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Online Assignment Submission Delay as a Behavioral Indicator of Procrastination

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ONLINE ASSIGNMENT SUBMISSION DELAY AS A BEHAVIORAL INDICATOR OF PROCRASTINATION

A Master's Thesis

Presented to

The Graduate College of

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In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Experimental Psychology

By

Ari L. Cunningham

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Psychology

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Master of Science

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Abstract

Procrastination has long been recognized as an important topic in higher education, and various tools for measuring procrastination have focused on either behavioral or subjective components of the phenomenon. This study examines how online assignment submission delay, used as an objective measure of procrastination, relates to several conceptualizations of procrastination and pacing style measured through self-report questionnaires. It was hypothesized that median assignment submission delay would have a positive relationship with the included self-report measures, a positive relationship with the deadline action pacing style, and a negative relationship with the steady pacing style. Data was collected from 66 students in an online experimental psychology course across 14 lab assignments and six surveys. The analysis included correlations of median assignment submission delay with each of the self-report measures as well as number of assignments turned in and average exam score. A multiple linear regression was conducted with submission delay as the outcome variable and these same variables as predictors. The hypotheses were only partially and weakly supported in that submission delay correlated with some, but not all, measures and few predictors were uniquely significant in the regression model. Submission delay was positively related to the deadline action pacing style but not related in either direction to the steady pacing style. These results should be interpreted with caution due to a limited sample size and a dataset that failed many assumptions for parametric analysis.

KEYWORDS: procrastination, delay, pacing style, online education, online assignments, behavioral measures, self-report measures

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TABLE OF CONTENTS

LIST OF TABLES

Introduction

Procrastination has been recognized for decades as a concerningly widespread phenomenon among college students. In an early study of student procrastination by Solomon and Rothblum (1984), nearly half of students reported that they always or nearly always procrastinate on term papers, and 65% wanted to decrease their procrastination on term papers. Around 75% of students considered themselves to be procrastinators in a 1987 study by Potts (as cited in Steel, 2007). Somewhat more recently, Schouwenberg (2004) found that 70% of students considered themselves procrastinators, indicating some consistency over the span of two decades. Despite the widespread nature of the phenomenon, procrastination has proved somewhat complex to define. Procrastination involves delay, but it is not the only form of delay. Many, perhaps the majority of, procrastination researchers hold the view that procrastination is primarily a negative or dysfunctional form of delay. Along these lines, Klingsieck (2013) proposed the following definition for procrastination, based on an earlier definition offered by Steel (2007): “The voluntary delay of an intended and necessary and/or [personally] important activity, despite expecting potential negative consequences that outweigh the positive consequences of the delay” (p. 26). This definition has the benefit of distinguishing procrastination from more functional forms of delay, while incorporating both the behavioral (delay) and subjective (intent, expectation) components of procrastination.

For decades, procrastination has been studied in relation to a wide range of variables related to personality, behavior, tasks, and context. Steel’s (2007) meta-analysis of 216 studies provides a helpful overview of some of the more commonly

studied relationships. In the meta-analysis, task aversiveness emerged as an important task characteristic related to procrastination, and there is some evidence that the timing of rewards and punishments is another task-level factor. Procrastination was also related to a variety of individual traits, most notably conscientiousness, self-efficacy, and self-esteem (negatively), and depression (positively). Men were found to procrastinate slightly more than women. Finally, procrastination studies across a variety of contexts have found it to have a slight negative relationship with outcomes such as academic performance, health, and financial well-being (Steel, 2007).

Most procrastination research has taken as a starting point that procrastination is by nature dysfunctional, but not all researchers agree. Chu and Choi (2005) proposed that a functional form called active procrastination exists as well and leads to more positive outcomes compared to other forms of procrastination. Active procrastination is thought to include four defining features: preference for time pressure, intentional decision to procrastinate, ability to meet deadlines, and satisfactory outcomes. Chu and Choi (2005) found that active procrastinators procrastinated in similar amounts to passive procrastinators but had outcomes (such as academic performance) similar to non-procrastinators, indicating that procrastination for these individuals was not harmful. However, the scale used in this study was not sufficiently reliable to draw firm conclusions. Choi and Moran (2009) further developed this line of research by creating a more reliable measure of active procrastination with a hierarchical factor structure (overall active procrastination and the four subscales for the defining features) and sufficient reliability. This study resulted in the Active Procrastination Scale (APS).

This proposal of a functional form of procrastination has been controversial among researchers on conceptual and empirical grounds. As an example, Hensley (2014) conducted a study examining active procrastination in relation to behavioral delay, passive procrastination, motivational beliefs, and achievement. Only three factors were found for active procrastination in this dataset: intentional decision to delay, ability to meet deadlines, and satisfying outcomes under pressure. Intentional decision to delay had a strong positive correlation with passive procrastination, while the other two factors were negatively correlated with both passive procrastination and intentional decision to delay. The researcher concluded that active procrastination seems to be measuring something other than procrastination, with the exception of the subscale representing intentional decision to delay (Hensley, 2014). Nevertheless, at least some students who consider themselves to be procrastinators view it is a functional method of accomplishing tasks while having to manage a wide variety of demands, as evidenced in Schraw, Wadkins, and Olafson's (2007) grounded theory study of procrastination.

Beyond the potential for functional and dysfunctional dimensions of procrastination, the phenomenon is multidimensional in another important way. Procrastination involves both objective and subjective components, and it can prove quite challenging to distinguish the two in research. The behavioral component has been referred to as delay or dilatory behavior, but procrastination is not the only reason for delay, as people tend to have many competing priorities and potential courses of action to choose from at any given time. Procrastination, according to the definition presented above, involves at minimum an intentional choice to delay, and many would argue that it also requires some amount of negative affect related to the dysfunctional

nature of procrastination (expecting to be worse off for the delay). These components of procrastination may even relate differentially to other relevant psychological variables, according to Malatincova (2015). In studying the relationship of reactance with procrastination, Malatincova (2015) found that reactance had a positive relationship with chronic delay but independently had a negative relationship with the subjective task-specific component of procrastination measured in the study. The article suggested that other variables could similarly relate in different ways to different components of procrastination, so it is important to consider them distinctly.

Another way to look at the behavioral or delay component of procrastination is as a form of the deadline action pacing style. Gevers et al. (2015) defined pacing style as "behavioral tendencies regarding the distribution of effort over time in working toward deadlines" and developed a scale to measure this construct: Pacing Action Categories of Effort Distribution (PACED). Though qualitative research resulted in the proposal of four pacing styles, factor analysis resulted in three that are measured by the PACED: deadline action pacing style (more work as the deadline approaches), steady action pacing style (work distributed somewhat evenly over time), and U-shaped pacing style (most work toward the beginning and end of the timeframe, but less in the middle). Further validity analysis of the scale provides evidence of the relationship of procrastination (as measured through a self-report scale of behavioral and cognitive avoidance reactions) with pacing style. Procrastination had a strong positive correlation with the deadline action pacing style, a moderate negative correlation with the steady pacing style, and a weak negative correlation with the U-shaped style. Like delay in general, the deadline action pacing style has much in common with the behavioral

aspect of procrastination, but also accounts for other reasons for completing work later in a given timeframe.

Procrastination has been measured through a variety of self-report as well as behavioral methods. Many self-report measures have been developed that reflect various aspects, contexts, and conceptualizations of procrastination, and these kinds of measures seem most poised to assess the more subjective aspects of procrastination. A meta-analysis by Kim and Seo (2015) demonstrates how choice of scale can mediate the results found in procrastination research. They described self-report scales along two dimensions regarding the assumptions made about procrastination in the measures: a negative versus positive view of procrastination, and portrayal of procrastination as a behavior versus trait. The meta-analysis focused on the relationship of procrastination with academic performance and found that the type of measure chosen to measure procrastination indeed mediated the relationship between procrastination and performance. Broadly speaking, the decision to use self-report versus behavioral measures mediated the relationship, but even within self-report measurement, the particular scale chosen also mediated this relationship. Furthermore, results comparing behavioral and self-report measures demonstrated that an objective assessment of academic performance was most strongly related to procrastination when the latter was also measured objectively. The relationship between procrastination and performance was weaker when using self-report measures for either or both variables. The authors concluded that students may be overestimating both their academic performance and their amount of procrastination in self-report measures.

The findings above hint at the broader issue of the validity of self-report scales of procrastination. Vangsness et al. (2022) assessed the psychometric properties of ten measures of procrastination. All the measures had acceptable internal reliability, but only three of the ten met acceptable standards through confirmatory factor analysis in their dataset. None of the measures significantly predicted pacing style in a Lasso analysis, while seven were significant predictors (with varying strength) of the number of days to study completion (how late in the semester students completed the study as part of a research requirement). The authors suggested that students may not be entirely aware of their strategies for completing tasks and that this could distort the observed relationship of procrastination (measured through self-report) with expected variables such as pacing style, or that the constructs of pacing style and procrastination have simply not been defined well enough to adequately test the relationship.

Behavioral or objective measures may be strong where self-report measures are weak, but these methods come with their own drawbacks. Behavioral measures of procrastination have included context-relevant procedures such as recording the amount of time it takes students to turn in assignments or to complete research requirements, as well as laboratory procedures measuring how long participants wait before beginning work on a given task when distractions are available. Studies of academic procrastination, when using a behavioral measure at all, have tended toward the former. An early example comes from Solomon and Rothblum (1984), who used as behavioral measures the number of quizzes taken within the last one-third of the semester as well as how late in the semester students completed the study for extra credit. Number of quizzes taken late in the semester related modestly positively to some

subscales of the Procrastination Assessment Scale for Students (PASS) developed for the study (Solomon and Rothblum, 1984). Beswick et al. (1988) measured the amount of time it took students to turn in three assignments: a term paper outline, a term paper, and a research questionnaire. Self-reported procrastination was most strongly related to time taken to turn in the outline and somewhat related to time taken to turn in the term paper. It was not related to time taken to turn in the research questionnaire. Since these early studies, various adaptations of submission or completion time have been used frequently in academic procrastination research.

As Kim and Seo (2015) found, procrastination measured behaviorally may demonstrate stronger relationships with other variables and thus may be more effective as a tool in procrastination research. Behavioral measures avoid many of the response biases that plague self-report measures of all kinds and reduce the need to depend on participants' memories of their experiences. Yet given the nature of procrastination as a deliberate form of delay, objective measures may introduce their own form of bias by neglecting to account for the subjective aspects of procrastination. The question becomes, are these methods genuinely measuring procrastination if they leave out the intent behind the observed delay? It is likely that both types of measures are needed to examine procrastination in its full complexity.

One recent study sought to specifically examine the ability of one procrastination scale to predict actual procrastination behavior. Zuber et al. (2019) assessed the ability of Steel's (2010) Pure Procrastination Scale (PPS) to predict procrastination behavior, as well as to examine how the behavior relates to the two dimensions of the scale: voluntary delay and observed delay. The behavioral variable in this case was the

number of days it took students to return a signed attendance sheet, given at least three weeks to do so. Overall, the PPS predicted 26.8% of the variance in behavioral procrastination as measured by this task. (Zuber et al., 2019). Both voluntary and observed delay were positively correlated with the behavior: $r = .41$, $r = .47$ respectively. The results serve as evidence for the validity of the PPS as well as shining light on the relationship between behavioral and self-report procrastination measures.

Researchers of academic procrastination have long measured procrastination behavior as the amount of time taken to hand in assignments in university courses. Increasingly, the growth of online education tools has made collection of this data easier and more objective. Howell et al. (2006) found that the submission times of assignments turned in online followed the hyperbolic pattern expected in procrastination and other temporal discounting, whereby more work is completed the closer the deadline approaches. They also assessed the relationship of assignment submission time with a handful of self-report measures. Assignment submission time here refers to the difference in time an assignment is started and the time it is due, and thus a larger time should correspond to a lower degree of procrastination (that is, starting work earlier). The researchers found that assignment submission time had only a moderate negative correlation with the PASS ($r = -.24$) and Tuckman's Procrastination Scale ($r = -.38$). However, it did have a somewhat stronger relationship with a self-report index of procrastination on these assignments ($r = -.45$) (Howell et al., 2006).

In a study with computer-based assignments in a self-paced course, Steel et al. (2001) found similar results. The self-report measure of procrastination used here was an index created by the researchers asking about procrastination at various points

during the semester, and the behavioral measure of postponement was a weighted average of assignment submission times (in this case, the data were coded such that a higher score should indicate more delay). Self-report procrastination was again moderately correlated with observed postponement (r = .37). Interestingly, observed postponement had a stronger relationship with self-reports of being behind schedule (r = .58), suggesting that procrastination may not be the only or even the best description for what assignment submission postponement is measuring. More research is needed to understand the behavioral measure of assignment submission time and how it can best be used in procrastination research.

The present study examined how online assignment submission delay relates to several conceptualizations of procrastination. I sought to replicate and extend the findings of Howell et al. (2006) regarding the relationship of online assignment delay with existing procrastination scales. This study will include a greater variety of self-report procrastination scales, along with the measure of pacing styles by Gevers et al. (2015). If assignment submission delay is going to be used as a behavioral indicator of procrastination, it is important to know what these data are in fact measuring.

The hypotheses for this study are as follows:

1. Median assignment submission time will have a positive relationship with each measure of self-report procrastination included in this study, with the exception of the Active Procrastination Scale (for which no hypothesis is made).
2. Median assignment submission time will be positively related to the deadline action pacing style and negatively related to the steady pacing style.

Method

Participants

This study was approved by the Institutional Review Board (IRB) of Missouri State University on September 28, 2021 and received Approval #IRB-FY2020-620 (See Appendix A). Students enrolled in an online research methods course (PSY 302: Experimental Psychology) were given the option to participate in this study. All students who agreed to participate were given extra credit in the course.

I conducted a power analysis for this study with G*Power using the lower correlation coefficient found in Howell et al. (2006): the correlation between assignment submission delay and the PASS . The number of participants needed to detect a relationship at 80% power with r = -.24 and α = .05, two-tailed, is 131.

Due to a stopping rule allowing me to defend this thesis with fewer participants, the goal of 131 participants was not reached during the allotted timeframe. The study included 66 participants who consented for their data to be used in the study: 53 identified as female, 11 identified as male, and 2 wrote in another gender. The mean age was 25.08 years old, with the oldest participant being 50 years old. Of the participants, 43 were seniors, 22 juniors, and 1 sophomore.

Materials

Apparatus. Participants responded to the surveys using Qualtrics on their own devices at a time of their choosing. Assignments used for submission time data were completed using Blackboard as part of the participants' usual course requirements. Blackboard is an online learning management system that can be used to manage online courses or to supplement in-person courses with online material.

Blackboard assignment data. Submission times for assignments were recorded directly from Blackboard. The assignments included were fourteen PSY 302 lab assignments of varying length and complexity. The lab assignments were designed to reinforce concepts and practices related to experimental psychology and included reading, writing, and analysis tasks. Each assignment was made available one at a time throughout the Spring 2023 semester. Roughly one assignment was posted per week, approximately 10 days before the due date. Students were allowed to turn in late work at any point until the end of the semester for partial credit. If late work was turned in before grades were posted for that assignment, the student was given 90% of their earned points. At any point after that, the student received 60% of their earned points.

Academic Procrastination Scale – Short Form (APSS). Yockey (2016) tested a short version of McClosky's (2011) Academic Procrastination Scale. It serves as a brief, unidimensional measure of overall academic procrastination. The short form scale includes five items with response options of 1 (agree) to 5 (disagree). It had good internal consistency, with Cronbach's α = .87. Total scores were calculated as the sum of scores.

Active Procrastination Scale (APS). The APS by Choi and Moran (2009) has sixteen items with responses measured on a seven-point Likert scale ranging from 1 (not at all true) to 7 (very true). Overall reliability was α = .80. It includes four subfactors: affective preference for time pressure (APS-PP), intentional cognitive decision to procrastinate (APS-ID), ability to meet deadlines (APS-AMD), and ability to achieve outcomes that are satisfactory (APS-OS). Subfactor reliabilities ranged from α = .70 to .83. Total scores were calculated as the mean of scores.

Pacing Action Categories of Effort Distribution (PACED). The PACED by Gevers et al. (2015) includes nine items measuring three pacing styles. The items are scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The deadline action pacing style (PACED-DA) and steady pacing style (PACED-SA) each have a reliability of α = .82. The U-shaped pacing style (PACED-US) has a Cronbach's α = .73. Factor scores were calculated as the mean of scores.

Procrastination Assessment Scale for Students (PASS). The PASS was developed by Solomon and Rothblum (1984) as a measure of many dimensions of academic procrastination, including procrastination on various types of academic tasks (assignments, exams, administrative tasks, etc.). It includes items about how regularly students procrastinate as well as to what degree they consider it a problem and would like to change the behavior. The items are scored on five-point Likert scales. For this study, I used a 12-item adaptation with items worded to refer more directly to the PSY 302 course that participants were drawn from. See Appendix B for the text that was used in this study. There are four factors: procrastination on weekly assignments for experimental psychology (PASS-WP), exams for experimental psychology (PASS-EP), homework assignments for other classes (PASS-WO), and exams for other classes (PASS-EO). Factor scores were calculated as the mean of scores.

Pure Procrastination Scale (PPS). Steel's (2010) measure of overall procrastination includes 12 items with response options provided on a five-point scale from 1 (very seldom or not true of me) to 5 (very often true of me). The scale had a reliability of α = .92. Rebetez et al. (2014) provided evidence that the PPS includes two

subfactors within the overall factor of general procrastination: voluntary delay (PPS-V) and observed delay (PPS-O). Total scores were calculated as the mean of scores.

Tuckman's Procrastination Scale (TPS). Tuckman's (1991) measure of overall procrastination includes 16 items within a single factor with four responses options on a Likert-style scale: that's me for sure, that's my tendency, that's not my tendency, and that's not me for sure. The reliability of the TPS was $\alpha = .86$. Total scores were calculated as the mean of scores.

Demographic questionnaire. In a brief demographic questionnaire, participants reported their gender—with the options Male, Female, Prefer to self-identify (text response), and Prefer not to say—as well as their age and academic year.

Design

The present study was correlational in nature and examined the relationship of assignment submission delay with various other measures of procrastination. I examined the correlation of median assignment submission delay with each of the following: APSS, APS overall as well as its four subscales, the four subscales of PASS, PPS overall as well as its two subscales, TPS, and the three subscales of PACED. I also conducted a regression analysis with the outcome variable of median assignment submission delay and the above variables as predictors (excluding the overall measures which had subscales, due to multicollinearity).

Procedure

PSY 302 students interested in completing the study were given a link to the surveys in Qualtrics. The first page was a consent form, including a brief description of the study and its effects on participants, prior to the beginning of the study. Those who

did not sign were thanked for their time and directed out of the survey. Those who gave consent were given extra credit for participating and directed to the beginning of the study. Participants were asked for their name (for the purpose of giving extra credit and pairing the data with assignment submission times from Blackboard) and then began the survey portion of the study. The surveys were presented in random order to balance any potential order effects, with the exception of the demographic questionnaire, which was presented last. Finally, participants saw a debrief of the study and its overall purpose along with the researchers' contact information for those wanting more information.

Assignment submission times for participants were recorded from Blackboard, with no further effort needed on the part of participants outside of their usual coursework. Using the names provided in Qualtrics, the Blackboard data was paired with the survey data. Once paired, all identifying information was deleted from the dataset and not stored in any form outside of what is already recorded in Blackboard.

Results

Analyses were conducted using a combination of R and JASP. The criterion for significance was $p < .05$. Before running analyses, I checked whether assumptions for parametric tests were met and screened for outliers.

Assignment submission delay is defined as the difference in time an assignment is turned in from the time that assignment is due (in hours), such that higher values indicate more delay. Submissions made before the deadline were recorded as negative values, and submissions made past the deadline were recorded as positive values. Due

to the highly skewed nature of procrastination-related delay, median delay for all lab assignments was used as the outcome variable.

Data Screening and Outliers

Outlier screening and assumption tests were conducted using R. The median delay of one participant was found to be more than three standard deviations beyond the overall mean for assignment submission delay. This participant also had a Cook's Distance beyond the cutoff (indicating an overly high influence on the results) but an acceptable leverage. Three other participants had a Cook's Distance beyond the cutoff, but they had acceptable leverage and fell within three standard deviations of the mean for assignment submission delay. Thus, only the former participant was designated as a true outlier. The median delay for this participant was in fact highly positive, indicating that assignments tended to be submitted far past the deadline. Results differed depending on whether this participant was included in the analysis, so both sets of results are reported below.

With this outlier included, the data met the assumptions of linearity and multicollinearity but did not meet the assumptions of normality, homogeneity, and homoscedasticity. With the outlier excluded, only the assumption of multicollinearity was met. Therefore, all results should be interpreted with caution.

Descriptive Results

The means (*M*) and standard deviations (*SD*) of each included variable were calculated in JASP and are listed in Table 1.

Table 1. Means and standard deviations of all included variables.

	Outlier included		Outlier excluded	
	M	*SD*	*M*	*SD*
Median assignment submission delay	-26.47	94.04	-36.07	52.84
APSS	15.88	6.23	15.82	6.25
APS-Overall	4.49	0.90	4.49	0.90
APS-OS	4.08	1.47	4.07	1.48
APS-PP	4.48	1.46	4.50	1.46
APS-ID	4.38	1.44	4.38	1.46
APS-AMD	5.05	1.40	5.05	1.41
PASS-WP	3.25	1.05	3.24	1.05
PASS-EP	3.44	1.11	3.43	1.11
PASS-WO	3.15	1.13	3.13	1.13
PASS-EO	3.32	1.15	3.31	1.15
PPS-Overall	2.68	0.89	2.68	0.90
PPS-V	2.94	0.99	2.95	1.00
PPS-O	2.15	0.97	2.14	0.97
TPS	2.50	0.64	2.49	0.64
PACED-DA	3.62	1.24	3.62	1.25
PACED-SA	2.87	1.21	2.88	1.22
PACED-US	3.49	1.15	3.50	1.15
Labs completed	13.05	1.69	13.14	1.52
Average exam score	71.69	14.29	71.69	14.41

Correlations

I computed the Pearson's correlations (*r*) and associated *p*-values of assignment submission delay with each of the following: APSS, APS overall as well as its four subscales, the four subscales of PASS, PPS overall as well as its two subscales, TPS, and three subscales of PACED, number of labs completed, and average exam score. This analysis was conducted in JASP. Results are reported in Table 2. With the outlier included, four variables were significantly correlated with median submission delay: number of labs completed, PASS-WP, PASS-EP, and PASS-WO, and PACED-DA. With the outlier removed, those five remained correlated to submission delay, along with four additional variables: APSS, APS-AMD, TPS, and average exam score.

Table 2. Pearson's correlations and p-values.

Correlation with median submission delay	Outlier included		Outlier excluded	
	r	*p*	*r*	*p*
APSS	.24	.055	.30*	.014
APS-Overall	.01	.956	.01	.929
APS-OS	.14	.271	.16	.197
APS-PP	-.10	.444	-.05	.712
APS-ID	.12	.328	.17	.171
APS-AMD	-.15	.234	-.26*	.037
PASS-WP	.35**	.004	.49***	<.001
PASS-EP	.26*	.036	.32**	.010
PASS-WO	.28*	.022	.32**	.010
PASS-EO	.20	.112	.19	.127
PPS-Overall	.12	.340	.22	.083
PPS-V	.07	.568	.22	.089
PPS-O	.21	.093	.22	.090
TPS	.21	.086	.345**	.005
PACED-DA	.25*	.044	.39**	.001
PACED-SA	-.15	.237	-.23	.062
PACED-US	-.02	.906	.11	.396
Labs completed	-.54***	<.001	-.34**	.006
Average exam score	-.14	.254	-.25*	.041

Regression Analysis

The primary analysis to test the hypotheses was a multiple regression with median assignment submission delay as the outcome variable and the following predictors: APSS, the four subscales of APS, the four subscales of PASS, the two subscales of PPS, TPS, the three subscales of PACED, number of labs completed, and average exam score. For measures with subscales, overall scores were not used in the analysis due to concerns of multicollinearity. With the outlier included, the overall model was significant with a large proportion of variance accounted for, $F(17,46) = 2.27$, $p = 0.014$, $R^2 = 0.46$. Only two predictors achieved significance: number of labs completed ($pr = .45$), and APS-PP ($pr = .29$). With the outlier excluded, the overall model was not significant but continued to have a notable coefficient of determination, $F(17,45) = 1.78$,

p = 0.063, R^2 = 0.40. For each predictor, b, β, t, and p, are reported in Table 3 (outlier included) and Table 4 (outlier excluded). These analyses were conducted using JASP.

Table 3. Multiple regression results for each predictor (outlier included).

Model		*b*	*SE*	*β*	*t*	*p*
H_0	(Intercept)	-26.83	11.93		-2.25	.028
H_1	(Intercept)	225.86	245.86		0.92	.363
	APSS	3.85	4.39	0.25	0.88	.385
	APS-OS	19.59	13.24	0.31	1.48	.146
	APS-PP*	-26.02	12.77	-0.40	-2.04	.047
	APS-ID	2.29	10.09	0.04	0.23	.821
	APS-AMD	11.75	16.21	0.17	0.73	.472
	PACED-DA	7.23	20.07	0.09	0.36	.720
	PACED-SA	2.48	15.20	0.03	0.16	.871
	PACED-US	-6.55	11.43	-0.08	-0.57	.570
	PASS-WP	22.00	25.63	0.24	0.86	.395
	PASS-EP	13.11	19.26	0.15	0.68	.499
	PASS-WO	4.72	19.78	0.06	0.24	.812
	PASS-EO	-7.75	17.48	-0.09	-0.44	.660
	PPS-V	-47.59	25.58	-0.49	-1.86	.069
	PPS-O	12.27	19.73	0.12	0.62	.537
	TPS	-20.36	52.33	-0.14	-0.39	.699
	Labs Completed***	-25.34	7.34	-0.45	-3.45	.001
	Exam Average	0.44	1.07	0.07	0.41	.683

Other Analyses

Although not part of the main hypotheses of the study, I also examined the relationship of procrastination with age (through Pearson's correlation), gender (through Analysis of Variance; ANOVA), and academic year (through ANOVA) using JASP. Since only two sophomores took part in the study, they could not be included in the ANOVA and only juniors and seniors were compared. I did not make any specific predictions for these analyses, and I did not expect to detect statistically significant

Table 4. Multiple regression results for each predictor (outlier excluded).

Model		*b*	*SE*	*β*	*t*	*p*
H_0	(Intercept)	-36.75	6.74		-5.45	< .001
H_1	(Intercept)	-51.88	147.99		-0.35	.728
	APSS	0.29	2.62	0.03	0.11	.914
	APS-OS	8.37	7.90	0.23	1.06	.295
	APS-PP	-5.87	7.83	-0.16	-0.75	.458
	APS-ID	2.19	5.95	0.06	0.37	.715
	APS-AMD	-4.73	9.72	-0.13	-0.49	.629
	PACED-DA	13.52	11.85	0.31	1.14	.260
	PACED-SA	0.49	8.96	0.01	0.05	.957
	PACED-US	-0.32	6.77	-0.01	-0.05	.963
	PASS-WP*	35.27	15.18	0.68	2.32	.025
	PASS-EP	9.06	11.36	0.19	0.80	.430
	PASS-WO	-2.12	11.69	-0.04	-0.18	.857
	PASS-EO	-13.38	10.33	-0.28	-1.30	.202
	PPS-V	-16.98	15.45	-0.32	-1.10	.277
	PPS-O	-11.04	11.90	-0.20	-0.93	.359
	TPS	-11.82	30.87	-0.14	-0.38	.704
	Labs completed	-3.41	4.92	-0.10	-0.69	.492
	Exam average	0.30	0.63	0.08	0.47	.638

relationships due to the likely restriction of range in the variables. As expected, the relationship between median submission delay and gender was not significant, with or without the outlier. Likewise, the relationship between median submission delay and academic year was not significant, with or without the outlier. With the outlier included, there was a significant relationship between median submission delay and age: $F(1,65) = 8.46$, $p = .005$, $R^2 = .12$ such that higher age was associated with more delay. This relationship was not significant when the outlier was excluded, and it should be noted that this outlier was also the oldest participant in the study, likely having a large influence on this relationship.

Discussion

There were two hypotheses for this study: (1) that median assignment submission delay would be positively correlated with the self-report procrastination measures included in the study (except for the APS), and (2) that median assignment submission delay would have a positive association with the deadline action pacing style and a negative association with the steady pacing style.

Based on the correlation analysis, assignment submission delay was positively related to procrastination as measured by the PASS on three subscales: weekly assignments for experimental psychology, exams for experimental psychology, and homework assignments for other classes. Assignment submission delay also had a moderate positive relationship with the delayed action pacing style and a moderate negative relationship with the number of lab assignments completed. There is some evidence for a negative relationship with average exam score, and a positive relationship with three other measures of procrastination: the APSS, APS-AMD, and TPS. This group of correlations was only significant after one outlier was removed. No significant correlations were found for the PPS or the other dimensions of the APS. This study generally replicated Howell et al. (2006), in that submission delay once again had a significant relationship with the PASS, especially when asking specifically about weekly assignments in experimental psychology, and possibly had a significant relationship with the TPS, depending on whether the outlier was included.

Results were inconclusive for the regression analysis. Without removing the outlier, the model significantly predicted assignment submission delay, with number of labs completed and APS-PP emerging as the only two significant predictors.

Interestingly, though the PASS subscales were among the few things that correlated with assignment submission delay, these measures were not significant predictors in the regression model. The reason for this is unclear, and further research with a larger sample is needed to better make sense of these results.

When the outlier was removed, the model was no longer significant. This outlier was the only participant to have a median assignment submission delay above 0 (and drastically so). The rules of the course allowed submission of assignments for partial credit anytime during the semester, and this individual waited until near the end of the semester to turn in several assignments. The same participant also turned in the fewest number of assignments, tied with one other participant, and was the oldest student to take part in the study. It is possible that this one outlier had an excessively high influence on the place of number of assignments within the model. Once the outlier was dropped, this variable was no longer significant. Furthermore, since number of assignments completed accounted for the largest share of the model's variance, the model as a whole was no longer significant without this portion of the variance. It may be that the dataset better represents the relationships involved when this participant's data is excluded, but the model is not significant in this case.

Alternatively, the model with the outlier included could be a better representation of the underlying reality that with certain course designs, some students intentionally take advantage of flexible deadlines and wait until the end of the semester to complete work for partial credit. These students could perhaps be seen as extreme procrastinators, making them an important part of the full range of data, though more

research is needed to determine whether procrastination or other motivations are in play.

In summary, hypotheses 1 and 2 were only partially and weakly supported. Some of the measures of procrastination, but not all of them, were significantly related to assignment submission delay in the correlation analysis. There is some evidence that assignment submission delay is a good indication of how students perceive themselves to procrastinate on schoolwork, but less an indication of overall self-reported procrastination. Furthermore, only one measure of procrastination contributed uniquely when predicting submission delay, even when the overall model was significant (that is, with the outlier included). The delayed action pacing style was indeed positively correlated with submission delay, but the steady action pacing style was not significantly related to submission delay in either direction.

These results should be interpreted with extreme caution due to the limitations of this dataset. The data failed most of the assumption tests, both with and without the outlier. This may in part be due to the skewed nature of assignment submission delay. Median was calculated rather than mean for each participant in order to help address the skewed nature of delay, but the variable was still highly skewed even with this measure taken. A future study of this nature should consider using a logarithmic transformation for assignment submission delay, as has been done in many procrastination studies in the past (e.g., Milgram et al.,1992; Nieberding & Heckler, 2021). If the data still fails assumption tests even with the logarithmic transformation applied, nonparametric hypothesis tests may be used instead of Pearson’s correlation and multiple linear regression.

Another important limitation of this study is that the sample size failed to reach the number of participants required by power analysis in order to achieve 80% power. The sample size needed was 131, and the number reached in the timeframe of this study was 66. Any results, whether positive or negative, are questionable with this weak of a sample. The fact that such a large proportion of variance was accounted for in both models (R^2 = .40 to .46) supports the possibility of a buried effect made marginal by the lack of an adequate sample. Moreover, an extreme outlier may have an especially strong impact on the results of such a small dataset, and there is evidence that this was the case in the present study. A larger sample, in addition to providing more power for the analysis, might help minimize the impact of outliers or demonstrate whether the outlier is in fact part of an important (though extreme) subset of participants.

Future research might replicate this study with a larger sample and with analytical tools to account for the skewed nature of delay (especially logarithmic transformation). It would also be informative to extend the study by comparing the results of the linear regression with and without number of assignments completed as a predictor, as this predictor may be accounting for a large share of the variance and burying the contribution of other, more relevant variables to some degree. A future study focusing on analysis methods might also compare results using the median versus mean of assignment submission delay to see if the results differ. Another possibility is to use the overall scores from the procrastination scales as predictors in the multiple regression, rather than using each of the subscales. These methodological variations could have a subtle impact on the results.

Going beyond the scope of this study, researchers might also examine other online course behaviors in a similar way by examining how they relate to self-report measures of procrastination and pacing style. Other measures that tend to be recorded by learning management systems include the time a submission was started, the time a document was downloaded or a video watched, and the number of clicks within a course module. Further research could examine how delay behavior relates to self-report measures across a variety of course formats: online, in-person, and blended. Online courses can also be either synchronous or asynchronous, and this could impact behavior. The sample for this study was drawn from an online course, and it is possible that students in online courses may demonstrate different procrastination behaviors than they do in person, or that students who choose to take online courses tend to procrastinate to a different degree. It likewise remains an open question whether students perceive their own procrastination tendencies differently within these contexts. In-person students (and those in synchronous online courses) tend to have more points of contact with the instructor and material, while asynchronous online learners are often left to manage their own time and engage with the material as they see fit. Some online learners may also choose online courses due to having more complex demands on their time, such as daytime jobs and children to look after. Another possibility is that habitually in-person versus online students may have differing time management skills. Research in other contexts, or comparing results across multiple contexts, could help to address the generalizability of these results.

Of particular importance for future research, given the impact one extreme case of delay had on the present results, is the way course design can relate to

procrastination behavior. The late policy in the course used for this study was very generous and allowed students to turn in late work through the end of the semester for partial credit. This flexibility may have encouraged extreme procrastination and therefore the presence of outliers in the data. More research with a larger sample is needed to determine whether this outlier is part of a larger subset of students or truly a special case. Either way, instructors should be aware that their late policies may be related to procrastination behavior among certain students, and procrastination researchers should take such variables into account when interpreting the results of their studies.

Within any given course format, it is clear that some students can manage their time well enough to procrastinate and still succeed in meeting their goals, while others struggle to plan for an appropriate amount of time to complete work and ultimately suffer a higher cost than intended. Confidence in one's ability to estimate the time a task will take may not necessarily indicate skill in doing so, and in fact the opposite could be true if something like the Dunning-Kruger effect occurs for time management skills (Kruger & Dunning, 1999). The ability to estimate how long a task will take is an important metacognitive skill, and such an examination of intent to procrastinate, metacognitive ability, and time management could make for a fruitful area of further research.

Academic procrastination continues to be a relevant problem for students and instructors, and it is important for research to evaluate the effectiveness of both self-report and behavioral measures used in this body of research. I aimed in this study to examine how assignment submission times in an online course related to procrastination across several widely used self-report measures, but the study's

limitations necessitate further research with a larger sample and statistical methods more suited to the data at hand.

References

Choi, J. N., & Moran, S. V. (2009). Why not procrastinate? Development and validation of a new active procrastination scale. *The Journal of Social Psychology, 149*(2), 195-211. https://doi.org/10.3200/SOCP.149.2.195-212.

Chu, A. H. C., & Choi, J. N. (2005). Rethinking procrastination: Positive effects of "active" procrastination behavior on attitudes and performance. *The Journal of Social Psychology, 145*(3), 245-264. https://doi.org/10.3200/SOCP.145.3.245-264

Gevers, J., Mohammed, S., & Baytalskaya, N. (2015). The conceptualisation and measurement of pacing styles. *Applied Psychology: An International Review, 64*(3), 499-540. https://doi.org/10.1111/apps.12016

Hensley, L. C. (2014). Reconsidering active procrastination: Relations to motivation and achievement in college anatomy. *Learning and Individual Differences, 36*, 157-164. https://doi.org/10.1016/j.lindif.2014.10.012

Howell, A. J., Watson, D. C., Powell, R. A., & Buro, K. (2006). Academic procrastination: The pattern and correlates of behavioural postponement. *Personality and Individual Differences, 40*(8), 1519-1530. https://doi.org/10.1016/j.paid.2005.11.023

Kim, K. R., & and Seo, E. H. (2015). The relationship between procrastination and academic performance: A meta-analysis. *Personality and Individual Differences, 82*, 26-33. http://dx.doi.org/10.1016/j.paid.2015.02.038

Klingsieck, K. B. (2013). Procrastination: When good things don't come to those who wait. *European Psychologist, 18*(1), 24-34. https://doi.org/10.1027/1016-9040/a000138

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Malatincova, T. (2015). The mystery of "should": Procrastination, delay, and reactance in academic settings. *Personality and Individual Differences, 72*, 52-58. http://dx.doi.org/10.1016/j.paid.2014.08.015

McCloskey, J. D. (2011). *Finally, my thesis on academic procrastination* [Master's thesis, University of Texas at Arlington]. University of Texas Arlington Library Research Commons. https://rc.library.uta.edu/uta-ir/handle/10106/9538

Milgram, N. A., Dangour, W., & Raviv, A. (1992). Situational and personal determinants of academic procrastination. *The Journal of General Psychology, 119*(2), 123-133. https://doi.org/10.1080/00221309.1992.9921166

Nieberding, M., & Heckler, A. F. (2021). Patterns in assignment submission times: Procrastination, gender, grades, and grade components. *Physical Review Physics Education Research, 17*(1), 1-12. https://doi.org/10.1103/PhysRevPhysEducRes.17.013106

Potts, T. J. (1987). *Predicting procrastination on academic tasks with self-report personality measures*. [Doctoral dissertation, Hofstra University]. ProQuest.

https://www.proquest.com/openview/458f9595d9a7e0af6798aca2bdfcae7d/1?pq-origsite=gscholar&cbl=18750&diss=y

Rebetez, M. M. L., Rochat, L., Gay, P., & Van der Linden, M. (2014). Validation of a French version of the Pure Procrastination Scale (PPS). *Comprehensive Psychiatry, 55*(6), 1442–1447. https://doi.org/10.1016/j.comppsych.2014.04.024

Schouwenburg, H. C. (2004). Procrastination in academic settings: General introduction. In H. C. Schouwenburg, C. H. Lay, T. A. Pychyl, & J. R. Ferrari (Eds.), *Counseling the procrastinator in academic settings* (pp. 3–17). American Psychological Association.

Schraw, G., Wadkins, T., & Olafson, L. (2007). Doing the things we do: A grounded theory of academic procrastination. *Journal of Educational Psychology, 99*(1), 12-25. https://doi.org/10.1037/0022-0663.99.1.12

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology, 31*(4), 503-509.

Steel, P., Brothen, T., & Wambach, C. (2001). Procrastination and personality, performance, and mood. *Personality and Individual Differences, 30*(1), 95–106. https://doi.org/10.1016/S0191-8869(00)00013-1

Steel, P. (2010). Arousal, avoidant and decisional procrastinators: Do they exist? *Personality and Individual Differences, 48*(8), 926–934. https://doi.org/10.1016/j.paid.2010.02.025

Tuckman, B. W. (1991). The development and concurrent validity of the procrastination scale. *Educational and Psychological Measurement, 51*, 473–480.

Vangsness, L., Voss, N. M., Maddox, N., Devereaux, V., & Martin, E. (2022). Self-report measures of procrastination exhibit inconsistent concurrent validity, predictive validity, and psychometric properties. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.784471

Yockey, R. D. (2016). Validation of the short form of the Academic Procrastination Scale. *Psychological Reports, 118*(1), 171-179. https://doi.org/10.1177/0033294115626825

Zuber, S., Cauvin, S., Haas, M., Daviet, A., Coelho, C. D. S., & Kliegel, M. (2019). Do self-reports of procrastination predict actual behavior? *International Journal of Methods in Psychiatric Research, 29*(4), 1-6. https://doi.org/10.1002/mpr.1843

Appendices

Appendix A: Human Subjects IRB Approval

Date: 9-28-2021

IRB #: IRB-FY2020-620
Title: Relaxation and Attention Study
Creation Date: 3-7-2020
End Date:
Status: Approved
Principal Investigator: Bogdan Kostic
Review Board: MSU
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Expedited	Approved

Key Study Contacts

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Appendix B: Procrastination Assessment Scale for Students

For each of the following activities, please rate the degree to which you delay or procrastinate.

I. Doing weekly assignments for Experimental Psychology

1) To what degree do you procrastinate on this task?

(Never procrastinate, Almost never, Sometimes, Nearly always, Always procrastinate)

2) To what degree is procrastination on this task a problem for you?

(Not at all a problem, Almost never, Sometimes, Nearly always, Always a problem)

3) To what extent do you want to decrease your tendency to procrastinate on this task?

(Do not want to decrease, [], Somewhat, [], Definitely want to decrease)

II. Studying for exams for Experimental Psychology

4) To what degree do you procrastinate on this task?

(Never procrastinate, Almost never, Sometimes, Nearly always, Always procrastinate)

5) To what degree is procrastination on this task a problem for you?

(Not at all a problem, Almost never, Sometimes, Nearly always, Always a problem)

6) To what extent do you want to decrease your tendency to procrastinate on this task?

(Do not want to decrease, [], Somewhat, [], Definitely want to decrease)

III. Doing homework assignments for other classes (classes other than Experimental Psychology)

7) To what degree do you procrastinate on this task?

(Never procrastinate, Almost never, Sometimes, Nearly always, Always procrastinate)

8) To what degree is procrastination on this task a problem for you?

(Not at all a problem, Almost never, Sometimes, Nearly always, Always a problem)

9) To what extent do you want to decrease your tendency to procrastinate on this task?

(Do not want to decrease, [], Somewhat, [], Definitely want to decrease)

IV. Studying for exams for other classes (classes other than Experimental Psychology)

10) To what degree do you procrastinate on this task?

(Never procrastinate, Almost never, Sometimes, Nearly always, Always procrastinate)

11) To what degree is procrastination on this task a problem for you?

(Not at all a problem, Almost never, Sometimes, Nearly always, Always a problem)

12) To what extent do you want to decrease your tendency to procrastinate on this task?

(Do not want to decrease, [], Somewhat, [], Definitely want to decrease)