Conceptual replication of Seo (2008), “Self-efficacy as a mediator in the relationship between self-oriented perfectionism and academic procrastination”

Matt N. Williams^a

Shoni R. Edwards^a

^aSchool of Psychology, Massey University

Send correspondence to m.n.williams@massey.ac.nz

Abstract

Self-oriented perfectionism is the tendency to set high standards for oneself and evaluate one's behaviour accordingly. Based on a study of 792 students in Korea, Seo (2008) reported finding a negative relationship between self-oriented perfectionism and academic procrastination—i.e., the tendency to procrastinate on academic tasks. Furthermore, Seo found that this relationship was completely mediated by self-efficacy. Seo's study has been influential in the literature but has not been independently replicated. In this study we report a conceptual replication utilising 575 students from OECD countries and a cross-sectional survey design. A detailed preregistration (including data processing and analysis syntax) was lodged in advance of data collection at <https://osf.io/xfvd8>. Both ordinary least squares regression and structural equation modelling were used to test hypotheses. We found no evidence of a bivariate relationship between self-oriented perfectionism academic procrastination in either set of analyses, meaning that we were unable to reproduce one of Seo's two key findings. However, we did find evidence of a small and negative *indirect* effect of self-oriented perfectionism on academic procrastination via self-efficacy, reproducing part of the mediation model reported by Seo.

Introduction

Academic procrastination is a phenomenon that will be familiar to most students and academics at universities. Assignments are neglected until the night before due date; presentation slides are written on the plane *en route* to the conference; and long-planned manuscripts about procrastination are left unwritten for months (see also Lay, 1986).

In terms of formal definitions, to procrastinate is to “voluntarily delay an intended course of action despite expecting to be worse off for the delay” (Steel, 2007, p. 66).

Academic procrastination, then, is “to voluntarily delay an intended course of *study-related* action despite expecting to be worse off for the delay” (Steel & Klingsieck, 2016, p. 37).

Academic procrastination is common for at least some types of academic tasks. Solomon and Rothblum (1984) found that 46% of a sample of 342 undergraduate students reported that they “always” or “nearly always” procrastinated on writing term papers (this being the most-procrastinated task for their sample of participants). Unsurprisingly, academic procrastination may be associated with negative academic outcomes: A meta-analysis of 33 studies by Kim and Seo (2015) found a negative (albeit small) weighted mean correlation of $-.13$ between procrastination and academic performance.

A number of studies have examined correlates and potential causes of procrastination. The relationship between “Big Five” personality variables and procrastination has been especially studied: A meta-analysis by van Eerde (2004) found a strong negative relationship between conscientiousness and procrastination (average weighted $r = -.65$, 11 studies, $N = 2,870$), a moderate positive relationship between neuroticism and procrastination (average weighted $r = .26$, 11 studies, $N = 2,748$), and smaller relationships between procrastination and the other three Big Five facets.

One potential correlate of academic procrastination is *perfectionism*. Perfectionism has been defined as “a multidimensional personality disposition characterized by striving for

flawlessness and setting exceedingly high standards of performance accompanied by overly critical evaluations of one's behavior" (Stoeber, 2017, p. 3). Perfectionism is often measured using the Multidimensional Perfectionism Scale (MPS; Hewitt & Flett, 1991). The MPS divides perfectionism into three components: Self-oriented, other-oriented, and socially-prescribed. Self-oriented perfectionism comprises behaviours relating to oneself that include setting high standards and evaluating and monitoring one's own behaviour. Other-oriented perfectionism comprises behaviours directed outward and involves beliefs and expectations about others' capabilities. Socially prescribed perfectionism comprises an individual's belief that others have perfectionistic expectations of them and evaluate them harshly (Hewitt & Flett, 1991).

Some authors have suggested that there is a positive relationship between perfectionism and procrastination, such that perfectionists are likely to be procrastinators: Burka and Yuen (1983) went so far as to list "I must be perfect" as the very first item in their "Procrastinator's Code" (a set of assumptions that, they argue, are commonly held by procrastinators). However, the relationship between perfectionism and procrastination seems to differ depending on the dimension of perfectionism examined. For example, Saddler and Sacks (1993) found a positive relationship ($r = .23$) between socially prescribed perfectionism and procrastination in a study of 150 students, but no significant relationships between procrastination and self- or other-oriented perfectionism. A similar finding was produced in a study of 135 students by Onwuegbuzie (2000), with a correlation of $.24$ ($p < .01$) between an overall measure of academic procrastination and socially-prescribed perfectionism, but correlations of just $-.03$ and $.01$ with self- and other-oriented perfectionism respectively. By contrast, a study of 230 Turkish students by Çapan (2010) found a statistically significant and negative relationship between self-oriented perfectionism and academic procrastination ($r = -.199$) but no significant relationships between procrastination

and other-oriented or socially prescribed perfectionism. Given these somewhat inconsistent findings, a meta-analysis is useful to aggregate the extant evidence. Such a meta-analysis was conducted by Steel (2007). Steel found that socially prescribed perfectionism was positively related to procrastination, mean $r = .18$, while there was little evidence of a relationship between procrastination and self- or other-oriented perfectionism.

Seo (2008)

One study on the relationship between perfectionism and academic procrastination that produced particularly interesting results was Seo (2008). Seo conducted a study of 792 students in Korea. She used structural equation modelling to investigate the relationship between self-oriented perfectionism (as measured using the MPS), self-efficacy (using the Korean general self-efficacy scale; A. Kim & Cha, 1996), and academic procrastination (as measured using the Procrastination Assessment Scale - Students; Solomon & Rothblum, 1984). Seo did not report investigations of the relationship between procrastination and the other two MPS dimensions (other-oriented perfectionism and socially prescribed perfectionism).

While Seo did not report the simple zero-order relationship between self-oriented perfectionism and academic procrastination, she did report relationships between “parcels” of items (two parcels for self-oriented perfectionism, three for self-efficacy, and two for procrastination). Significant negative correlations (between $r = .19$ and $r = .25$) were present between each of the two self-oriented perfectionism parcels and each of the two procrastination parcels. Her main analysis, though, was a structural equation model. The parameter estimates from this structural equation model indicated that self-oriented perfectionism had a positive and statistically significant relationship with self-efficacy (standardised $b' = .65$), which in turn had a negative and statistically significant relationship

with academic procrastination (standardised $b' = -.71$). She also reported that self-efficacy *completely* mediated the effect of self-oriented perfectionism on academic procrastination, given that a model with a direct effect of self-oriented perfectionism on academic procrastination did not fit significantly better than one without this direct effect included.

Seo's study seems to be worth replicating on several counts. Firstly, its findings are somewhat inconsistent with others in the literature: As noted above, several other investigations of procrastination and perfectionism have *not* found evidence of a negative relationship between self-oriented perfectionism and academic procrastination (e.g., Flett et al., 1992; Onwuegbuzie, 2000; Saddler & Sacks, 1993; Steel, 2007). It is also surprising that Seo found that this relationship was completely mediated by self-efficacy (with a positive effect of self-oriented perfectionism on self-efficacy), given that evidence of a *negative* relationship between self-oriented perfectionism and self-efficacy has previously been reported in the literature (Hart et al., 1998).

Additionally, Seo's study was not preregistered. Preregistration is the practice of prespecifying plans for data collection and analysis (see Nosek et al., 2018), and has gained popularity in psychology in recent years as a strategy for dealing with the problem that flexibility in data collection and analysis can allow researchers to easily produce statistically significant findings even in the absence of any true relationships (see Simmons et al., 2011). Seo's study contained at least one significant data-dependent analysis decision: The addition of correlated error terms between the self-efficacy facet of self-confidence and the two item-parcel indicators of self-oriented perfectionism. In addition, Seo's study has had a relatively substantial degree of influence in the literature (Google Scholar list 162 citations as at 10 March 2020), and a literature search suggests that it has not previously been replicated. The study's findings are also important in an applied sense because they imply that addressing perfectionism could be an actively *counterproductive* strategy for reducing academic

procrastination (c.f. Foster, 2007). Given these considerations, the replication value of Seo (2008) appears to be high (see Nosek et al., 2012).

Aims and Hypotheses

In the current study, a conceptual (non-exact) replication of Seo (2008) was conducted to replicate the main conclusions of her study using a different population, different measures, and a different (but related) set of analyses. Seo summarised her findings as such: “The first major finding was that self-efficacy completely mediates the relationship between self-oriented perfectionism and academic procrastination” (p. 760); “The second major finding of our study was that self-oriented perfectionism often leads to less academic procrastination” (p. 761). Our (preregistered) hypotheses restated these claims in clear falsifiable terms, taking into account the directions of relationships reported in Seo’s results section:

1. There is a positive bivariate relationship between self-oriented perfectionism and self-efficacy.
2. There is a negative bivariate relationship between self-oriented perfectionism and academic procrastination.
3. There is a negative bivariate relationship between self-efficacy and academic procrastination.
4. There is a negative indirect effect of self-oriented perfectionism on academic procrastination (via an effect of self-oriented perfectionism on self-efficacy).
5. When controlling for the effect of self-efficacy, there is no direct effect of self-oriented perfectionism on academic procrastination (i.e., the relationship between self-oriented perfectionism and academic procrastination is *completely* mediated by self-efficacy).

Method

Participants and Procedure

This study used a cross-sectional survey design. The participants were 575 students aged ≥ 18 recruited via the Prolific Academic platform. Pre-screening criteria were set using Prolific Academic such that only current full-time students (74.8%) and part-time students (25.2%) could participate; participants also needed to have a 95% “approval rate” from prior studies to participate¹. Each participant was paid a small reward (GBP0.85) to thank them for their participation. Prolific Academic permits participation from almost all OECD countries, so participants lived in a range of countries, with the majority from the United Kingdom (19.7%) and the USA (32.7%). 57.0% of the sample identified as male, 41.6% as female, and 1.4% as nonbinary/gender diverse. University/college students comprised most of the sample (80.7%), followed by high school students (8.5%), polytechnic/technical institute students (7.0%), and “other” (3.5%). Unsurprisingly, the sample was relatively young: 68.0% were aged 18-24, and most of the remainder (26.4%) aged 25-34.

A power analysis (for a significance test for a single coefficient within a multiple regression with two predictor) with a small effect size of Cohen’s $f^2 = 0.02$ was specified in the pre-registration. This suggested that a sample size of 528 was required to achieve power of 90% with a 2-tailed test and an alpha level of 0.05. While the sample size suggested for this replication is smaller than Seo’s (2008) sample size of 692, the sample size in the original study was large: To the extent that the original study had limitations, sample size was not one of them. A target sample size of 584 was specified in Prolific Academic, which

¹ Prolific Academic defines a participant’s “approval rate” as the upper bound of a 95% confidence interval for their approval rate based on the previous studies the participant has participated in.

allowed for the possibility of close to² 10% of responses needing to be removed (after the application of exclusion criteria) without power falling beneath 90%. The original number of responses collected in Qualtrics was 623, largely due to the presence of some participants who started the study and then were determined to be ineligible (and thus didn't count towards the target sample size). The preregistered exclusion criteria are summarised below (see the preregistration for the full criteria).

1. Any participant who did not answer “Yes” to the consent question after the information sheet (no exclusions)
2. Any participant who indicated they were under 18 years of age (2 exclusions)
3. Any participant that indicated they were not current students (applied as a pre-screening criteria in Prolific and then checked with a survey item; 27 further exclusions)
4. Participants who responded to fewer than 75% of the items of the 25 items in the three main study scales (7 further exclusions)
5. Responses that were identified as 1 (preview), 2 (test), 8, 9 or 12 (possible spam / duplicate responses) by Qualtrics (no further exclusions).
6. Giving an incorrect or missing response to an attention check reading “Please demonstrate that you are paying attention by ticking “5 – Strongly agree” to this item” (12 further exclusions).
7. Any duplicate responses from the same Prolific worker (as indicated by a matching Prolific ID; no further exclusions)

² Our preregistration stated that a target sample size of 587 would be specified in Prolific; the actual target set in Prolific was set to 584 due to a typographical error.

After applying the exclusion criteria, the final sample size was $N = 575$, with just one missing response of a study item. This missing response was imputed using expectation-maximisation imputation (as preregistered).

Measures

Academic procrastination was measured using adapted parts of Solomon and Rothblum's (1984) Procrastination Assessment Scale – Students (PASS). The PASS is comprised of two major sections (areas of procrastination and reasons for procrastination). The first section contains six different academic areas; it was adapted for the current study in order to improve its relevance to modern students. For example, questions covering “attendance tasks” (meeting with an advisor, making an appointment) and “administrative tasks” (filling out forms, registering for classes, getting an ID card) were omitted, since some of these tasks are no longer common (or largely automated) for many students. The second section (reasons for procrastination) was not used in Seo (2008) and was therefore not included in this study. Responses to the PASS were summed to obtain a total academic procrastination score with a possible range of 12 – 60.

Self-oriented perfectionism was measured using the 5-item self-oriented perfectionism subscale of the Big Three Perfectionism Scale (Smith, Saklofske, Stoeber, & Sherry, 2016). Seo (2008) measured self-oriented perfectionism using the self-oriented perfectionism subscale of the Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), however, this was not used in this study due to copyright restrictions, which are problematic from an open science perspective (the full materials from this study are available on our OSF project page at https://osf.io/m5dy6/?view_only=b20934f188744dc89166785a158a0a1c). Responses to this measure were summed to obtain a self-oriented perfectionism score with a possible range of 5 – 25.

Self-efficacy was measured using the New General Self-Efficacy Scale (NGSE; Chen et al., 2001b). Seo (2008) used the Korean General Self Efficacy Scale, which was not suitable for this research given that the participants were generally not speakers of Korean. The NGSE was selected for this study given its evidence of good psychometric properties (Chen et al., 2001b; Scherbaum et al., 2006), its brief nature, and its relatively permissive copyright restrictions (see Chen et al., 2001a). Responses to this measure were summed to obtain a self-efficacy score with a possible range of 8–40.

Pilot/Pretesting

A “pilot” study with 10 participants was completed in order to check for survey usability issues. The pilot participants were not eligible to take part in the main study, and their data is not included in the study as described here.

Analyses

Two main sets of preregistered analyses were conducted. The first set of analyses were OLS regression analyses in which the variables self-oriented perfectionism, self-efficacy, and academic procrastination were treated as *observed*. The second set of analyses treated these variables as *latent* (using structural equation modelling), allowing for the effects of measurement error to be explicitly modelled and accounted for. While the latter set of analyses more closely aligns with Seo’s (2008) original analyses, the inclusion of both sets allowed us to examine how well Seo’s findings replicated across two reasonable alternative ways of testing the hypotheses

In Seo’s analyses, item parcels were used as latent variable indicators in her SEM models. The current study did not use item parcels as indicators of the self-oriented perfectionism and self-efficacy latent variables because the number of items for each of these

latent variables was already low. There was also little *a priori* reason to assume that the parcels used by Seo are unidimensional. However, item parcelling *was* used in this study for the indicators of the 12-item Academic Procrastination Measure (PASS): The same three questions were asked for each of the four individual activities (where each activity was treated as an item parcel). If the individual items had been entered as observed variables there would thus have been an arguable need to specify correlated error terms across the four items using the same wording (for different activities) and across the three items asked about each activity, potentially resulting in a large number of correlated error terms. Using item parcelling allowed for a more parsimonious specification. For a more detailed explanation of these decisions regarding parcelling, please refer to the preregistration <https://osf.io/xfvd8>

The data was analysed in R (R Core Team, 2018) with SEM analyses using the lavaan package (Rosseel, 2012). Diagonally weighted least squares was the estimation method selected for SEM, with robust standard errors and a Satorra-Bentler scaled test statistic (“WLSM” estimation). This method helped to account for the fact that the data was collected using discrete rating scale items and was thus not drawn from a multivariate normal distribution. Scaling of the variance of latent variables was accomplished by setting the factor loading of the first indicator of each latent variable to 1.

A preregistration, de-identified copy of the data, the R script, and exported survey are available at https://osf.io/m5dy6/?view_only=b20934f188744dc89166785a158a0a1c. The analysis script for this study formed part of the preregistration prior to data collection, with minor revisions (highlighted with comments) after data collection.

Ethics approval

This study was evaluated by peer review and determined to be low risk. A low risk notification (similar to “exempt review” in North America) was submitted to the authors’ institution’s ethics committee

Results

The means, standard deviations, and Cronbach's alpha estimates for academic procrastination, self-oriented perfectionism, and self-efficacy are shown in Table 1. The Cronbach's alpha values were relatively high for all three scales, despite the short length of these scales.

Table 1.

Descriptive Statistics

Variables	<i>M</i>	<i>SD</i>	α
Academic procrastination (PASS)	42.05	9.02	.89
Self-oriented perfectionism (SOP)	15.39	4.99	.90
Self-efficacy (NGSE)	30.67	5.55	.89

Note. Possible ranges for each scale, PASS 12 – 60; SOP 5 – 25; NGSE 8 – 40.

Regression analyses

As per the preregistration, simple linear regression models were used to test hypotheses 1 to 3. Hypothesis 1 was supported, with a positive bivariate relationship between self-oriented perfectionism and self-efficacy, $b = 0.22$, 95% CI [0.13, 0.31], $p < 0.001$, $r = .20$. Hypothesis 2 was not supported: The relationship between self-oriented perfectionism and academic procrastination was very slightly negative but not statistically significant, $b = -0.05$, 95% CI [-0.20, 0.10], $p = .533$, $r = -.03$. Hypothesis 3 was supported, with a negative bivariate relationship between self-efficacy and academic procrastination, $b = -0.32$, 95% CI [-0.45, 0.19], $p < 0.001$, $r = -.20$.

Hypotheses 4 and 5 were tested using a mediation model, with confidence intervals estimated via nonparametric bootstrapping with 1000 simulations, as specified in the pre-

registration. Specifically, bias-corrected and accelerated (BCa) bootstraps were computed. The fourth hypothesis was that there is a negative indirect effect of self-oriented perfectionism on academic procrastination (via an effect of self-oriented perfectionism on self-efficacy). The results of the regression analyses supported hypothesis 4 with an unstandardised indirect effect of $ab = -0.07$, 95% CI $[-0.12, -0.03]$, $p < 0.001$, standardised $ab' = 0.04$.

Hypothesis 5 was that, when controlling for the effect of self-efficacy, there would be no direct effect of self-oriented perfectionism on academic procrastination (i.e., the relationship between self-oriented perfectionism and academic procrastination is completely mediated by self-efficacy). As specified on the pre-registration, this hypothesis would be considered supported if the p value for the direct effect was not statistically significant (i.e., $p > 0.05$, 2-tailed) and the lower and upper limits of a 90% bootstrapped confidence interval both fell within the range -0.1 to 0.1. The range -0.1 to 0.1 was selected to denote an effect practically equivalent to zero (i.e., a “negligible” effect) given that standardised regression coefficients are similar to correlation coefficients in scale; Cohen (1988) defined a correlation of 0.1 as “small” (p. 79). Comparing a 90% confidence interval to these “equivalence bounds” effectively produces an equivalence test where the risk of falsely concluding that the true effect is between -0.1 and 0.1 is no higher than 5% if the true standardised effect is 0.1 or greater in absolute value (see Lakens et al., 2018). The analysis produced a standardised direct effect of 0.01, 90% bootstrapped CI $[-0.06, 0.08]$, $p = 0.77$, supporting hypothesis five.

Structural equation model analyses

A structural equation model (SEM) was also used to test hypotheses 1 to 5, where self-oriented perfectionism, self-efficacy and academic procrastination were all treated as latent variables (see Figure 1).

Hypothesis 1 was supported in the SEM analysis: The effect of self-oriented perfectionism on self-efficacy was positive and statistically significant (standardised regression path $b' = 0.23$, 95% CI [0.13, 0.33], $p < 0.001$). Hypothesis 2, however, was not supported: The total effect of self-oriented perfectionism on academic procrastination was not statistically significant, standardised total effect = -0.04, 95% CI [-0.13, 0.05], $p = .337$. Hypothesis 3 was supported, with a significant and negative relationship between self-efficacy and academic procrastination, $b' = -0.24$, 95% CI [-0.34, -0.15], $p < .001$. Hypothesis 4 was also supported, with a negative and significant indirect effect of self-oriented perfectionism on academic procrastination, standardised indirect effect $ab' = -0.06$, 95% CI [-0.09, -0.02], $p = 0.001$. That said, this effect was much smaller than the standardised indirect effect of $0.65 * -0.71 = -0.46$ in Seo (2008).

Finally, hypothesis 5 was supported by the analyses: The standardised direct effect of self-oriented perfectionism on academic procrastination was not statistically significant, $b' = .01$, $p = 0.825$, and its 90% confidence interval again fell within the preregistered equivalence bounds of -0.1 to 0.1, 90% CI [-0.07, 0.09].

The preregistration indicated that global fit of the model would be tested using the Satorra-Bentler chi-square statistic (which is scaled for non-normality), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR). The preregistration did not specify whether the RMSEA would be scaled for non-normality, but we report the scaled version here in order to be consistent with the $SB\chi^2$ calculation. The Satorra-Bentler chi-square statistic, $SB\chi^2(116) = 430.8$, $p < .001$, indicated the null hypothesis of exact fit of the model in the population could be rejected. The RMSEA of 0.07 was greater than the preregistered threshold of .06 for good fit, suggesting that the quantity of error in the approximation of the sample covariance matrix was substantial. However, the robust SRMR estimate 0.05 (being less than the preregistered threshold for good fit of 0.08)

indicated only a small difference between the sample correlation matrix and that implied by the model. As indicated in the preregistration, these fit statistics were not used to test the validity of the hypotheses themselves, but they do indicate that the fit of the model to the sample covariance matrix was less than perfect. This possible misspecification in turn means that some of the parameter estimates may have been biased, implying the presence of additional uncertainty around the estimates of direct and indirect effects (and other parameters).

Figure 1. Path diagram showing completely standardised parameter estimates.

Exploratory Analysis: Non-Linearity

The analyses reported thus far assume purely linear relationships between variables (as did the analyses reported by Seo). However, the true relationships may not in fact be linear. This is particularly plausible for the key relationship in the study (between self-oriented perfectionism and academic procrastination). It might be, for example, that moderate perfectionism is associated with a low level of procrastination, while very low levels or high levels of perfectionism are associated with higher levels of procrastination (given that too little perfectionism may result in low motivation to produce work, while too much perfectionism might result in an ability to *stop* working and submit a finished product). We

therefore conducted an additional exploratory (non-preregistered) analysis where we examined whether there is evidence of non-linearity in the relationship between the two key variables of self-oriented perfectionism and academic procrastination.

The results of this analysis were somewhat mixed. A simple scatter plot (not shown) was largely uninformative, with too much dispersion in the plot points for any relationship (linear or otherwise) to be readily apparent. An alternative approach is to fit a spline model (see Ahlberg et al., 1967). A spline model is a piecewise polynomial model, where the line of best fit can have “knots” where the parameters of the function connecting the independent variable(s) to the dependent variable (e.g., the slope) changes. Furthermore, each line *segment* (i.e., the line between two knots) can be either rectilinear (i.e., a straight line), or defined by a polynomial function (e.g., quadratic, cubic). Spline analysis was subsequently completed in the *crs* package (Nie & Racine, 2012), with automatic selection of the number of segments and polynomial form via expected Kullback-Leibler cross-validation (Hurvich et al., 1998). This analysis suggested a polynomial model of order two with one segment (no knots)—i.e., a quadratic model. This quadratic model had a negative and non-significant coefficient for self-oriented perfectionism, $b_1' = -0.02$, $p = .611$, and a positive and significant coefficient for the square of self-oriented perfectionism, $b_2' = 0.10$, $p = .011$, suggesting a strongly U-shaped relationship.

However, a p value of around 0.01 represents rather weak evidence (Benjamin et al., 2017), especially given the exploratory nature of this analysis. Furthermore, Simonsohn (2018) points out that a quadratic analysis imposes strong assumptions about functional form that can result in a high risk of falsely concluding that a relationship is U-shaped (Benjamin et al., 2017). Simonsohn (2018) thus developed a “two lines” test, where a regression line is broken into two linear components (with a break point that is automatically identified using a “Robin Hood” algorithm). When this test provides two regression slopes of different signs,

both statistically significant, this comprises evidence of a U-shaped (or reverse U-shaped) relationship. In the current study, the two lines analysis identified a break point of $z = +.12$ (i.e., a change in slope when self-oriented perfectionism reaches a slightly above-average point). The slope was positive and significant below this point, $b' = -.17$, $p = .039$, and negative but not significant above this point, $b' = 0.17$, $p = .116$ (see Figure 2). This result is mildly suggestive of a U-shaped relationship but does not provide strong evidence for it (given that the second slope was not statistically significant, and the first only barely so). Overall, this analysis of non-linearity provides equivocal results, although it does not rule out the presence of non-linearity.

Figure 2. Assessment of non-linearity in the relationship between self-oriented perfectionism and academic procrastination using Simonsohn's (2018) two lines procedure.

Discussion

The present study aimed to conceptually replicate Seo's (2008) study of self-oriented perfectionism, self-efficacy, and academic procrastination. Five hypotheses were specified

based on Seo's study, those hypotheses encapsulating her key findings: A negative relationship between self-oriented perfectionism and academic procrastination, with this relationship being completely mediated by self-efficacy.

In our study, we tested the hypotheses using both OLS regression models (treating the variables as observed) and SEM analyses (treating the variables as measured with error). These analyses provided different quantitative estimates of the relevant relationships, but were fully consistent in terms of which hypotheses were supported and which not supported. Our results supported hypothesis 1 (that there is positive bivariate relationship between self-oriented perfectionism and self-efficacy), hypothesis 3 (that there is a negative bivariate relationship between self-efficacy and academic procrastination), and hypothesis 4 (that there is a negative indirect effect of self-oriented perfectionism on academic procrastination (via an effect of self-oriented perfectionism on self-efficacy)). They also supported hypothesis 5 (that, after controlling for self-efficacy, there is no direct effect of self-oriented perfectionism on academic procrastination).

While the fact that four of our five hypotheses were supported might suggest that our replication was largely successful, hypothesis 2 (that there is a negative bivariate relationship between self-oriented perfectionism and academic procrastination) was not supported by analyses. This hypothesis was arguably the most crucial in this replication. Our finding is consistent with an earlier meta-analysis (Steel, 2007), which found no evidence of a relationship between self-oriented perfectionism and procrastination.

The fact that we found no evidence of a total effect (i.e., a relationship between self-oriented perfectionism as the independent variable and academic procrastination as the dependent variable) obviously has implications for the results of our mediation analysis. Interestingly, we *did* find evidence of the hypothesised indirect effect of self-oriented perfectionism on academic procrastination via self-efficacy, albeit the size of this effect was

small. This finding partly reflects the fact that the estimate of the direct effect was slightly positive (albeit not significant) and the indirect effect slightly negative; the sum of these two effects as the total effect was thus closer to zero than the indirect effect, and not significant. Zhao et al. (2010) describe this scenario of direct and indirect effects of opposite sign as “competitive mediation” (p. 199). In terms of whether this pattern of findings reflects the true underlying causal effects, it is possible that self-oriented perfectionism might have a negative indirect causal effect on academic procrastination that is exactly balanced by a *positive* direct causal effect (resulting in no total effect whatsoever). However, it’s also entirely possible that the unusual combination of a significant indirect and non-significant total effect reflects sampling error or sampling bias.

One aspect of hypothesis 5 merits further discussion. In our preregistration, we described this hypothesis as follows: “H5: When controlling for the effect of self-efficacy, there is no direct effect of self-oriented perfectionism on academic procrastination (i.e., the relationship between self-oriented perfectionism and academic procrastination is completely mediated by self-efficacy)”. Our unexpected pattern of results means that while hypothesis 5 is supported according to our inferential criteria, it would be somewhat misleading to claim that there was empirical support for the parenthetical part of the hypothesis (that “the relationship between self-oriented perfectionism and academic procrastination is completely mediated by self-efficacy”). That part of the hypothesis implicitly assumes the existence of a relationship between self-oriented perfectionism and academic procrastination to be mediated, and we found no evidence of such a relationship.

Strengths and Limitations

Our study had some strengths as a replication, most notably in the fact that it was comprehensively preregistered (including a preregistered R script for data processing and

analysis), limiting the possibility of data-dependent analysis decisions (see Gelman & Loken, 2014; Simmons et al., 2011). Our analysis and reporting also included some improvements over Seo's study (e.g., the fact that we reported indirect and total effects along with confidence intervals and significance tests). However, our study nevertheless constituted a conceptual rather than direct replication: We used different measures (in a different language), drew our sample from a different population, and, applied different (albeit similar) data analyses. This means that we obviously cannot determine whether our discrepant findings are a reflection of these differences versus an indication that Seo's findings represent erroneous inferences (e.g., Type I errors). It might be, as one example, that our inability to reproduce one of Seo's key findings is due to a difference in reliability and validity of the self-oriented perfectionism subscale of the Big Three Perfectionism Scale (utilised in our study) in comparison to the relevant subscale of the MPS (as utilised in Seo, 2008). That said, positive evidence for the reliability and validity of the Big Three Perfectionism Scale was reported by Smith et al. (2016), and the Cronbach's alpha value of .90 in our sample was high. Another limitation of our replication was the fact that our study had a slightly smaller sample size than Seo's, although this represented the outcome of a deliberate and considered decision based on a power analysis which suggested the planned sample size would be sufficient.

There are also some significant limitations that apply both to Seo's original study and our replication. First, both studies used convenience samples (albeit collected via different methods); as such, substantial uncertainty remains with respect to the extent to which the findings of each study apply to its respective population. Second, as studies testing mediation models, both are concerned with the drawing of causal inferences (e.g., Seo, p. 761: "That is, self-oriented perfectionism was found to have *a positive influence on self-efficacy*" [emphasis added]), but both studies used purely correlational cross-sectional designs without

any experimental manipulation, longitudinal element, or statistical controls for plausible confounding variables.

Directions for Future Research

Following on from the point in the previous paragraph, one important direction for future research in this area will be to use causal identification strategies to provide stronger tests of hypotheses about causal effects. For example, it may be possible to experimentally manipulate perfectionism levels (e.g., Rozental et al., 2017) and thereby test downstream effects on variables such as procrastination. Alternatively, careful specification of plausible confounding and collider variables in a graphical causal model may permit the estimation of causal effects using observational data (see Rohrer, 2018).

Another important direction for future research stems from our supplementary exploratory analysis of possible non-linearity in the relationship between self-oriented perfectionism and academic procrastination. Our findings with respect to this question were somewhat tentative, with some equivocal evidence of a U-shaped relationship. It may be useful for future research to take a confirmatory approach to this question, with a preregistered method for testing the hypothesis of a U-shaped relationship (e.g., the two lines approach of Simonsohn, 2018), with a sample size planned in order to deliver adequate power for this approach.

Finally, both our study and Seo's take a nomothetic approach, and implicitly assume that the effect of self-oriented perfectionism is constant across individuals. It is plausible that this effect may vary substantially across individuals: For some, an increase in perfectionism may be useful in combatting procrastination, whereas for others it is not. Idiographic approaches (see Molenaar, 2004) involving multiple measurements over time from the same individuals could allow for the estimation of the relationship between self-oriented

perfectionism and academic procrastination *within* individuals. Temporal network analysis may be a useful method in this regard (see Costantini et al., 2019; Epskamp et al., 2018).

Conclusions

We found no evidence of a relationship between self-oriented perfectionism and academic procrastination, meaning that we were unable to reproduce one of Seo's (2008) two key findings. We nevertheless did find evidence of a small, negative and indirect effect of self-oriented perfectionism on academic procrastination via an effect on self-efficacy.

References

- Ahlberg, J. H., Nilson, E. N., & Walsh, J. L. (1967). *The theory of splines and their applications* (Vol. 38). Academic Press.
- Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E.-J., Berk, R., Bollen, K. A., Brembs, B., Brown, L., Camerer, C., Cesarini, D., Chambers, C. D., Clyde, M., Cook, T. D., Boeck, P. D., Dienes, Z., Dreber, A., Easwaran, K., Efferson, C., ... Johnson, V. E. (2017). Redefine statistical significance. *Nature Human Behaviour*, 1. <https://doi.org/10.1038/s41562-017-0189-z>
- Burka, J. B., & Yuen, L. M. (1983). *Procrastination: Why you do it, what to do about it*. Addison-Wesley.
- Çapan, B. E. (2010). Relationship among perfectionism, academic procrastination and life satisfaction of university students. *Procedia - Social and Behavioral Sciences*, 5, 1665–1671. <https://doi.org/10.1016/j.sbspro.2010.07.342>
- Chen, G., Gully, S. M., & Eden, D. (2001a). *New general self-efficacy scale [Database record]*. Retrieved from PsycTESTS. <https://doi.org/10.1037/t08800-000>

Chen, G., Gully, S. M., & Eden, D. (2001b). Validation of a new general self-efficacy scale.

Organizational Research Methods, 4(1), 62–83.

<https://doi.org/10.1177/109442810141004>

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.

Costantini, G., Richetin, J., Preti, E., Casini, E., Epskamp, S., & Perugini, M. (2019).

Stability and variability of personality networks. A tutorial on recent developments in network psychometrics. *Personality and Individual Differences*, 136, 68–78.

<https://doi.org/10.1016/j.paid.2017.06.011>

Epskamp, S., van Borkulo, C. D., van der Veen, D. C., Servaas, M. N., Isvoranu, A.-M.,

Riese, H., & Cramer, A. O. J. (2018). Personalized network modeling in psychopathology: The importance of contemporaneous and temporal connections.

Clinical Psychological Science, 6(3), 416–427.

<https://doi.org/10.1177/2167702617744325>

Flett, G. L., Blankstein, K. R., Hewitt, P. L., & Koledin, S. (1992). Components of

perfectionism and procrastination in college students. *Social Behavior and Personality: An International Journal*, 20(2), 85–94.

<https://doi.org/10.2444/sbp.1992.20.2.85>

Foster, J. F. (2007). Procrastination and perfectionism: Connections, understandings, and

control. *Gifted Education International*, 23(3), 264–272.

<https://doi.org/10.1177/026142940702300307>

Gelman, A., & Loken, E. (2014). The statistical crisis in science. *American Scientist*, 102(6),

460–465. <https://doi.org/10.1511/2014.111.460>

Hart, B. A., Gilner, F. H., Handal, P. J., & Gfeller, J. D. (1998). The relationship between

perfectionism and self-efficacy. *Personality and Individual Differences*, 24(1), 109–

113. [https://doi.org/10.1016/S0191-8869\(97\)00116-5](https://doi.org/10.1016/S0191-8869(97)00116-5)

- Hewitt, P. L., & Flett, G. L. (1991). Perfectionism in the self and social contexts: Conceptualization, assessment, and association with psychopathology. *Journal of Personality and Social Psychology*, 60(3), 456–470. <https://doi.org/10.1037/0022-3514.60.3.456>
- Hurvich, C. M., Simonoff, J. S., & Tsai, C.-L. (1998). Smoothing parameter selection in nonparametric regression using an improved Akaike information criterion. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 60(2), 271–293. <https://doi.org/10.1111/1467-9868.00125>
- Kim, A., & Cha, J. (1996). General self-efficacy and its measurement. *Winter Conference of Korean Industrial and Organizational Psychological Association*.
- Kim, K. R., & Seo, E. H. (2015). The relationship between procrastination and academic performance: A meta-analysis. *Personality and Individual Differences*, 82, 26–33. <https://doi.org/10.1016/j.paid.2015.02.038>
- Lakens, D., Scheel, A. M., & Isager, P. M. (2018). Equivalence testing for psychological research: A tutorial. *Advances in Methods and Practices in Psychological Science*, 1(2), 259–269. <https://doi.org/10.1177/2515245918770963>
- Lay, C. H. (1986). At last, my research article on procrastination. *Journal of Research in Personality*, 20(4), 474–495. [https://doi.org/10.1016/0092-6566\(86\)90127-3](https://doi.org/10.1016/0092-6566(86)90127-3)
- Molenaar, P. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time forever. *Measurement: Interdisciplinary Research & Perspective*, 2(4), 201–218. https://doi.org/10.1207/s15366359mea0204_1
- Nie, Z., & Racine, J. S. (2012). The crs package: Nonparametric regression splines for continuous and categorical predictors. *The R Journal*, 4(2), 48–56.

- Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). The preregistration revolution. *Proceedings of the National Academy of Sciences*, 115(11), 2600–2606. <https://doi.org/10.1073/pnas.1708274114>
- Nosek, B. A., Spies, J. R., & Motyl, M. (2012). Scientific utopia: II. Restructuring incentives and practices to promote truth over publishability. *Perspectives on Psychological Science*, 7(6), 615–631. <https://doi.org/10.1177/1745691612459058>
- Onwuegbuzie, A. J. (2000). Academic procrastinators and perfectionistic tendencies among graduate students. *Journal of Social Behavior & Personality*, 15(5), 103–109.
- R Core Team. (2018). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <http://www.R-project.org/>
- Rohrer, J. M. (2018). Thinking clearly about correlations and causation: Graphical causal models for observational data. *Advances in Methods and Practices in Psychological Science*, 1(1), 27–42. <https://doi.org/10.1177/2515245917745629>
- Rosseel, Y. (2012). An R package for structural equation modeling. *Journal of Statistical Software*, 48(2). <https://doi.org/10.18637/jss.v048.i02>
- Rozental, A., Shafran, R., Wade, T., Egan, S., Nordgren, L. B., Carlbring, P., Landström, A., Roos, S., Skoglund, M., Thelander, E., Trosell, L., Örténholm, A., & Andersson, G. (2017). A randomized controlled trial of Internet-Based Cognitive Behavior Therapy for perfectionism including an investigation of outcome predictors. *Behaviour Research and Therapy*, 95, 79–86. <https://doi.org/10.1016/j.brat.2017.05.015>
- Saddler, C. D., & Sacks, L. A. (1993). Multidimensional perfectionism and academic procrastination: Relationships with depression in university students. *Psychological Reports*, 73(3, Pt 1), 863–871. <https://doi.org/10.2466/pr0.1993.73.3.863>
- Scherbaum, C. A., Cohen-Charash, Y., & Kern, M. J. (2006). Measuring general self-efficacy: A comparison of three measures using item response theory. *Educational and*

Psychological Measurement, 66(6), 1047–1063.

<https://doi.org/10.1177/0013164406288171>

Seo, E. H. (2008). Self-efficacy as a mediator in the relationship between self-oriented perfectionism and academic procrastination. *Social Behavior & Personality: An International Journal*, 36(6), 753–764. <https://doi.org/10.2224/sbp.2008.36.6.753>

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, 22(11), 1359–1366.

<https://doi.org/10.1177/0956797611417632>

Simonsohn, U. (2018). Two lines: A valid alternative to the invalid testing of U-shaped relationships with quadratic regressions. *Advances in Methods and Practices in Psychological Science*, 1(4), 538–555. <https://doi.org/10.1177/2515245918805755>

Smith, M. M., Saklofske, D. H., Stoeber, J., & Sherry, S. B. (2016). The big three perfectionism scale: A new measure of perfectionism. *Journal of Psychoeducational Assessment*, 34(7), 670–687. <https://doi.org/10.1177/0734282916651539>

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology*, 31(4), 503–509. <https://doi.org/10.1037/0022-0167.31.4.503>

Steel, P. (2007). The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. *Psychological Bulletin*, 133(1), 65–94. <https://doi.org/10.1037/0033-2909.133.1.65>

Steel, P., & Klingsieck, K. B. (2016). Academic procrastination: Psychological antecedents revisited. *Australian Psychologist*, 51(1), 36–46. <https://doi.org/10.1111/ap.12173>

Stoeber, J. (2017). The psychology of perfectionism: An introduction. In J. Stoeber (Ed.), *The psychology of perfectionism* (pp. 3–16). Routledge.

- van Eerde, W. (2004). Procrastination in academic settings and the Big Five model of personality: A meta-analysis. In H. C. Schouwenburg, C. H. Lay, A. Pychyl, & J. R. Ferrari (Eds.), *Counseling the procrastinator in academic settings* (pp. 29–40). American Psychological Association.
- Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, 37(2), 197–206.
<https://doi.org/10.1086/651257>