THREE PATHWAYS FROM ACHIEVEMENT GOALS TO ACADEMIC PERFORMANCE IN AN UNDERGRADUATE STATISTICS COURSE

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ABSTRACT

The purpose of this study was to test three pathways from achievement goals to academic performance in statistics classes. Participants were 247 undergraduate students in psychology taking an introductory course on statistics. They completed questionnaires shortly after the mid-term, and their final grades were provided by their professors at the end of the semester. Structural equation modeling results reveal three distinct paths from achievement goals to academic performance. Results suggest that the more participants adopted mastery goals in the context of their statistics course, the less they experienced anxiety and the better they performed in the course at the end of the semester.

Keywords: *Statistics education research; Achievement goals; Statistics anxiety; Procrastination; Academic achievement*

1. INTRODUCTION

Statistics courses are often a mandatory component of the curricula in undergraduate degrees, regardless of the area of specialization (Onwuegbuzie, 2003). For instance, psychology, sociology, and education majors must complete at least one statistics course successfully to satisfy program requirements. For a large number of non-mathematics majors, this requirement may be upsetting because statistics courses represent a potential source of anxiety (González, Rodríguez, Faílde, & Carrera, 2016; Onwuegbuzie, 2003, 2004; Zeidner, 1991).

In the present study, we investigated the roles of statistics anxiety and procrastination in the associations between the type of goals one endorses in the context of a statistics class and academic achievement. A better understanding of statistics anxiety should help identify ways to reduce students' anxiety in this context and help them achieve better performance in the class.

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1.1. STATISTICS ANXIETY

Statistics anxiety generally refers to anticipating a statistics course negatively and experiencing high levels of unpleasant emotions while taking the course (Dettmers et al., 2011). In the early 1990s, Zeidner (1991) defined statistics anxiety as being

> characterized by extensive worry, intrusive thoughts, mental disorganization, tension, and physiological arousal when exposed to statistics content, problems, instructional situations, or evaluative contexts, and is commonly claimed to debilitate performance in a wide variety of academic situations by interfering with the manipulation of statistics data and solution of statistics problems. (p. 319)

More recently, Chew and Dillon (2014) suggested redefining statistics anxiety as

> a negative state of emotional arousal experienced by individuals as a result of encountering statistics in any form and at any level; this emotional state is preceded by negative attitudes toward statistics and is related to but distinct from mathematics anxiety. (p. 199)

Both definitions of statistics anxiety require a cognitive component (worry) and an emotional component (fear) to be present in the individual when confronted by different aspects of statistics. Indeed, statistics anxiety is considered multidimensional in nature (González et al., 2016; Onwuegbuzie, 2003; Zeidner, 1991). These dimensions include 1) fear of asking for help, which includes fear of the statistics teacher; 2) anxiety related to the interpretation of statistical data; and 3) statistics test anxiety (González et al., 2016).

A construct similar but not identical to statistics anxiety is general test anxiety. There are two components to test anxiety: worry and emotionality when confronted with a test or evaluation (see Brady, Hard, & Gross, 2017). This construct is broader than statistics anxiety, which only concerns negative thoughts and feelings regarding statistics. In this study, we measured both types of anxiety (statistics and test) in order to identify the specific precursors of statistics anxiety and one of its most important outcomes—academic performance. In other words, we sought to measure the impact of statistics anxiety on performance while controlling for test anxiety.

Academic performance One negative consequence of statistics anxiety is poor academic performance. Although this association is more complex than it may first appear (see Macher, Papousek, Ruggeri, & Paechter, 2015), several studies have nonetheless found a negative correlation between self-reported statistics anxiety and academic performance in a statistics course (Cantinotti, Lalande, Ferlatte, & Cousineau, 2017; Fitzgerald, Jurs, & Hudson, 1996; Lalonde & Gardner, 1993; Onwuegbuzie, 2003; Onwuegbuzie & Seaman, 1995; Zeidner, 1991). Moreover, a study found that those who had failed their statistics course (either the first, second, or third time around) had previously reported higher levels of statistics anxiety at the onset of the course than those who passed the course at the first attempt (Galli, Ciancaleoni, Chiesi, & Primi, 2008). Statistics anxiety has even been considered one of the most important negative influences on academic performance (Onwuegbuzie & Wilson, 2003).

Procrastination Statistics anxiety is also associated with academic procrastination. Procrastination refers to a delay to begin or to complete a task despite expecting negative consequences because of the delay (Klingsieck, 2013). Procrastination is associated with a number of negative consequences such as decreased academic performance (Kim & Seo, 2015; Macher et al., 2013), decreased productivity (Peper, Harvey, Lin, & Duvvuri, 2014), stress, exhaustion, and sleep-related problems as well as feelings of guilt, shame, and anxiety (Grunschel, Patrzek, & Fries, 2013; Scher & Osterman, 2002; Sirois, 2004; Tice & Baumeister, 1997).

In regard to statistics anxiety, a study among graduate students from various disciplines revealed positive associations between different dimensions of statistics anxiety (e.g., fear of asking for help, anxiety concerning the interpretation of statistical results, test and class anxiety) and procrastination (Onwuegbuzie, 2004). Similarly, Walsh and Ugaumba-Agwunobi (2002) reported positive correlations between procrastination and all of the following dimensions of statistics anxiety among undergraduate students taking a statistics/research methods course: fear of the statistics teacher, fear of asking for help, test and class anxiety, and interpretation anxiety. Rodarte-Luna and Sherry (2008) observed similar associations between dimensions of statistics anxiety and procrastination among college students.

Given the negative impact of procrastination and statistics anxiety on academic performance, it appears necessary to find ways to reduce students' tendencies to procrastinate and to experience anxiety when confronted with statistics courses (Onwuegbuzie, 2004). Consequently, less statistics anxiety and less procrastination should lead to better performance. The purpose of the present study was, therefore, to test a pathway—beginning with achievement goals—through which both procrastination and statistics anxiety may be lessened, leading to increased performance.

1.2. ACHIEVEMENT GOALS

The type of goals students pursue in the context of a statistics course may influence their tendency to procrastinate, the level of anxiety they experience, and their overall performance. According to the Hierarchical Model of Approach and Avoidance Achievement Motivation (Elliot & Church, 1997), there are three types of goals one can pursue in an achievement context: mastery goals, performance-approach goals, and performance-avoidance goals. Mastery goals refer to seeking to develop competence by mastering a task. For instance, a student can be eager to learn statistics in order to understand the subject matter and apply this knowledge in the statistics course and beyond. Performance-approach goals refer to seeking to appear competent compared to others. For instance, a student may want to learn statistics in order to be better than his or her classmates. Finally, performance-avoidance goals refer to aiming to not be the least competent. That is, the student with performance-avoidance goals in statistics wants to avoid being the worst in the class.

Achievement goals and academic performance The three types of achievement goals are associated with academic performance in different ways. For instance, performance-avoidance goals are typically negatively associated with performance (Elliot & Church, 1997; Linnenbrink-Garcia, Tyson, & Patall, 2008). Therefore, seeking to not be the worst in the class may hinder academic achievement. Performance-approach goals, however, are typically positively associated with performance (Barron & Harackiewicz, 2001; Elliot & Church, 1997; Elliot & McGregor, 2001; Linnenbrink-Garcia et al., 2008). Stated differently, those who seek to outperform classmates may obtain better grades. Finally, the association between mastery goals and performance is less clear. A review of more than 90 published studies (Linnenbrink-Garcia et al., 2008) revealed that a little over half of the studies (55%) found no significant relationship between mastery goals and performance. Forty percent of these studies found a positive association between mastery goals and performance and only a few (5%) observed a negative association between these variables (a level consistent with type-I error rate). Although the association between mastery goals and performance is inconsistent, it is important to note that it is more often positive than negative. When a student's goal is to understand the subject matter, he or she may therefore have a slight edge when it comes to academic achievement.

Achievement goals and anxiety The three types of achievement goals are also associated with anxiety in different ways. Performance-avoidance goals have been positively associated with fear of failure (Elliot & Church, 1997) and statistics anxiety (Lavasani & Weisani, 2013). Similarly, performance-approach goals have been positively associated with fear of failure (Elliot & Church, 1997), test anxiety (Bandalos, Finney, & Geske, 2003; Dull, Schleifer, & McMillan, 2015) and statistics anxiety (Lavasani & Weisani, 2013). Although some researchers found no association between mastery goals and fear of failure (Elliot & Church, 1997), others reported negative associations between mastery goals and test anxiety (Bandalos et al., 2003) as well as between these goals and statistics anxiety (Lavasani & Weisani, 2013).

Achievement goals and procrastination Again, there are different relationships between the three types of achievement goals and procrastination. Performance-avoidance goals are positively associated with procrastination (McGregor & Elliot, 2002; Wolters, 2003). The relation between performance-approach goals and procrastination is less clear, however. Although some researchers did not observe any association between these variables (Howell & Watson, 2007; McGregor & Elliot, 2002), some reported a positive association (Ganesan, Bt Mamat, Mellor, Rizzuto, & Kolar, 2014; Wolters, 2003) and others reported a negative association (Howell & Buro, 2009). Mastery goals, in contrast, appear

to be consistently negatively associated with procrastination in the literature (e.g., Ganesan et al., 2014; Howell & Watson, 2007; Scher & Osterman, 2002; Wolters, 2003).

In sum, the literature on achievement goals suggests that even though performance-approach goals are consistently associated with higher academic achievement, they are also often associated with more anxiety and, sometimes, more procrastination. In statistics classes, emphasizing performance-approach goals may therefore be unfitting as this class is already associated with higher levels of anxiety among students (González et al., 2016). In comparison, mastery goals, which are sometimes associated with higher academic achievement, are also consistently associated with less anxiety and less procrastination. Emphasizing mastery goals in the statistics class may be worthwhile if one aims to achieve a balance between performance and well-being.

The purpose of the present study was to test three pathways from achievement goals to academic performance in an undergraduate level statistics course via procrastination and statistics anxiety.

2. METHOD

2.1. PARTICIPANTS

A total of 437 undergraduate students in psychology at two universities in the province of Quebec, Canada were approached to participate in the study. They were recruited from six classes averaging 73 students per class (ranging from 37 to 103). Among these, 268 students agreed to participate, corresponding to a response rate of 61.3%. All students were taking an introductory statistics course at the time of the study. The statistics courses at both universities were taught by only one professor who recommended the same instruction manual and gave one three-hour lecture per week of the course content in roughly the same order, following the textbook. Also, students from both universities had access to a computer lab to practice the analyses taught in class. The midterm and final exams, although not identical, were very similar in content and style. Missing values on the academic performance variable reduced the final sample size to 247 (from 19 to 68 respondents per class), 83% female, mean age of 21.82 years with standard deviation of 0.29 years.

2.2. PROCEDURE

Data collection took place two weeks after the midterm exam. At the beginning of the class, a research assistant briefly described the study and then handed out paper questionnaires to those who agreed to participate. Informed consent was obtained from all participants prior to survey completion, which took approximately 20 minutes. Participants could take part in a raffle to win one of four $50 gift certificates to a university bookstore. We used the open source optical mark recognition program Scripts for Data Acquisition with Paper-based Surveys (SDAPS; Berg, 2015) to generate the paper questionnaires and to automate data acquisition.

2.3. MEASURES

Data were derived from one objective measure of academic performance and participants' answers to four self-report questionnaires. The means for the questionnaire items were used in the analyses.

Academic performance Students' objective performance in statistics was measured using their final grade (out of 100) in the introductory statistics course. The instructor provided this information. Students grades were then transformed to *z*-scores for each class separately.

Statistics anxiety A translated and validated French version (Cantinotti et al., 2017) of the Statistical Anxiety Scale (SAS; Vigil-Colet, Lorenzo-Seva, & Condon, 2008) was used to measure statistics anxiety. Using a 5-point Likert-type scale, the instrument contains 24 items that measure three components of statistics anxiety: evaluation anxiety (eight items, e.g., Doing the final examination in a statistics course), anxiety related to asking for help (eight items, e.g., Going to ask my statistics teacher for individual help with material I am having difficulty understanding), and anxiety related to interpreting statistical material (eight items, e.g., Trying to understand a mathematical demonstration).

A 21-item version of the SAS was used as it was found to perform better in a French sample than the original 24-item version (Cantinotti et al. 2017). This shortened version showed good convergent validity (statistically significant positive correlations with a measure of state-anxiety) and discriminant validity (statistically significant negative correlations with self-esteem). A mean score for all 21 items was computed for the present study and showed good internal consistency (Cronbach's alpha of 0.91 and McDonald's omega of 0.94).

State Test anxiety The State Test Anxiety Scale is a French validated six-item self-report instrument that measures two dimensions of test anxiety (Beaudoin & Desrichard, 2009). Three items measure emotionality during a testing situation (e.g., I feel relaxed) and three items measure worry (e.g., I'm thinking of things I'm preoccupied with). The instrument showed good psychometric properties in the original study, including reliability (Cronbach's alpha coefficients ranging from 0.58 to 0.80 in six different studies), convergent validity (significant correlations with other valid test anxiety measures), criterion-related validity (significantly higher scores just before an examination than several months before) and construct validity (significant correlations with gender, performance expectations and actual performance). Cronbach's alpha coefficients were 0.69 and 0.79 in the present sample for the emotionality and worry sub-scales respectively (McDonald's omegas were 0.74 and 0.89 respectively).

Procrastination We used selected items from the Procrastination Assessment Scale-Student translated into French by Nadeau, Senécal, and Guay (2003) to measure students' tendencies to procrastinate in the context of their introduction to statistics class. The full 35-item validated scale is composed of two parts: 1) level of procrastination and 2) reasons for procrastinating. In the first part, nine items are used to measure a) the frequency of procrastination (3 items), b) the extent to which procrastination is a problem for the student (3 items), and c) the student's desire to decrease his or her procrastination (3 items). In the second part, 26 items are used to measure the different reasons a student might procrastinate. All items are scored using a 5-point Likert-type scale. For the present study, only the three items reflecting the frequency of procrastination were used because we were interested in the participants' behavior, not their evaluations of how problematic this behavior is nor how much they desire to change it. The frequency of procrastination subscale showed adequate internal consistency in the present sample (Cronbach's alpha of 0.74 and McDonald's omega of 0.75).

Achievement goals We used a French-language questionnaire measuring goals in the academic context (Bouffard et al., 1998) to assess the degree to which participants endorse three types of goals in the context of a statistics course. The 22 items were scored using a 5-point Likert-type scale. Eight items measured mastery goals (Cronbach's alpha with the present sample of 0.89; omega of 0.91), seven items measured performance-approach goals (Cronbach's alpha of 0.75; omega of 0.86), and seven items measured performance-avoidance goals (Cronbach's alpha of 0.82; omega of 0.89).

3. RESULTS

3.1. DATA SCREENING

Data screening revealed a total of four univariate outlier participants out of 247: three on the mastery goals variable and one on the academic performance variable. Outliers were identified as having standardized (*z*) scores greater than three. Mahalanobis distance scores revealed no multivariate outliers. In addition, Cook's distance scores for nearly all participants were below 0.071, only three were above 0.5. Because the distributions for most variables were approximately normal (maximum observed skewness = –0.66; maximum observed kurtosis = 0.88) and because we used analytic methods robust to mild deviation from normality, no participants were excluded from the analyses, and no transformations were carried out to correct for asymmetry. Also, calculation of variance inflation factor (VIF) sores for all measured variables revealed no evidence of collinearity (maximum observed VIF = 2.149).

Means, standard deviations, and correlations for all measures are presented in Table 1. Raw data scores were used to calculate the means, standard deviations, and correlation coefficients.

Table 1. Summary of correlations, means, and standard deviations for all variables

Measure	2	3	4	5	6	7	8	*M*	*SD*
1. Mastery goals	–0.01	–0.37	–0.17	–0.18	–0.03	0.03	0.16	4.57	0.90
2. Performance approach goals		–0.19	0.11	0.05	0.19	0.15	0.37	3.75	0.95
3. Performance avoidance goals			0.33	0.22	0.10	–0.12	–0.33	2.92	0.79
4. Procrastination				0.14	0.42	0.20	–0.14	2.85	0.80
5. Statistics anxiety					0.35	0.27	–0.32	3.06	0.66
6. Test anxiety–worry						0.64	–0.14	3.21	1.11
7. Test anxiety–emotionality							–0.05	3.81	1.12
8. Academic achievement								76.28	10.50

Note. If the absolute value of the correlation is larger than 0.12, the *p*-value for test of the null hypothesis that the true correlation is zero is smaller than 0.05. If the absolute value of the correlation is larger than 0.16, the *p*-value is smaller than 0.01.

3.2. MODEL FITTING

We used structural equation modeling analyses using the maximum likelihood (ML) estimation procedure in EQS 6.1 (Bentler, 1995). Specifically, we conducted path analyses with observed variables (7 scales plus academic achievement; see Figure 1). Model fit was assessed using a chi-square test in addition to the following indices: the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), and the Root Mean Square Error of Approximation (RMSEA). According to Tabachnick and Fidell (2007) as well as Kline (2011), CFI and IFI values above 0.90 indicate acceptable model fit. An RMSEA value below 0.05 is indicative of a good fit and 0.08 is indicative of acceptable model fit (e.g., Kline, 2011).

We first tested a model that reflected the associations among variables outlined in the literature review. In the first pathway, we expected mastery goals to negatively predict statistics anxiety and procrastination (which were expected to negatively predict academic achievement). We also expected mastery goals to directly negatively predict academic achievement. In the second pathway, we expected performance-approach goals to positively predict statistics anxiety, procrastination, and academic achievement. Finally, in the third pathway, we expected performance-avoidance goals to positively predict statistics anxiety and procrastination and to negatively predict academic achievement. We also expected both dimensions of test anxiety to negatively predict academic achievement. We ran the analysis then adjusted the model according to the empirically driven Wald and Lagrange Multiplier test (Bentler, 1995) recommendations. The Wald test indicates which parameters should be dropped and the Lagrange Multiplier test indicates which parameters should be added to enhance model fit. For example, because test anxiety did not predict academic achievement in the present study, the Wald test suggested we remove these associations from the final model.

Figure 1 presents the final model based on the present data. For each path, we first present its unstandardized coefficient (B) and 95% confidence interval followed by its standardized coefficient (β), and corresponding *p*-value. Mastery goals negatively predicted statistics anxiety (although the *p*-value was 0.06), (B = –0.09, 95% CI [–0.18, 0.00]; β = –0.12, $p = 0.063$), which negatively predicted academic performance (B = –0.39, 95% CI [–0.54, –0.25]; β = –0.29, $p < 0.001$). Performance-approach goals positively predicted academic achievement (B = 0.32, 95% CI [0.22, 0.42]; β = 0.34, $p < 0.001$) and procrastination (B = 0.15, 95% CI [0.06, 0.24]; β = 0.18, $p = 0.005$), which positively predicted the cognitive (B = 0.55, 95% CI [0.40, 0.70]; β = 0.40, $p < 0.001$) and emotional (B = 0.34, 95% CI [0.18, 0.50]; β = 0.25, $p < 0.001$) components of test anxiety. Finally, performance-avoidance goals negatively predicted academic achievement (B = –0.22, 95% CI [–0.35, –0.09]; β = –0.19, $p < 0.001$), positively predicted procrastination (B = 0.36, 95% CI [0.24, 0.48]; β = 0.36, $p < 0.001$), and

negatively predicted the emotionality component of test anxiety (B = –0.26, 95% CI [–0.38, –0.12]; β = –0.19, $p < 0.001$). The indirect effect of statistics anxiety in the association between performance-avoidance goals and academic achievement was also statistically significant (B = –0.39, 95% CI [–0.50, –0.18]; β = –0.29, $p < 0.001$). Overall, the model fit was excellent, S-B χ^2 (13, $n = 247$) = 11.62, p = 0.56, CFI = 1.00, IFI = 1.00, RMSEA = 0.00 (90% CI: [0.00, 0.06]) and accounted for 29.8% of the variance in academic achievement.

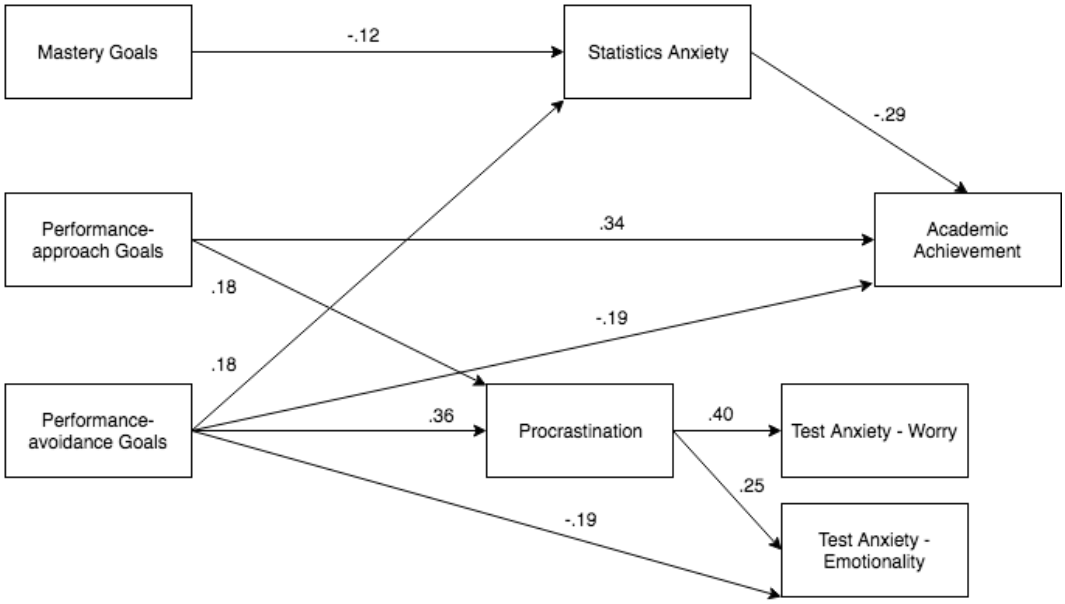

Figure 1. Standardized path coefficients from structural equation analysis

4. DISCUSSION

The purpose of the present study was to test three different pathways from achievement goals to academic performance for undergraduate psychology students currently enrolled in a mandatory statistics course. These pathways will be described from, arguably, the least beneficial to the most beneficial for students to the extent that they appear to strike a reasonable balance between academic achievement and emotional well-being.

The least beneficial path begins with performance-avoidance goals. Our results suggest the more participants endorse this type of goal, the more they procrastinate. The positive association between performance-avoidance goals and procrastination has been documented previously (McGregor & Elliot, 2002; Wolters, 2003). Procrastination, in the present study, positively predicts both components of test anxiety—worry and emotionality. These measures of general test anxiety are not associated with academic achievement in the present study. Performance-avoidance goals are, however, negatively and directly associated with academic achievement. Performance-avoidance goals also indirectly predict performance, through its association with statistics anxiety. In other words, performance-avoidance goals are associated with higher levels of statistics anxiety which, in turn, are associated with lower levels of performance in the course. The negative association between statistics anxiety and academic performance is also well documented (see Galli et al., 2008; Onwuegbuzie, 2003). The present results corroborate existing research. Interestingly, performance-avoidance goals are negatively associated with the emotionality component of test anxiety in the present study. That is, the more participants endorse performance-avoidance goals, the less test anxiety they feel. Perhaps these students deliberately choose this type of goal in order to avoid the negative emotions often associated with academic evaluation. Further research is needed to test this hypothesis. Overall, based on this pattern of correlations, it is not recommended for students to adopt performance-avoidance goals as this is associated with being prone to procrastinate, worry, and experience statistics anxiety. Consequently,

their academic performance is likely to suffer. Indeed, the literature has shown rather undesirable consequences associated with performance-avoidance goals (see Linnenbrink-Garcia et al., 2008).

The second, considerably more beneficial pathway, begins with performance-approach goals. In the present study, this type of goal is directly and positively associated with academic achievement. In other words, the more students desire to outperform their classmates, the greater their objective performance is at the end of the semester. This result is in line with a number of studies that have reported a positive association between performance-approach goals and academic achievement (Barron & Harackiewicz, 2001; Elliot & Church, 1997; Elliot & McGregor, 2001). It is important to note, however, that performance-approach goals also positively predict procrastination, which, in turn, positively predicts both components of test anxiety. Therefore, whereas performance-approach goals seem to favor academic performance, they are also associated with detrimental behaviors, thoughts, and emotions.

The third and arguably most beneficial pathway for students begins with mastery goals. The more students endorse mastery goals, the less they report experiencing statistics anxiety. Although this effect is only marginally statistically significant in the present study, it does replicate previous findings (e.g., Lavasani & Weisani, 2013; Linnenbrink-Garcia et al., 2008). Importantly, this is the only type of goal that negatively predicts statistics anxiety. To summarize this pathway, those with mastery goals benefit from higher levels of academic achievement while experiencing less anxiety. Furthermore, students with mastery goals, unlike those with performance goals, do not tend to engage in procrastination. The reader will notice the absence of a direct association between mastery goals and academic achievement. Performance-approach goals, therefore, represent the strongest predictors of academic achievement in the present study. Mastery goals nonetheless appear to be the most beneficial for students because these types of goals also, although indirectly, predict higher levels of achievement and, unlike performance-approach goals, do not involve procrastination and general test anxiety. The pathway beginning with mastery goals therefore appears to strike a reasonable balance between academic achievement and well-being. The pedagogical implications of these results are worth noting. It is feasible for a professor, at the beginning of his or her statistics course, to encourage students to focus on learning rather than performing. Although this brief intervention may not yield any meaningful results for a number of students who tightly hold to performance-goals, others may be encouraged by this message and aim to focus on mastering the course material. In light of the present results, doing so would appear to be rather beneficial for them throughout the semester. Whereas a number of the associations reported here have been observed in previous research, to our knowledge no studies have yet investigated statistics anxiety while controlling for general test anxiety. The inclusion of test anxiety allows us to isolate the effect of statistics anxiety on academic achievement and allow us to obtain a clearer picture of the thoughts, emotions, and behaviors of undergraduate students currently enrolled in undergraduate statistics courses. Also, because academic performance was measured objectively and subsequent to all other measures, we begin to get a sense of the effects of these variables on academic achievement over time.

To be sure, this study has limitations that should be acknowledged to fully appreciate the results. First, aside from the academic achievement variable, all other variables were measured at the same time. Although it is tempting to see a causal pathway in structural equation models, it is not possible to make such conclusions with the present data. Additional longitudinal research is necessary to test the proposed sequence of events over longer periods of time. Secondly, the pathway between mastery goals and statistics anxiety should be interpreted with caution as the effect is relatively small. Future research will allow us to determine the reliability of this association with different samples. Third, only three items were used to measure the frequency of procrastination. A more thorough measurement of this variable including the perceived effects of procrastinating could be useful in future studies. Fourth, we measured a limited number of predictors in this study. Future research should seek to include other relevant variables. Fifth, the sample consisted mostly of female undergraduate students in psychology currently enrolled in statistics courses at francophone universities. Generalizability of the present findings should therefore be limited to similar populations. Future research with different populations of students would be needed to evaluate how replicable these results are. Finally, it should also be noted that some researchers (e.g., Keeley, Zayac, & Correia, 2008) have observed non-linear associations between statistics anxiety and academic achievement. Such results suggest that up to a certain level, anxiety is positively associated with achievement, then as it continues to increase, it becomes negatively associated with achievement. Perhaps a moderate amount of anxiety may be beneficial for students in

undergraduate statistics courses. Future research should investigate how much anxiety is just enough and how much is too much to favor both achievement and well-being.

Despite these limitations, the present research suggests that there may be an optimal pathway that strikes a reasonable balance between good grades and emotional well-being in undergraduate statistics courses. This pathway begins with how students orient their course objectives, by focusing on 1) integrating and understanding the course material, 2) outperforming their classmates, or 3) avoiding being outperformed. Mastery goals, which focus on understanding the material, present the unique advantage of being associated with lower statistics anxiety compared to the other types of goals, while still stimulating academic achievement. It therefore seems fitting from a motivational and emotional standpoint to encourage students to focus on learning the material (mastery goals) rather than focus on being better (performance-approach goals) or not worse (performance-avoidance goals) than their classmates. Promoting mastery goals represents an important challenge however because the context of undergraduate studies often invites competition among students who wish to be admitted to graduate school. If students nonetheless succeed in adopting a mastery-focused orientation, this may help fend off the all too common feeling of anxiety associated with statistics and may help students more graciously accept the passage through this often mandatory course.

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