33	7	0.21	-2.037
Chart	21	10	0.48	

Note. Test significant at the 0.05 level, two-tailed.