

ORIGINAL RESEARCH REPORT

Self-Control and Affect Regulation Styles Predict Anxiety Longitudinally in University Students

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The performance and well-being of university students is influenced by many factors, including self-control and affect regulation, but little is known about how these factors relate. We therefore analyzed data from a multi-site research project that assessed trait self-control, affect regulation, and anxiety in a longitudinal cohort design ($N = 1314$) using structural equation modeling. We specifically tested hypotheses that trait self-control, assessed upon entering school, would predict anxiety outcomes during students' third year, and this relationship would be mediated by affect regulation styles (adaptive or maladaptive). We found that greater self-control did predict lower third-year anxiety, even after accounting for anxiety levels upon entering school. Furthermore, this relationship was partially mediated by maladaptive affect regulation, where students with greater self-control endorsed less use of maladaptive coping strategies (e.g., denial, self-blame), which in turn predicted less subsequent anxiety. In contrast, adaptive coping strategies did not mediate the relationship between trait self-control and anxiety. These findings highlight trait self-control as an important predictor of anxiety, and they identify maladaptive affect regulation as a target for interventions to promote student well-being and success.

Keywords: self-control; anxiety; university students; affect regulation; self-regulation

The mental health of university students is a growing area of concern (Bayram & Bilgel, 2008; Blanco et al., 2008; Twenge et al., 2010; Wilcox et al., 2010). In a representative sample of over 14,000 students in the United States, 32% had a positive pre-screen for a mental health problem, and 9.8% (12.2% for women) had a positive pre-screen for an anxiety disorder (Eisenberg, Hunt, & Speer, 2013). The mental health of students has furthermore been related to their achievement in school. Negative affect (e.g., anxiety about school) has been associated with less adaptive academic motivation and strategies, lower grades, and withdrawal from courses and university programs altogether (Pekrun, 2000; Pekrun, Goetz, Titz, & Perry, 2002; Ruthig, Hladkyi, Hall, Pekrun, & Perry, 2002; Ziegler, 2001). These findings underscore the need for a better understanding of the individual differences underlying student well-being, and anxiety in particular. This knowledge will be crucial for identifying students at risk for poor outcomes, and it will pave the way for the development of interventions that can target key mechanisms in academic performance.

One individual difference that has been consistently related to both affective wellness and academic outcomes is trait self-control. Trait self-control is the tendency or

capacity to consciously behave in opposition to immediate internal or situational forces in pursuit of a goal (Hoyle & Davisson, 2016). In university student samples and adult samples, trait self-control shows consistent positive relationships with well-being, life satisfaction, overall mental health, and academic measures such as grades and academic engagement (Galla & Duckworth, 2015; Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014; Howell, 2009; Robinson, 2007; Tangney, Baumeister, & Boone, 2004). This evidence does not define a causal mechanism linking self-control to these positive outcomes, but, by definition, self-control involves efforts to optimize long-term outcomes. Indeed trait self-control seems to evince or support general self-regulatory success and is associated with a wide array of beneficial self-regulatory processes and effects (Duckworth, Gendler, & Gross, 2016; Galla & Duckworth, 2015; Hoyle & Davisson, 2016; Converse, Juarez, & Hennecke, 2019).

Another body of research has implicated affect regulation as another individual difference linked to well-being in university students. *Affect* has been conceptualized as an umbrella term encompassing stress responses, emotions, and moods; correspondingly, the term *affect regulation* encompasses efforts to alter affective states through coping, emotion regulation, and mood regulation, or mood repair, respectively (Gross, 2015). Extremera and Fernández-Berrocal (2006) found self-reported affect regulation to be negatively related to anxiety and depression and positively related

to measures of mental health, general health, vitality, and social function in university students. Again, these findings do not specifically establish a causal effect of affect regulation on these outcomes. Nevertheless, given that affect reflects coordinated changes in physiology, cognition, and behavior, its regulation would likely have broad consequences across functional domains (Gross, 2015). The consequences of affect regulation on students' well-being, however, depend on the specific strategies employed. For example, Gross and John (2003) examined university students and examined outcomes associated with the habitual use of two strategies: reappraisal, which refers to changing one's perspective or interpretation of a stimulus to alter emotional response, and expressive suppression, the act of inhibiting expressive behavior related to emotions. Reappraisal was generally adaptive. Gross and John found a positive profile of associations with reappraisal including less experience of negative emotion and depressive symptoms; greater experience of positive emotion, liking by peers, optimism, self-esteem, and life satisfaction; and closer relationships. Expressive suppression, on the other hand, was generally maladaptive, and the opposite profile was observed. Thus, affect regulation may impact student well-being and success, but specific outcomes likely differ by particular affect regulation habits.

Individual differences in self-control and affect regulation have each been associated with anxiety and other aspects of student well-being, but they likely work in tandem. Greater trait self-control, for example, may facilitate more consistent or effective applications of affect regulation strategies. Additionally, effective affect regulation may support self-control, as self-control challenges often have an affective component. For example, affect regulation may be beneficial for reducing negative affect that results from opposing immediate motivational forces when exercising self-control, or it could bolster positive affect associated with making progress toward self-relevant goals. Indeed, some evidence in university students suggests an association between these factors. For instance, current and former university students reporting higher self-control performed better on a laboratory task of emotion regulation as assessed by self-report and neural activation (Paschke et al., 2016). University students have also demonstrated better performance on tasks of self-regulation following positive affect inductions (Isen & Reeve, 2005; Tice, Baumeister, Shmueli, & Muraven, 2007). In addition, trait self-control has been found to predict life satisfaction, partially mediated by affective well-being (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014). While the specific mechanisms underlying these associations are not yet clear, this initial evidence underscores the importance of examining affect regulation and self-control together to better understand their effects on well-being.

The current study utilizes a multi-site, longitudinal cohort data set to examine how trait self-control and individual differences in affect regulation predict anxiety, a particularly relevant mental health concern in this population. In a recent report aggregating data from

147 college and university counseling centers, clinicians identified anxiety (from a list of 44 potential concerns) as the most common primary concern of students presenting for treatment (24.1% of students) and the most common concern overall (62.2% of students; counting all applicable concerns; Center for Collegiate Mental Health, 2018). Students for whom anxiety was the primary presenting concern also accounted for the largest portion of clinical services usage (23.3%) of all students presenting for treatment. Focusing on this marker of well-being provides a modeling target that is specific, relevant, and clearly interpretable. Based on the evidence noted above, we predict that greater trait self-control will enable more effective and adaptive affect regulation in university students, resulting in lower levels of anxiety. Self-control enables the pursuit of goals despite situational pressures. Therefore, we expect that self-control will facilitate the pursuit of affect regulation goals, ultimately increasing the effectiveness of affect regulation. The previous studies linking self-control with more successful emotion regulation (Paschke et al., 2016) and greater life satisfaction through affective well-being (Hofmann et al., 2014) support this hypothesis of a mediated relationship. However, self-control may also reduce anxiety through a more direct pathway, for example, by reducing the experience of goal-incongruent states that can provoke anxiety (e.g., doing poorly in school). Using this data set, we test both of these pathways—the direct prediction of trait self-control on anxiety and its indirect effects through affect regulation. Thus, we hypothesize a negative predictive relationship between self-control and anxiety, and a partial mediation of this relationship by affect regulation. Because of known sex differences in the experience of anxiety (Donner & Lowry, 2013) and possibly mechanisms of affect regulation (Domes et al., 2010), we simultaneously estimate models for both females and males to explore potential differences. These analyses extend previous work by providing a more detailed understanding of the role of trait self-control and affect regulation as mechanisms underlying a key indicator of university student well-being in a large sample.

Methods

Data Collection

Data for this project were collected as part of the Resilience Project, a collaborative, longitudinal research project aimed at understanding and improving the well-being and success of university students. The present analyses included data from three institutions: Duke University ($n = 745$, 56.7%), Davidson College ($n = 218$, 16.6%), and Furman University ($n = 351$, 26.7%; total $N = 1314$). The sample size was maximized by including all available data from the Resilience Project that met the timing constraints and criteria for completeness of record described below. Exclusions from the full sample were made on the basis of missing data (see below). Demographics were consistent with undergraduate populations across schools. Participants' race and ethnicity were as follows: African American/Black ($n = 70$, 5.3%); Asian/Asian American ($n = 177$, 13.5%); Latinx ($n = 34$, 2.6%); White/Caucasian

($n = 770$, 58.6%); Bi-/Multi-Racial ($n = 125$, 9.5%); Other ($n = 14$, 1.1%; 3 participants did not report race/ethnicity; 121 participants were international students, who were classified separately in the race and ethnicity data of the data set). Race and ethnicity were associated with institution ($\chi^2(10, N = 1190) = 150.29$, $p < .001$, $V = .36$). This association was largely driven by variation in the degree of diversity of the participant subsamples across institutions (more generally diverse vs. more predominantly White/Caucasian). There were more females ($n = 831$, 63.2%) than males in the sample ($n = 483$, 36.8%), and there was a small difference in the proportion of female to male participants across institutions ($\chi^2(2, N = 1314) = 10.36$, $p = .006$, $V = .09$). Participants' ages varied throughout the study, but ages were calculated here using birthdates and day of baseline survey completion. At baseline, participants were an average of 18.38 years old ($SD = 0.46$, n missing = 18) with a very small difference in age across institutions ($F(2, 1293) = 3.84$, $p = .022$, $\eta^2 = .006$).

Around the time of beginning their undergraduate program, students in the 2018 graduation cohort received a letter and emails inviting them to participate in the study. Students who completed the full baseline assessment (corresponding to their approximate time of entry into their undergraduate program) were invited to continue in the study by completing follow-up assessments each semester for the next four years. At the time of the present analyses, the latest available data were from the spring semester of the students' third year in school. We were also specifically interested in assessing this time point to evaluate students' experiences well into their program, but without strong influences from imminent program completion. Each assessment consisted of a wide variety of self-report measures (Table S1). Participants 18 years of age and older provided informed consent electronically and completed the assessments online at their convenience. Participants under the age of 18 at the time of initial recruitment into the study instead completed an electronic assent form. A waiver of written parental consent was approved by the Institutional Review Boards; however, these participants' parents received emails and physical letters about this study and were given the option of contacting the project staff to prevent their child's participation. Participants were not compensated for the baseline assessment, but they were provided monetary compensation for completing follow-up assessments (rates varied by institution). The Institutional Review Boards of each of the participating institutions approved the study.

Measures

The following measures were included in the present analyses. As discussed under "Analyses" below, the set of collected measures varied by assessment. Details on when the included measures were collected are summarized in **Table 1**. Summaries of how these measures were combined, descriptive statistics, and reliability estimates are presented in **Tables 1, 2 and 3**, respectively.

Brief Capacity for Self-Control Scale (BCSCS)

Trait self-control was measured with the BCSCS, a nine-item measure of trait self-control, which includes subscales for initiation (i.e., overriding a pull towards inaction to produce goal-consistent behavior), inhibition (i.e., overriding a pull towards goal-inconsistent behavior), and continuation (i.e., persisting at initiation or inhibition in an ongoing self-control challenge despite pull to stop; Hoyle & Davison, 2016). This instrument asks the student to indicate how often his or her behavior is reflected by statements relating to different aspects of self-control on a scale of 1 (*hardly ever*) to 5 (*nearly always*). The mean scale score was computed for each student after re-coding reverse-scored items.

Given that there is no published validation study of the BCSCS, we briefly present information about the scale's validity and reliability. In this sample, there was evidence of reliability (see **Table 3**) and convergent validity with the Big Five Inventory-Conscientiousness subscale (John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008), which was administered at baseline along with the BCSCS ($r = .649$, $t(1208) = 29.65$, $p < .001$). Evidence of the scale's criterion validity comes from administrative data on students' grade point averages in a subsample of Duke University students from this data set. The BCSCS positively predicted grade point average, although not always significantly (e.g., students' first semester in college: $r = 0.08$, $t(327) = 1.45$, $p = 0.148$; cumulative grade point average at the end of junior year $r = 0.11$, $t(416) = 2.26$, $p = 0.024$). Other samples that included the long version of this scale (which includes the nine items in the BCSCS and 11 additional items) provide additional information on validity and reliability (see osf.io/u4vpx for a summary of analyses). In a sample of 125 undergraduate students at Duke University who participated in an unrelated, unpublished study ($M_{\text{age}} = 19.99$; 39 identified as male, 86 as female), the BCSCS was moderately reliable ($\alpha = 0.68$, $\omega_{\text{total}} = 0.78$). In that study, students reported the expected difficulty of sixteen behaviors during finals week. To estimate criterion validity for the purposes of the current paper, we calculated the association between BCSCS and four behaviors selected a priori as those that likely require self-control for most people. Consistent with the construct of self-control, people who scored higher on the nine-item BCSCS expected that it would be easier to avoid procrastination ($r = -0.47$, $p < .001$), avoid wasting time on social media and the internet ($r = -.41$, $p < .001$), complete everything on a to-do list ($r = -.38$, $p < .001$), and stick to a planned study schedule ($r = -.47$, $p < .001$) during the upcoming finals period. The Duke University undergraduate sample also provided evidence of discriminant validity; the correlation between BCSCS and the Brief Sensation Seeking Scale (Cronbach's $\alpha = 0.78$; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002) was not significantly different from zero ($r = -0.001$, $p = 0.99$). In a sample of 398 Amazon Mechanical Turk workers ($M_{\text{age}} = 33.80$; 207 identified as male, 188 as female), who participated in an unrelated study (described in a poster, available at osf.io/yr75x), the BCSCS was reliable (Cronbach's $\alpha = 0.85$,

McDonald's $\omega = 0.89$). Participants in this online sample also completed other individual difference measures related to self-regulatory skill, which provide evidence of convergent validity; the BCSCS was strongly correlated with Grit (Cronbach's $\alpha = 0.90$; $r = 0.76$, $p < .001$; Duckworth, Peterson, Matthews, & Kelly, 2007) and moderately correlated with Consideration of Future Consequences (Cronbach's $\alpha = 0.90$; $r = 0.56$, $p < .001$; Strathman, Gleicher, Boninger, & Edwards, 1994).

Symptoms Checklist 90-R (SCL-90R)

The SCL-90R was designed to measure psychological symptoms in patient and community samples (Derogatis, 1994). A subset of 34 items from the SCL-90R were administered here, comprising scales for symptoms of somatization, depression, and anxiety. This instrument asks the student to indicate the degree to which phrases related to various psychiatric symptoms describe his or her experience over the past month on a scale of 0 (*not at all*) to 4 (*extremely*). We extracted scores for the 10 items relating to general anxiety.

Brief Symptom Inventory 18 (BSI-18)

The BSI-18 was designed to measure psychological distress and psychiatric features in patient and community samples (Derogatis, 2001). The instrument includes 18 items comprising scales for symptoms of somatization, depression, and anxiety. Global and subscale scores on the BSI-18 correlate highly with those of the SCL-90R based on a large community sample, as the items of the BSI-18 are a subset of the items from the larger SCL-90R ($r > .9$ for all; $r = .97$ for anxiety subscales specifically; Prinz et al., 2013). This instrument asks the student to indicate the degree to which statements related to various psychiatric symptoms describe his or her experience over the past seven days on a scale of 0 (*not at all*) to 4 (*extremely*). The anxiety scale can be further divided into items relating to general anxiety and panic. We extracted scores for the three items relating to general anxiety for each individual, which are a subset of the anxiety items included in the SCL-90R.

Positive and Negative Affect Schedule (PANAS)

The PANAS was designed to measure various categories of affect (Watson, Clark, & Tellegen, 1988). A subset of 21 items from the PANAS-Expanded Form was administered here (Watson & Clark, 1999). The participant is instructed to rate the extent to which various individual affective labels describe his or her experience over the past week on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). We extracted scores from the three items from the anxiety/fear subscale for each individual.

Brief COPE (BCOPE)

The BCOPE was designed to assess a wide variety of coping responses (Carver, 1997), including some presumed to be functional and some dysfunctional. The instrument consists of 28 items comprising 14 scales that correspond to different categories of coping responses (two items per scale). The student is asked to indicate how often

his or her behavior is generally reflected by statements relating to different methods of coping on a scale of 1 (*I don't do this at all*) to 5 (*I do this a lot*). We extracted scale scores for categories of coping responses that have most reliably been considered either adaptive or maladaptive (refer to Table S2 in the Supplemental Materials for a list of the items in these scales). The adaptive coping scales included active coping, instrumental support, positive reframing, planning, and acceptance (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Carver, Scheier, & Weintraub, 1989; Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000; Naragon-Gainey, McMahon, & Chacko, 2017; Thompson et al., 2010). The maladaptive scales included denial, substance use, behavioral disengagement, and self-blame (Abbey, Smith, & Scott, 1993; Carver et al., 1989; Carver, 1997; Connor-Smith et al., 2000; Cooper, Frone, Russell, & Mudar, 1995; Hampel & Petermann, 2006; Mantzicopoulos, 1990; Vollrath, 1998; Wills & Shiffman, 1985). Evaluations of the remaining scales—self-distraction, use of emotional support, venting, humor, and religion—have not been as consistently evaluated as either adaptive or maladaptive (Brown, Westbrook, & Challagalla, 2005; Carver et al., 1989; Connor-Smith et al., 2000; Martin, Puhlik-Doris, Larsen, Gray, & Weir, 2003; McCrae & Costa, 1986; Naragon-Gainey et al., 2017; Seybold & Hill, 2001); therefore, these scales were not included in the present analyses. We then computed composite measures of adaptive and maladaptive affect regulation by averaging the respective item scores for each individual.

Big Five Inventory (BFI)

The BFI was designed to measure five dimensions of personality (John, Donahue, Kentle, 1991). The instrument includes 44 items comprising scales for extraversion, agreeableness, conscientiousness, neuroticism, and openness. This instrument asks the student to rate their agreement with statements describing how they see themselves on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). We extracted scores for the nine items of the conscientiousness scale.

Analyses

The instruments that were administered in the data set varied by assessment. Therefore, the data included in these analyses were drawn from the relevant instruments that were available from the baseline and third-year spring assessments (see **Table 1**). A composite score for baseline anxiety was computed as the mean of the extracted items from the BSI-18 (three items) and the PANAS (three items), and a composite score for third-year anxiety was computed as the mean of the extracted items from the SCL-90R (10 items) and the PANAS (three items). Structural equation modeling (SEM) was used to evaluate the relationships between trait self-control, baseline anxiety, and third-year anxiety (direct-effects-only model), and how the relationship between trait self-control and third-year anxiety was mediated by adaptive and maladaptive affect regulation (mediated model). Parameters for these relationships were estimated simultaneously for females

Table 1: Composition and timing of variables in models.

Variable	Measure	Sample Items	Collection Time
Trait Self-Control	BCSCS	I am able to resist temptations. After I have started on a challenging task, I find it easy to stick with it.	Fall of year 1
Baseline Anxiety	Composite of anxiety items from BSI-18 and PANAS	Feeling tense or keyed up Nervousness or shakiness inside Nervous Shaky	Fall of year 1 (or summer before) Fall of year 1
3 rd -Year Anxiety	Composite of anxiety items from SCL-90R and PANAS	[see BSI-18] [see above]	Late spring of year 3 Late spring of year 3
Adaptive Affect Regulation	Composite of BCOPE scales	[When I am stressed or anxious,] I've been taking action to try to make the situation better. [...] I've been looking for something good in what is happening.	Fall of year 1 (or summer before)
Maladaptive Affect Regulation	Composite of BCOPE scales	[...] I've been refusing to believe that it has happened. [...] I've been using alcohol or other drugs to help me get through it.	Fall of year 1 (or summer before)
Conscientiousness	BFI-Conscientiousness	[I see myself as someone who] does a thorough job. [...] perseveres until the task is finished.	Fall of year 1 (or summer before)

Note: BCSCS = Brief Capacity for Self-Control Scale; BFI = Big Five Inventory; BSI-18 = Brief Symptom Inventory 18; PANAS = Positive and Negative Affect Schedule; SCL-90R = Symptoms Checklist 90R; BCOPE = Brief COPE. The items of the BSI-18 are a subset of the items of the SCL-90R (Prinz et al., 2013, observed a correlation of their anxiety subscales of $r = .97$), but neither scale was available at both baseline and year-3 time points. The BSI-18, BCOPE, and BFI were part of a survey that participants were first invited to complete during the summer before their first year, but responses to this survey were accepted through the fall. Note, the full list of items from the BCOPE that were used in the present analyses are provided in Table S2 in the supplementary materials.

Table 2: Main measure *N*s, means, standard deviations, effect sizes of mean differences, skewness, and kurtosis by sex.

Measure	<i>N</i>	<i>M</i>	<i>SD</i>	<i>d</i>	Skew	Kurtosis
Trait Self-Control	776/438	3.35/3.31	0.61/0.58	.08	0.16/−0.05	−0.17/0.23
Baseline Anxiety	831/483	1.21/0.91	0.79/0.78	.38	0.56/0.82	0.03/0.43
3 rd -Year Anxiety	504/238	0.86/0.70	0.67/0.61	.24	1.62/2.01	2.83/4.30
Adaptive Affect Regulation	830/483	3.66/3.62	0.57/0.63	.07	−0.15/−0.69	−0.04/1.36
Maladaptive Affect Regulation	831/483	2.04/1.93	0.57/0.54	.19	0.73/0.49	1.02/−0.25

Note: *M* and *SD* represent mean and standard deviation, respectively. Results are presented by self-reported sex as [females]/[males]. The possible range of composite anxiety scores (disregarding missing data) was 0.5–4.5 for baseline anxiety and 0.23–4.23 for third-year anxiety.

and males. The observed variables that were incorporated into these models and their relationships are summarized in **Tables 1** and **4**.

Missing data

Multiple strategies were used to handle missing data. Listwise deletion was used in two stages and FIML was used beyond that. First, participants who were missing more than one variable in the direct-effects-only model

were excluded ($n = 906$). From the remaining sample, participants who did not report sex were then excluded ($n = 40$). This left a sample of 1314 used for analyses. Participants who were excluded from analyses were compared to those who were not in (non-missing observation) mean scores on the five variables in the model (osf.io/rw874). The only difference in mean scores was on baseline anxiety, which a Welch *t*-test indicated was lower among participants who were excluded from

the analysis set ($M = 0.80, SD = 0.94$) than those who were not ($M = 1.10, SD = 0.80; t(967.54) = 6.59, p < 0.001, d = 0.35$).

Missing data among the responses of included participants were accounted for using full information maximum likelihood (FIML). In contrast to listwise deletion, FIML allows people with some missing data to be included in analyses. When missingness is related to other measured variables but is not caused by the missing values themselves, FIML can produce unbiased parameter estimates and standard errors (Finkbeiner, 1979). In this data set, FIML is a reasonable approach; missingness on particular items and scales does not appear to be caused by people choosing to withhold responses to specific items or scales. For example, most people missing year three anxiety did not complete that entire survey, so their missingness is unlikely to be caused by systematic failures to report particular values (e.g., people high in anxiety not reporting their anxiety). Missingness is not completely random and can be predicted by other measured variables in the model as we describe below.

Of included participants, about half were not missing any data ($n = 642$; see osf.io/rw874 for more information on patterns of missingness). Average scores were computed based on available items, and the percentage of missing data for each variable in analyses was very low for baseline anxiety (n missing = 0), adaptive affect regulation (n missing = 1), maladaptive affect regulation (n missing = 1), and trait self-control (n missing = 100, 7.6%), but high for third-year anxiety (n missing = 572, 43.5%). Participants who were missing on third-year anxiety were compared to those who were non-missing on all other variables in the model using Welch t -tests and differed on one of the four variables (for all tests, see osf.io/rw874); people missing on third-year anxiety scored lower on baseline anxiety ($M = 0.98, SD = 0.86$) than those who were non-missing ($M = 1.19, SD = 0.74; t(1125.4) = 4.82, p < .001, d = 0.27$).

Analysis strategy

Data were prepared for analysis in R, which entailed selecting the included participants, computing summary scores, evaluating measure reliability (using the *psych* package, Revelle, 2018; *lavaan*, Rosseel, 2012; and H index calculator, Hammer, 2016), evaluating normality (using the *MVN* package; Korkmaz, Goksuluk, & Zararsiz, 2014), and calculating descriptive statistics and other basic analyses (e.g., the previously reported t -tests). Our OSF project contains markdown documents (osf.io/9wzu8) and an R project to assist people in reproducing our analyses using shared data (osf.io/tp6c9). To protect the privacy of participants, analysis data sets did not include demographic information. Reported descriptive statistics were computed by Resilience Project staff and thus are not included in the analysis scripts.

Data were non-normal at the multivariate level (Mardia Skewness = 553.14, $p < .001$; Mardia Kurtosis = 14.09, $p < .001$; Henze-Zirkler $T = 3.78, p < .001$) and all variables except trait self-control were non-normal at the univariate level (Shapiro-Wilk range 0.81–0.99, $ps < .01$). The patterns were not meaningfully different when

males and females were assessed separately, except that trait self-control was normal at the univariate level for males only (see osf.io/9wd8c). Given the univariate and multivariate non-normality, maximum likelihood with robust standard errors (Huber-White) and a scaled test statistic was used for estimation (Satorra & Bentler, 1994). The following standard fit statistic cutoffs were utilized to evaluate model fit: CFI > 0.95 (Hu & Bentler, 1999); RMSEA < 0.05 (Browne & Cudeck, 1992); SRMR < 0.08 (Hu & Bentler, 1999).

Reliability

As shown in **Table 3**, we used three complementary approaches to estimate reliability. The measures included in the administered survey were designed to prioritize breadth and be as short as possible. By design, our measures capture different aspects of a construct and use few items to do so; they should have moderate rather than high internal consistency (Clifton, 2019).

All measures appear to be reliable, as differently estimated by alpha, McDonald's total omega, and the construct replicability index H . Alpha values for all measures are moderate to high, ranging from .68 (Baseline Anxiety) to .92 (3rd Year Anxiety). However, alpha underestimates reliability when items do not have equal covariances and factor loadings (Revelle & Condon, 2019). Other approaches improve on alpha by taking item factor structure into account. McDonald's total omega is one such model-based estimate of total reliability. Total omega captures the common variance among items while considering a more complex factor structure (Revelle & Condon, 2019). Total omega estimates suggest that all measures are reliable and, more specifically, that over 80% of variance in (unit-weighted) scores is attributable to common sources of variance among items (Rodriguez, Reise, & Haviland, 2016). The construct replicability index, H , evaluates how well a set of items represents a latent variable (Hancock & Mueller, 2001). High values (>.80) suggest one well-defined latent variable while lower values of H indicate that scores do not reflect one underlying latent construct (Rodriguez et al., 2016). We calculated H with the help of an Excel macro (Hammer, 2016; see osf.io/7rknz for analysis script and macro). All measures except maladaptive affect regulation have high (>.80)

Table 3: Main measure number of items and reliability estimates (Cronbach's alpha, McDonald's omega, and construct replicability index, H).

Measure	Number of items	α	ω	H
Trait Self-Control	9	.78	.86	.92
Baseline Anxiety	6	.68	.83	.80
3 rd -Year Anxiety	13	.92	.94	.90
Adaptive Affect Regulation	10	.77	.86	.82
Maladaptive Affect Regulation	8	.72	.86	.72

Note: α indicates Cronbach's alpha, ω indicates McDonald's omega total, and H indicates construct replicability.

Table 4: *N* and measure correlations with confidence intervals.

Variable	<i>N</i>	1	2	3	4
1. Trait Self-Control	1214				
2. Baseline Anxiety	1314	-.13***			
		[-.18, -.07]			
3. 3 rd -Year Anxiety	742	-.21***	.38***		
		[-.28, -.13]	[.31, .44]		
4. Adaptive Affect Regulation	1313	.24***	-.11***	-.09*	
		[.19, .29]	[-.16, -.05]	[-.16, -.02]	
5. Maladaptive Affect Regulation	1313	-.32***	.34***	.30***	-.24***
		[-.37, -.26]	[.29, .38]	[.23, .36]	[-.29, -.18]

Note: Results are presented for the entire analysis sample. Pairwise complete observations were used. Values in square brackets indicate the 95% confidence interval for each correlation. *indicates $p < .05$. **indicates $p < .01$. ***indicates $p < .001$. Correlations were also examined by self-reported sex. Estimates differed significantly between females and males for the following two pairwise correlations ([females]/[males]): baseline anxiety and 3rd-year anxiety ($N = 504/238$; $r = .43^{***}/.20^{***}$; $z = 3.25$, $p = .001$); adaptive affect regulation and maladaptive affect regulation ($N = 829/483$; $r = -.29^{***}/-.16^{***}$, $z = 2.39$, $p = 0.017$).

values of H . For maladaptive affect regulation, the value of H suggests that scores reflect somewhat distinct strategies rather than one coherent style of regulating affect. For example, people who tend to regulate their affect with substance use don't necessarily regulate their affect with self-blame, behavioral disengagement, and denial.

Results

A direct-effects-only model regressed third-year anxiety on baseline anxiety and trait self-control (see **Figure 1A**). A multi-group model in which the regression coefficients and covariance between predictors were constrained to be equal for females and males met the SRMR fit criterion, but not CFI or RMSEA criteria: $\chi^2(N = 1314, df = 3) = 9.49$, $p = .013$, CFI = .947, RMSEA = .063, SRMR = .046. Lagrange Multiplier Tests indicated that fit would improve significantly if the equality constraint on the path from baseline to third-year anxiety were released. Indeed, this model provided a very good account of the data, $\chi^2(N = 1314, df = 2) = 2.166$, $p = .311$, CFI = .998, RMSEA = .015, SRMR = .0152, and evidenced a significant improvement in standard test statistic fit compared to the fully constrained model, $\Delta\chi^2(N = 1314, df = 1) = 6.76$, $p = .009$. Parameter estimates are provided in **Figure 1A**. This model showed a negative relationship between trait self-control and third-year anxiety, while accounting for the positive autoregressive effect of baseline anxiety (which was stronger for females vs. males). Trait self-control was also negatively related to baseline anxiety.

Having shown significant direct effects of baseline anxiety and trait self-control on third-year anxiety, we next examined a model in which indirect effects through adaptive and maladaptive affect regulation were added. As with the direct-effects-only model, we simultaneously estimated the model for females and males, initially constraining all free parameters to equality. This model

surpassed fit cutoffs for CFI and SRMR but not RMSEA, $\chi^2(N = 1314, df = 10) = 24.12$, $p = .003$, CFI = .968, RMSEA = .051, SRMR = .046. Lagrange Multiplier tests indicated that model fit could be improved by releasing one or more equality constraints. As in the direct-effects-only model, the path from baseline to third-year anxiety was not invariant. Releasing this equality constraint resulted in a model that fit the data well, $\chi^2(N = 1314, df = 9) = 16.04$, $p = .039$, CFI = .984, RMSEA = .038, SRMR = .028, and improved upon the fit of the model with full equality constraints, $\Delta\chi^2(N = 1314, df = 1) = 7.25$, $p = .007$. Lagrange Multiplier tests indicated that model fit could be further improved; the path from trait self-control to adaptive affect regulation differed for females and males. Releasing this equality constraint resulted in a model that fit the data well, $\chi^2(N = 1314, df = 8) = 11.63$, $p = .113$, CFI = .991, RMSEA = .031, SRMR = .029, and improved upon the fit of the model with full equality constraints, $\Delta\chi^2(N = 1314, df = 1) = 4.64$, $p = .031$. Releasing any of the remaining equality constraints did not result in improved fit. Parameter estimates are provided in **Figure 1B**.

This model indicated significant relationships between trait self-control and affect regulation. Students with higher trait self-control endorsed adaptive coping responses to stress to a greater degree (more so for males than females) and maladaptive coping responses to a lesser degree. Furthermore, maladaptive and adaptive affect regulation were negatively associated with each other. In addition, maladaptive affect regulation was then positively related to third-year anxiety, whereas adaptive regulation was not related to third-year anxiety. The indirect effect of trait self-control on third-year anxiety through maladaptive affect regulation was significant (for females and males; $ab = -0.050$, $p < .001$), and constituted the following proportions of the total effect of trait self-control on third-year anxiety: for females 31.8% and for

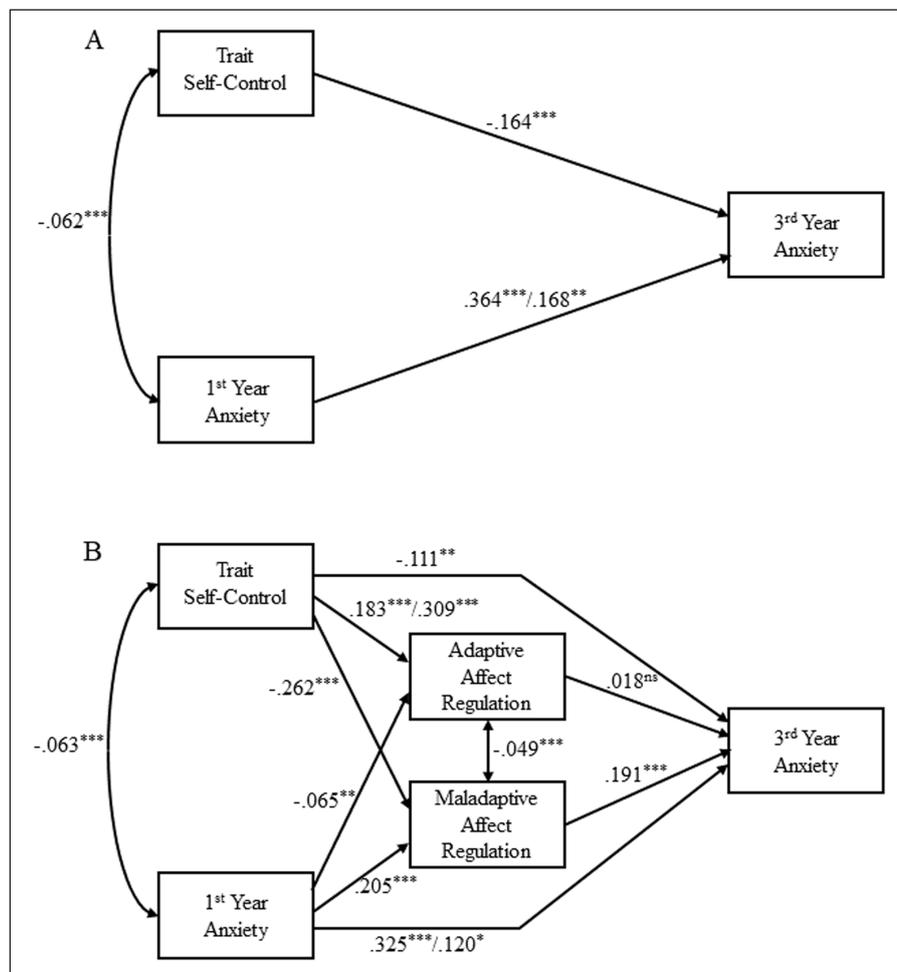


Figure 1: Path diagrams of the direct-effects-only model (A) and mediated model (B), showing unstandardized parameter estimates. Where the parameter estimate was the same for females and males, a single value is shown. When parameter estimates differed by sex, the values are shown as [females]/[males]. Double-headed arrows indicate covariances; single-headed arrows indicate directional effects. * $p < .05$, ** $p < .01$, *** $p < .001$. The covariance between adaptive and maladaptive affect regulation is between their disturbances.

males 32.2%. The indirect effect of baseline anxiety on third-year anxiety through maladaptive affect regulation was also significant (for females and males; $ab = 0.039$, $p < .001$), and constituted the following proportions of the total effect of baseline anxiety of third-year anxiety: 10.8% for females and 24.8% for males. In contrast, no indirect effects on third-year anxiety through adaptive affect regulation were significant. Thus, the mediated model revealed that the effect of trait self-control on third-year anxiety was partially mediated by maladaptive affect regulation, but not adaptive affect regulation. Also, the effect of baseline anxiety on third-year anxiety was partially mediated by maladaptive affect regulation.

To better understand how specific this dynamic is to trait self-control we conducted additional analyses substituting conscientiousness (BFI-Conscientiousness scale, measured at baseline) in the place of trait self-control. Full results are described in supplemental materials. Conscientiousness showed high internal consistency (Cronbach's alpha = 0.81; McDonald's total omega = 0.86; and construct replicability index $H = 0.79$) and was correlated with trait self-control ($r = 0.65$; $t(1208) = 29.65$, $p < .001$). The conscientiousness models were

broadly similar to the models with trait self-control, with a similar structure, similar fit, and similar conclusions despite slight differences in parameter estimates. Conscientiousness was negatively related to baseline and third-year anxiety. In the mediation model, as with trait self-control, conscientiousness was positively associated with adaptive affect regulation and negatively associated with maladaptive affect regulation. For conscientiousness, sex differences emerged for maladaptive but not adaptive affect regulation; the negative relationship between conscientiousness and maladaptive affect regulation was stronger for females than males. The effect of conscientiousness on third-year anxiety was mediated by maladaptive (but not adaptive) affect regulation, just as with trait self-control. The proportion of this effect that was mediated by maladaptive affect regulation was similar to that of trait self-control for females (31.8%) but smaller for males (16.8%).

Discussion

In this study, we aimed to better understand how self-control and affect regulation relate to the well-being of university students. We specifically tested hypotheses that

trait self-control would predict anxiety longitudinally, and this relationship would be mediated by affect regulation. Our findings supported these hypotheses and emphasized maladaptive affect regulation, in particular, as a key factor linking self-control with mental health outcomes.

First, we found that greater self-control upon entering school was associated with lower levels of anxiety at baseline, and predicted lower anxiety in the latter half of students' third year. This relationship held even while accounting for the positive predictive relationship between anxiety at baseline and year three. The baseline association here echoes previous findings linking self-control and well-being (Hofmann et al., 2014; Howell, 2009; Tangney et al., 2004), but these results add to this literature by demonstrating that self-control can predict such outcomes years into the future. They also specifically highlight a relationship between self-control and anxiety, which is a growing mental health problem in university students. Thus, these results highlight trait self-control (in addition to measures of anxiety) as one measure universities can use to identify students at matriculation who may be at greater risk for poor mental health during school.

Second, we observed that greater self-control predicted more adaptive profiles of affect regulation, that is, greater endorsement of adaptive coping responses and less endorsement of maladaptive coping responses. These results extend previous laboratory-based research to coping skills in daily life. Paschke et al. (2016) found that greater self-control was associated with better performance on an active emotion regulation task. The emotional distancing task used in that study does not directly correspond to any of the coping scales measured in the current analyses, but it would likely classify as an active response in the adaptive category. Most of the coping responses included in our composite measure of adaptive affect regulation are similarly characterized by the individual actively exerting effort to improve his or her situation or affective response (e.g., active coping, seeking instrumental support, planning how to improve the situation, trying to see the situation in a more positive light). Therefore, we would expect a greater capacity for self-control to correspond with greater use of these skills. Likewise, most of the responses in our measure of maladaptive affect regulation avoid directly dealing with the stressor (e.g., denial, behavioral disengagement, self-blame), so students with lower capacity for self-control may tend towards these more passive responses, giving rise to the observed pattern of effects.

Third, we found that greater maladaptive affect regulation at baseline predicted greater third-year anxiety, while no relationship was found between adaptive affect regulation and anxiety outcomes. Furthermore, maladaptive affect regulation partially mediated the predictive relationship between self-control and third-year anxiety. In other words, greater self-control predicted less maladaptive coping and more adaptive coping, but only the former effect helped to explain levels of anxiety more than two years later. Through a series of studies, Hofmann et al. (2014) proposed that self-control may

relate to well-being through several pathways, including 1) avoiding stressful situations of inner conflict between goals (e.g., seeking a pleasurable experience in the present vs. pursuing a difficult but satisfying long-term goal; see also Duckworth, Gendler, & Gross, 2016) and 2) better managing such situations to reduce emotional distress. The measures of affect regulation employed here addressed how students respond to stressors rather than the frequency of those stressors; however, the direct relationship between self-control and third-year anxiety that remained after accounting for affect regulation may, in part, reflect how students with greater self-control use planning to minimize their exposure to situations of goal conflict (e.g., temptations). These students may then reduce their overall number of stressors and resultant negative affect, such as anxiety. Regarding the second pathway, responding better to motivational conflicts, students with greater self-control do seem to respond more actively and adaptively to stressors, and some of these stressors likely include managing behavior under conflicting goals. In addition to these two pathways, greater self-control may also enable more effective, active coping responses to stressors that do not arise directly from goal conflict (e.g., receiving a poor grade or getting news of a sick loved one). Nevertheless, only maladaptive responding was related to anxiety outcomes. At first, this might be surprising given how adaptive and maladaptive coping would seem to be mutually exclusive. Indeed, adaptive and maladaptive affect regulation were negatively associated in current study, but human affective responses can be multifaceted and relate to affective outcomes in complex ways (Aldao & Nolen-Hoeksema, 2013; Bonanno & Burton, 2013). This effect may reflect a more intrinsic connection between anxiety and the maladaptive coping responses, such that the maladaptive responses measured here may have more direct associations with anxiety outcomes than the adaptive responses. Thus, adaptive affect regulation may demonstrate a stronger association with other measures of well-being.

These results also showed a few relationships that differed by sex. First, anxiety was more stable from baseline to year three for females compared to males. This effect was present in both the direct-effects-only and mediated models, and it is consistent with the more prominent nature of anxiety in women relative to men (Donner & Lowry, 2013; also, see anxiety scores for females vs. males in **Table 2**). Second, trait self-control was more strongly related to adaptive affect regulation in males relative to females. This effect did not impact the primary results of this study, since there was no relationship between adaptive affect regulation and third-year anxiety for females or males. Nevertheless, this difference could prove important for other measures of well-being more directly related to adaptive affect regulation skills.

Analyses substituting conscientiousness for trait self-control suggest that the associations we observed may not be totally unique to trait self-control, and that similar dynamics may occur with other traits that predict anxiety longitudinally. In particular, findings may be quite similar for self-report measures closely connected to adaptive

self-regulatory skills, tendencies, and functioning. Such measures often share considerable variance, and can be conceptualized and modeled as reflecting a massive latent variable (e.g., Eisenberg et al., 2019). Despite the likelihood that other measures reflect self-regulatory skill and may similarly show effects on anxiety mediated through affect regulation, we think trait self-control is a particularly worthy self-regulatory measure to focus on in seeking to understand affective regulation. Trait self-control is associated with academic outcomes and overlaps theoretically with affect regulation processes. It is therefore a useful focus for continued research on affective regulation and wellness, especially in academic contexts and populations.

With regard to practical applications, these findings first emphasize the utility of trait self-control as a longitudinal predictor of anxiety in university students. In combination with previous findings identifying self-control as a predictor of grade point average (Richardson, Abraham, & Bond, 2012), self-control serves as an important predictor of both student well-being and academic performance. These findings beg the question: what can be done for students at risk for poor outcomes in relation to low trait self-control? But they also point to one potential solution. The malleability of self-control in late adolescence and early adulthood is controversial (Beaver, Connolly, Schwartz, Al-Ghamdi, & Kobeisy, 2013; Burt, Sweeten, & Simons, 2014); therefore, it is unclear whether interventions aimed at increasing self-control in this population would be effective. In contrast, a variety of interventions focused on affect regulation skills in university students have been shown to be effective (Regehr, Glancy, & Pitts, 2013). In particular, the present results indicate that targeting reductions in maladaptive affect regulation may be just as important as instructing more adaptive skills. Given the specific constraint of low self-control, training skills with less persistent self-regulatory demands, such as situation selection (Duckworth et al., 2016; Magen & Gross, 2010), guided relaxation techniques (Unger, Busse, & Yim, 2017), or coping through social interactions (Zaki & Williams, 2013) may prove most beneficial.

One of the main strengths of the present data set was that it allowed for simultaneous modeling of the associations of individual differences in trait self-control and affect regulation with mental health; however, our ability to draw conclusions about the mechanisms of these effects is limited by the survey nature of the data and the timing of assessments. As noted above, there are numerous potential pathways by which self-control and affect regulation may jointly influence affective outcomes, including pathways beyond the scope of the current measures. While these results are consistent with pathways by which self-control is positively related to more adaptive (or less maladaptive) affect regulation, more precise causal mechanisms cannot be distinguished from these data. Pathways linking greater self-control to more negative affective experiences or more maladaptive regulation could also be contributing to these data, but may be masked by stronger effects in the observed directions. For example, anxiety is characterized as

a negatively valenced state concerning uncertain or potentially poor outcomes; thus, students inclined to worry about future outcomes might be more inclined to thoughts and behaviors related to self-control, or at least, some degree of anxiety might be associated with self-regulatory efforts to avoid undesirable outcomes.

Future experimental work and more detailed survey research will be important for identifying the various components of these relationships and their relative contributions to these global effects. In particular, detailed individual profiles of stressor type and frequency could help to elucidate how the experience of stressors varies as a function of trait self-control. These questions could also benefit from further investigations into how affective experience varies by trait self-control and type of self-regulatory behavior, and how these affective experiences accumulate across time (e.g., Kim-Prieto, E. Diener, Tamir, Scollon, & M. Diener, 2005). Furthermore, an assessment of affect regulation at a time point intermediate to the baseline and third-year assessments would have been ideal for supporting a mediational effect between trait self-control and anxiety outcomes; however, the primary measure of affect regulation was only collected at baseline in this data set. While these results, therefore, do not clearly define the nature of the associative influence of trait self-control and affect regulation on anxiety, they nevertheless provide support for the presence of such an effect. We suggest here that one reasonable interpretation with which these data are consistent is that trait self-control may influence the selection and efficacy of affect regulation skills, which in turn influence levels of anxiety, although other interpretations are possible and may be tested more specifically in future work.

The present study is also limited by various features of the participant sample. This sample was drawn from three universities in the Southeastern United States. Although the universities differ in their attributes (e.g., size, endowments), they do not provide complete or representative coverage of universities and university students. Students who attend universities in other regions and other countries may differ from the students in this sample. In addition, the particular students in this sample may not be fully representative of students at their respective universities, as these individuals volunteered to provide detailed longitudinal data on their experiences. Notably, although the rates of clinically relevant anxiety may be near 30% in the university student population, in this sample, the average level of anxiety reported was generally low (see **Table 2**). Like most longitudinal studies, this study also suffered from sample attrition and missing data. We attempted to account for missingness in this data set using optimal procedures; FIML produces unbiased estimates when data are missing completely at random and missing at random. These assumptions appeared to be appropriate for this data set, but nonetheless, the possibility of biases in the missing data cannot be conclusively ruled out.

In summary, we leveraged a multi-site, longitudinal cohort data set and found that trait self-control upon entering school predicted anxiety levels over two years

later in university students. This effect was partially mediated by students' self-reported tendencies to utilize maladaptive responses to stressors. These findings underscore the importance of trait self-control as a longitudinal predictor of university students' well-being in addition to academic performance, and they specifically demonstrate this relationship with anxiety, a dominant feature of poor mental health in university students. These findings further identify affect regulation skills as a training target to promote more successful outcomes in these students, and highlight maladaptive affect regulation as being particularly influential in these relationships. Future work will be needed to better understand the mechanisms underlying these findings; nevertheless, the present study demonstrates that trait self-control is associated with long-term well-being in students in multiple ways, including a predictive relationship mediated by affect regulation.

Data Accessibility Statement

The abstract, preprint, data, and analysis scripts for this study have been made available through the Open Science Framework at <https://osf.io/7rknz/>.

Additional File

The additional file for this article can be found as follows:

- **Supplemental Materials.** Conscientiousness Analysis Results. DOI: <https://doi.org/10.1525/collabra.280.s1>

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Competing Interests

The authors have no competing interests to declare.

Author Contributions

- Contributed to conception and design: JPP, HM, RHH
- Contributed to acquisition of data: RHH
- Contributed to analysis and interpretation of data: JPP, HM, RHH

- Drafted and revised the article: JPP, HM, RHH
- Approved the submitted version for publication: JPP, HM, RHH

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