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But I'm Bad at Math: Students' Feelings about Math and Intention to Declare a Degree in Psychology

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Abstract

The current study investigated the association between math anxiety, math self-concept, and math self-efficacy with intention to declare a degree in psychology. Additionally, the study investigated whether knowledge of the statistics requirement in psychology was associated with psychology degree intentions and whether the three math factors were associated with time since last math course. Undergraduate students completed a questionnaire concerning their intention to pursue a psychology degree, the revised version of the Fennema-Sherman Mathematics Anxiety Scale, the Self-Description Questionnaire III Mathematics Subscale, and the Mathematics Self-Efficacy Scale. Results revealed no significant relationships between scores on the three math scales and intentions to declare a degree in psychology. However, significant, negative correlations were found between time since last math course with math anxiety and math self-efficacy scores, and all three math constructs were significant for non-psychology-interested participants. Overall, psychology-interested participants appear intent on entering psychology, regardless of the statistics requirement.

Keywords: math anxiety, math self-concept, math self-efficacy, psychology, registration, psychology degree, undergraduate students, STEM

But I'm Bad at Math: Students' Feelings about Math and Intention to Declare a Degree in Psychology

Mathematical understanding is of crucial importance to everyday life, careers, and higher education. Chernoff and Stone (2014) stated that mathematics is pervasive in our everyday lives, in which we need mathematical knowledge to understand everything from polls on social media pages to the gas mileage of a car. Thurston (1990) further suggested the importance of mathematics in everyday expenditures and its significance as a tool for many occupations within and beyond the scientific domain, such as lawyer, real estate agent, bookkeeper, and nurse. Similarly, Betz (1978b) suggested that given our increasingly technological society, mathematical understanding is essential to higher education programs that do not explicitly fall within the scientific domain, such as those within business, the humanities, and social sciences.

Despite the clear importance of mathematics for daily living, many students avoid math courses during course selection in secondary and post-secondary education (e.g., Betz, 1978b; Meece et al., 1990; Brown et al., 2008). Beilock and Maloney (2015) suggested that such avoidance of math courses restricts career opportunities in increasingly important STEM fields (science, technology, engineering, and math). Hafni et al. (2020) suggested that given our rapid growth in digital technologies in many fields, from communication to education, STEM education is imperative to students' function in our modern world. These suggestions emphasize the significant role of mathematics in numerous careers and higher education beyond scientific and technical programs and the importance of examining the factors that may contribute to students' avoidance of math courses and their reduced ability to participate in STEM fields.

A potential explanation for students' avoidance of math courses and STEM participation

is math anxiety (e.g., Richardson & Suinn, 1972; Ashcraft & Moore, 2009; Malik, 2014; Hart & Ganley, 2019). The Mathematics Anxiety Rating Scale (MARS; Richardson and Suinn, 1972) has been recognized as the earliest assessment of math anxiety (Ashcraft, 2002). Richardson and Suinn (1972) defined math anxiety as nervousness and anxiety in academic and non-academic situations when faced with mathematical problem-solving or manipulation of numbers. Although math anxiety is a well-defined concept, findings on its relation to general anxiety have been mixed; Hembree (1990) found the correlation to be weak, while Hart and Ganley (2019) found the correlation to be significantly positive. Furthermore, in examining the relationship between math anxiety and anxiety towards other academic subjects, Punaro and Reeve (2012) observed that math produced significantly greater anxiety levels than other academic subjects, such as those that were literacy-based. Moreover, math anxiety should not be combined with other forms of anxiety as Dew et al. (1984) and Ashcraft and Ridley (2005) proposed that math anxiety scales such as the MARS and the Fennema-Sherman Mathematics Anxiety Scale (FSMAS; Fennema & Sherman, 1976) correlate highly with one another. Specifically, Dew et al. (1984) found that the MARS and the FSMAS were more highly correlated than with test anxiety measures. Subsequently, math anxiety, feelings of nervousness in mathematical situations, is a distinct form of anxiety that may explain students' reduced participation in math courses and STEM fields.

Another closely related but distinct construct to math anxiety is statistics anxiety (Malik, 2014). Onwuegbuzie et al. (1997) defined statistics anxiety as anxiety that occurs when statistics are encountered in multiple formats at any level, including those in secondary and post-secondary education, when being evaluated in a statistics course or when exposed or instructed on statistics content within the classroom. Baloğlu (2004) suggested that because statistics

courses are often found within math departments, many researchers and students think math anxiety and statistics anxiety should be considered the same. In an influential review of statistics anxiety, Onwuegbuzie & Wilson (2003) found that much of the research that measures statistics anxiety has relied on the MARS, a test of math anxiety (e.g., Mitton & Ann, 1987). Because math anxiety may be a separate construct from statistics anxiety, reliance on the MARS is problematic. However, Paechter et al. (2017) used three structural equation models and reported that math anxiety and statistics anxiety are separate concepts, despite being highly correlated when placed as antecedents for one another. Baloğlu (1999), Baloğlu (2004), and Malik (2014) further supported the distinction between these two constructs by defining them separately in their research designs.

Despite its high correlation with statistics anxiety, the distinct construct of math anxiety extends to multiple levels of education as studies show an increased avoidance of math courses and STEM participation in future careers when math anxiety is present. Ashcraft (2002), drawing on Hembree's (1990) meta-analysis, suggested that students who were high in math anxiety in both high school and college took fewer math courses as electives than those lower in math anxiety, held negative self-perceptions about their math abilities, and avoided post-secondary and job pathways that required math skill. In addition, Espino et al. (2017) found that grade 11 students with math anxiety reported a higher likelihood to study within the humanities or social sciences because they contained fewer math courses. Similarly, Ahmed (2018), in a 7-year longitudinal study with adolescents in grades 7 and 10, reported that students with low math anxiety were significantly more likely than students with increasing or consistently high levels of math anxiety to work in a STEM field as adults. As well, the highly math-anxious students were more likely to avoid math-based courses throughout their education. Thus, studies show that

students high in math anxiety are more avoidant of math courses in school, which limits their future career selection.

Generally, female students are also more likely to be affected by math anxiety than male students, although some gender variance during the first year of a four-year academic program has been reported. Hembree (1990) suggested that female students reported significantly higher ratings of math anxiety in all grades than males (e.g., Betz, 1978b; Wigfield & Meece, 1988; Devine et al., 2012). However, Hembree (1990) indicated that males who reported high math anxiety levels avoided math courses in junior and senior high school more than females high in math anxiety. Similarly, Daker et al. (2021) found that first-year university-aged females reported higher levels of math anxiety than males when measured for math anxiety and controlling for math ability. Chipman et al. (1992) found that females had higher levels of math anxiety that predicted avoidance of math courses and less interest in pursuing a STEM profession which subsequently impacted their career paths. Interestingly, Daker et al. (2021) found that higher levels of math anxiety in the first semester of year one predicted fewer STEM courses taken throughout a student's four years, regardless of their actual math abilities. Thus, studies show that math anxiety has a greater tendency to affect females than males, although high levels of math anxiety in both male and female students at the start of their four-year academic program have been linked to greater avoidance of math courses in both genders.

In connection to females' reduced participation in math courses and STEM fields, math self-concept is another factor that has been proposed for students' avoidance of the aforementioned areas, in which studies show females to hold a lower math self-concept than males. Math self-concept is defined as an individual's rating of their abilities to learn and perform in mathematics (Reyes, 1984; Bong & Skaalvik, 2003; Sax et al., 2015). Recently,

Lauermann et al. (2015) looked at the effects of adolescent-aged students' math self-concept and English self-concept on items from Wigfield & Eccles (2000) expectancy-value theory of motivation, which measures ability and expected success in math and English on students' predicted future career plans in STEM or human services. Lauermann et al. (2015) reported that males were more likely to aim for and report plans to enter math or science careers and females for human service careers, which the researchers predicted was due to males' slightly higher math self-concepts. Similarly, Sax (1994) reported that math self-concept declined steadily over a four-year undergraduate period, particularly for women who entered university with lower levels of confidence in their math abilities (see also Fennema & Sherman, 1978). The underrepresentation of women in STEM courses may prevent them from forming a higher math self-concept—a likely outcome of reduced STEM course/major participation. More recently, Sax et al. (2015) reported that math self-concept was significantly higher in STEM majors than non-STEM majors, that women consistently reported lower math self-concept than men in all STEM fields, and that there was a reduced tendency for women to select a major within STEM.

Furthermore, gender differences are also evident in a third construct that has been proposed for students' avoidance of math courses and STEM participation, math self-efficacy. Math self-efficacy is defined as an individual's belief in their ability to achieve a goal in mathematics (Chamberlin, 2010; Cribbs et al., 2021). Matsui et al. (1990) found that male first-year undergraduates reported higher math self-efficacy ratings than women on the Mathematics Self-Efficacy Scale (MSES; Betz & Hackett, 1983). Moreover, Betz and Hackett (1983) found that college males' higher math self-efficacy levels were associated with a greater likelihood to select a STEM major in college (see also Hackett & Betz, 1982 and Hackett, 1985). Likewise, Lin et al. (2018) suggested that students higher in math self-efficacy were more likely to select a

STEM major, while Blotnicky et al. (2018) found that students who reported higher math self-efficacy had the most knowledge of STEM course requirements and were more likely to indicate future career participation in STEM. Further, in an all-female sample, O'brien et al. (1999) indicated that higher math self-efficacy ratings on the MSES predicted greater interest in pursuing a career in science or mathematics. Subsequently, studies suggest that students who possess higher math self-efficacy, predominantly males, exhibit greater participation in math courses and future STEM careers.

Thus, math anxiety, math self-concept, and math self-efficacy have been investigated as separate but closely related concepts with reciprocal relationships that influence students' interest in STEM career selection, in which those high in math anxiety and low in math self-concept and math self-efficacy, are more avoidant of STEM pathways. Lee (2009) measured participants' math anxiety, math self-concept, and math self-efficacy and found the three constructs to be significantly different from each other—a finding maintained across and within cultures from 41 countries (see also Lent et al. 1997). Moreover, the reciprocal relationships between the three concepts indicated that higher math self-concept and math self-efficacy were associated with lower math anxiety, and lower math anxiety was associated with higher math self-concept and math self-efficacy in middle and high school-aged students (e.g., Jain & Dowson, 2009; Ahmed et al., 2012; Li et al., 2021) and traditional and adult college students—the latter often older than 22 years of age and may not have directly entered post-secondary after high school (e.g., Bhowmick et al., 2017; Jameson & Fusco, 2014). Huang et al. (2018) found in grade 7 boys and girls, that higher ratings of math self-efficacy were associated with lower levels of math anxiety and higher math anxiety levels were related to less interest in STEM careers—particularly in females. In addition, Cribbs et al. (2021), in a sample of first-year university

students, found that math anxiety measured on the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R; Betz, 1978a), indicated math self-efficacy to be related to math anxiety, and that math identity, a combination of one's recognition of how others perceive them in mathematics and their interest to learn about math, mediated the relationship between math mindset, math anxiety, and career interest in STEM. Overall, these studies suggest that math anxiety, math self-concept, and math self-efficacy produce reciprocal relationships, in which students with high ratings in math anxiety and lower ratings in math self-concept and math self-efficacy, are less interested or avoidant of STEM courses, majors, and careers.

Furthermore, given the high degree of association between math anxiety, math self-concept, and math self-efficacy and their influence on STEM career selection, it is important to consider the influence that these motivational and affective factors may have on disciplines that may not be explicitly recognized as part of the STEM field, but inclusive of a math component. Psychology as a discipline straddle both STEM and the social sciences while including a math component. The *APA Guidelines for the Undergraduate Psychology Major* (American Psychological Association, 2013) outlined the expectations for what undergraduates should learn in psychology. Specifically, the guidelines state that psychology is a science and that students must acquire the ability to explain research methods and experimental design, conduct studies, and understand quantitative research. Consistent with the importance of quantitative literacy in psychology, Stoloff et al. (2010) found that around 75% of psychology programs in a sample of 374 North American post-secondary schools, require a minimum of one methods or statistics course (e.g., Perlman & McCann, 1993; Nahornick, 2016). The *APA Guidelines* further suggested that these methods and statistics courses are foundational and should be taken at the end of year one or two to support research understanding in later courses (American

Psychological Association, 2013) (e.g., Freng et al., 2011; Betancur et al., 2019). Overall, although psychology may incorporate both STEM and the social sciences, the requirement for psychology students to participate in courses that focus on the acquisition of quantitative skills, suggests that psychology as a discipline has a math component.

Given the requirements of the psychology discipline to acquire and display mathematical skill over the course of a degree, it is essential to consider the potential role of affective and motivational math factors on psychology students. Poor academic and affective/motivational outcomes that inhibit potential opportunities to participate in STEM have been linked to math anxiety, math self-concept, and math self-efficacy in students within psychology. Betz (1978b) found that psychology students in one psychology course and one of two math courses reported high levels of math anxiety on Betz's (1978a) FSMAS-R. Conversely, Townsend et al. (1998) found that students in an Educational Psychology course with a statistics component demonstrated somewhat positive math self-concepts and moderate levels of math anxiety when assessed at the beginning of their course and when collaborative interventions were implemented, math self-concept increased. However, math anxiety remained the same on Betz's (1978a) FSMAS-R. Furthermore, Morris et al. (1978) indicated that psychology students reported significantly higher levels of math anxiety than post-secondary students in math courses. These higher ratings of math anxiety in psychology students were further associated with lower performance levels on final exams and grades in an introductory level statistics course. Finally, Núñez-Peña et al. (2013) reported that high math anxiety levels in a sample of students in a Research Methods course in a psychology program were negatively related to performance on final exams, overall passing of math-based courses, and self-confidence in math. Consequently, these studies suggest that psychology students do report high levels of math

anxiety, and that these high levels are associated with decreased performance in math-based courses.

Nevertheless, it remains unclear whether the affective and motivational constructs of math anxiety, math self-concept, and math self-efficacy impact if a student decides to choose a degree in psychology and their expectations relating to the role of math in psychology courses. Many psychology majors reported that they wanted or felt limited to attend graduate school within psychology after their undergraduate degree (McGovern & Hawks, 1986; Collisson & Eck, 2021). Furthermore, McGovern and Hawks (1986) indicated that students reported greater difficulty and less interest in statistics and other scientific courses and identified courses like Abnormal Psychology as more practical and aligned with the outcomes they desired to achieve from their major: understanding human issues and career readiness (see also Rajecki et al., 2005 and Collisson et al., 2021). In line with this preference, Holmes and Beins (2009) reported that despite psychology majors' development of scientific thinking skills over their undergraduate degree, their perspective that psychology is a science did not significantly increase, nor did their interest in scientific activities such as conducting an experiment. Manning et al. (2006) found similar reports from a sample of psychology students who completed a Research Methods course. Moreover, students considering declaring a Bachelor of Arts (BA) in psychology were more influenced by the math and science degree requirements and reported significantly higher anxiety levels and avoidance of presumptive scientific requirements than those considering a Bachelor of Science (BSc) in psychology when making their declaration (Hong et al., 2019). Therefore, deconstructing the motivational and affective factors on students who selected a degree in psychology is helpful to understanding the avoidance of math-based courses and how they may negatively impact the future of psychology students (Collisson et al., 2021).

The current study investigated whether math anxiety, math self-concept, and math self-efficacy influenced the intentions of students in a first-year psychology course to declare a module within the psychology program at the end of their first year. At Brescia, all students selecting a Major, Honours Specialization, or Specialization in psychology must complete 1.0 credits in a second-year level statistics course. Those in the latter two modules must also complete 1.0 credits in a first-year mathematics course and a second-year level Research Methods course, and those in an Honours Specialization must also take 0.5 credits in Psychological Statistics Using Computers, a third-year course (Western University, 2021a; Western University, 2021b; Western University, 2021c). Thus, students must participate in math and quantitative-based courses to various degrees in most psychology modules.

Participants completed a questionnaire that included demographic questions regarding their age, gender, and amount of time since they participated in their last math course. Then, they completed questions assessing their knowledge of the courses offered in the psychology program, their interest in the psychology program, and their current intention to register in a psychology module. Next, they completed math anxiety, math self-concept, and math self-efficacy scales. Math anxiety was measured using all 10 items from Betz's (1978a) revised version of the Fennema-Sherman Mathematics Anxiety Scale. Math self-concept was measured using the 10 items from the Self-Description Questionnaire III Mathematics Subscale (SDQ-III; Marsh & O'Neill, 1984), and math self-efficacy was measured using 9 items from Nielsen and Moore's (2003) Mathematics Self-Efficacy Scale. It was predicted that lower math anxiety scores on the FSMAS-R, which would indicate higher math anxiety, would predict a lower likelihood to report intending to select a module within the psychology program. We further predicted that lower math self-concept scores on the SDQ-III and lower math self-efficacy scores

on the MSES would predict a lower likelihood to intend to declare a module within the psychology program at ITR.

Method

Participants

Eighty-five undergraduate students ages 18 to 42 (M =19.91) from Brescia University College participated in the study. Most participants identified as female (n = 84), and 1 did not disclose their gender identity. Participants were enrolled in Psychology 1015B at Brescia University College, a first-year psychology course offered in the second term of the 2021/2022 academic school year (January to April 2022). Participation in the study was voluntary, and participants were notified before giving their informed consent that they could withdraw from the study at any time. Participants received one research credit for their participation.

Materials

The study consisted of an online survey composed of 4 questionnaires administered via Qualtrics. The questionnaires presented to participants in the survey were the Demographic and Intent to Register questions (Appendix A), the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R; Betz, 1978a), the Self-Description Questionnaire III Mathematics Subscale (SDQ-III; Marsh & O'Neill, 1984), and the Mathematics Self-Efficacy Scale (MSES; Nielsen & Moore, 2003).

Demographic and Intent to Register Questions

Participants initially completed three demographic questions about their gender identity, age, and amount of time since participation in a math course. Next, participants were provided with an explanation of Intent to Register (ITR) at Brescia to inform them about the terminology used in questions five and six of the ITR section. Following the ITR instructions, participants

were asked to indicate whether they were interested in the psychology program at Brescia by selecting either "Yes" or "No" and their rating on a 5-point Likert scale ranging from "Very Unlikely" to "Very Likely" to pursue a module within psychology at their upcoming ITR. Participants who were not interested in the psychology program were asked to indicate which program they were interested in instead by typing in their response.

Fennema-Sherman Mathematics Anxiety Scale—Revised

After the demographic questionnaire, participants completed 10 questions from the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R; Betz, 1978a), which determined their level of math anxiety. Participants responded on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) to questions that included, "I have usually been at ease in math courses," and "Mathematics makes me feel uncomfortable and nervous."

Self-Description Questionnaire III Mathematics Subscale

After the FSMAS-R (Betz, 1978a), participants completed 10 questions from the Self-Description Questionnaire III Mathematics Subscale (SDQ-III; Marsh & O'Neill, 1984). The SDQ-III was used to determine how strongly participants identified with math. Participants responded on an 8-point True-False scale ranging from 1 (Definitely False) to 8 (Definitely True) to statements such as, "I have trouble understanding anything that is based upon mathematics," and "I never do well on tests that require mathematical reasoning."

Mathematics Self-Efficacy Scale

Finally, participants completed nine questions from the Mathematics Self-Efficacy Scale (MSES; Nielsen & Moore, 2003), which measured their level of math self-efficacy. Responses were chosen on a 5-point Likert-type scale ranging from 1 (Not at all confident) to 5 (Very

confident) about performing mathematical tasks in the classroom or on a test, such as “An algebra problem” or “Work with decimals.”

Procedure

Participants who signed up for the study on the research participation website received a link to access the survey on Qualtrics. Once participants clicked the link, they were presented with the Letter of Information and asked to consent to participation in the study by clicking the arrow in the bottom right-hand corner, which took them to the survey. Participants then completed four questionnaires: the demographic/ITR questionnaire, the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R; Betz, 1978a), the Self-Description Questionnaire III Mathematics Subscale (SDQ-III; Marsh & O’Neill, 1984), and the Mathematics Self-Efficacy Scale (MSES; Nielsen & Moore, 2003). Participants were provided with specific instructions for each of the four questionnaires at the top of the page. After completing the four questionnaires, participants were automatically directed to read a debriefing form that outlined the purpose of the study, researcher contact information, and additional resources on the study topic to read if interested. The entire study took approximately 15 minutes to complete.

Results

Math Anxiety, Math Self-Concept, and Math Self-Efficacy Scores and Likelihood to Register in Psychology

In order to test the hypothesis that lower math anxiety, math self-concept, and math self-efficacy scores would predict a lower likelihood to report intending to register in a psychology module, we first conducted two-tailed Pearson correlations to assess the association of all participants’ scores on the FSMAS-R math anxiety scale, the SDQ-III math self-concept

subscale, and the MSES math self-efficacy scale with likelihood to register in a psychology module (M = 2.06, SD = 2.29). Means and standard deviations for scores of all participants are available in Table 1. One participant did not provide a response to the question that addressed their likelihood to register in a psychology module at ITR and was not included in these analyses. The correlations between participants' likelihood to register in psychology with FSMAS-R math anxiety scores, $r(84) = -.19$, $p = .087$, SDQ-III math self-concept scores, $r(84) = -.10$, $p = .355$, and MSES math self-efficacy scores, $r(84) = -.02$, $p = .886$, were not significant.

Intercorrelations between the three math scales were also investigated. The correlation between FSMAS-R math anxiety scores with SDQ-III math self-concept scores was significant, strong, and positive, $r(84) = .87$, $p < .001$, indicating that a higher FSMAS-R math anxiety score (low math anxiety) was associated with a higher SDQ-III math self-concept score. Similarly, the correlation between FSMAS-R math anxiety scores with MSES math self-efficacy scores was also significant, moderate, and positive, $r(84) = .64$, $p < .001$, indicating that a higher FSMAS-R math anxiety score was associated with a higher MSES math self-efficacy score. Finally, the correlation between SDQ-III math self-concept scores with MSES math self-efficacy scores was significant, strong, and positive, $r(84) = .74$, $p < .001$, indicating that a higher SDQ-III math self-concept score was associated with a higher MSES math self-efficacy score.

To further investigate intention to major in psychology and scores on the math scales, participants who responded "Yes" to the item "Are you interested in going into Brescia's psychology program?" were analyzed separately. Pearson correlations were conducted for psychology-interested participants' likelihood to register in psychology (M = 4.44, SD = 0.82), with FSMAS-R math anxiety scores (M = 21.46, SD = 9.11), SDQ-III math self-concept scores (M = 37.39, SD = 15.94), and MSES math self-efficacy scores (M = 29.59, SD = 8.19). Of the 40

Table 1

Means and Standard Deviations for Math Assessments and Psychology Interest

Scores	Participants Interested in Psychology		Participants Not Interested in Psychology		All Participants	
	M	*SD*	*M*	*SD*	*M*	*SD*
FSMAS-R	21.46	9.11	24.36	9.05	22.86	9.19
SDQ-III	37.28	16.11	39.69	14.77	38.28	15.50
MSES	29.62	8.13	29.07	8.70	29.08	8.63

Note. Higher scores on the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R), indicate more positive attitudes toward math and thus lower levels of math anxiety, while higher scores on the Self-Description Questionnaire III (SDQ-III) Mathematics Subscale that measures math self-concept, and the Math Self-Efficacy Scale (MSES), indicate higher math self-concept and math self-efficacy.

participants who responded "Yes," one was discarded because they did not provide a response to the question that addressed their likelihood to register in a psychology module. The correlations between psychology-interested participants' likelihood to register in psychology with FSMAS-R math anxiety scores (see Figure 1), $r(39) = -.21$, $p = .206$, SDQ-III math self-concept scores (see Figure 2), $r(39) = -.17$, $p = .306$, and MSES math self-efficacy scores, $r(39) = -.29$, $p = .074$ (see Figure 3), were not significant.

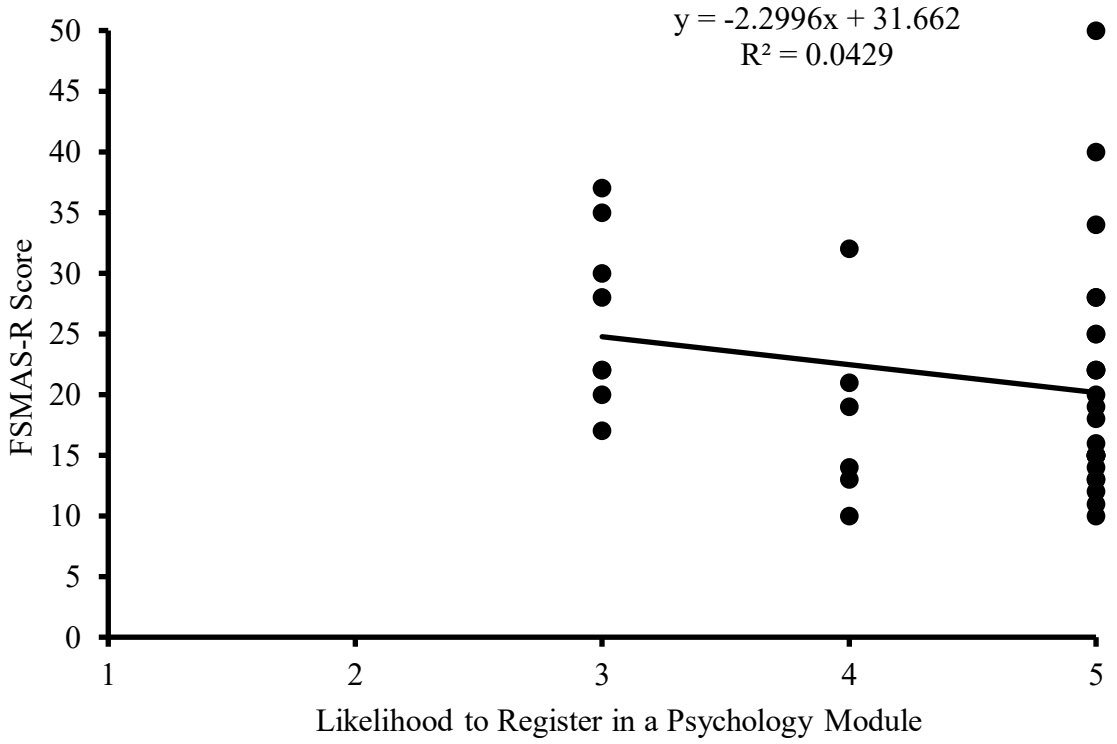
Knowledge of the Statistics Requirement in the Psychology Curriculum and Likelihood to Register in Psychology

To determine whether participants were aware of the statistics requirement in the psychology modules, participants' responses to the item that asked them to select courses within psychology were analyzed. Responses that included the statistics course were coded as 1, and responses that did not include it were coded as 2. We conducted a Point-Biserial correlation to assess the relationship between all participants' knowledge of the statistics requirement in the psychology curriculum with likelihood to register in a psychology module. The analyses revealed that the correlation between knowledge of the statistics requirement in the psychology curriculum ($M = 1.44$, $SD = 0.50$) with likelihood to register in a psychology module ($M = 2.04$, $SD = 2.29$) was marginally significant, $r(85) = -.21$, $p = .052$. Thus, knowing that statistics is a part of the psychology curriculum did not deter participants' interest in entering the psychology program, although this result must be interpreted with caution.

Additionally, an independent samples *t*-test was conducted between the number of participants interested in entering Brescia's psychology program ($n = 40$) and not interested in entering psychology ($n = 45$) in knowledge of the statistics requirement in the psychology curriculum. Levene's test was significant, Levene's $F(1, 83) = 4.27$, $p = .042$, so Welch's *t* was

Figure 1

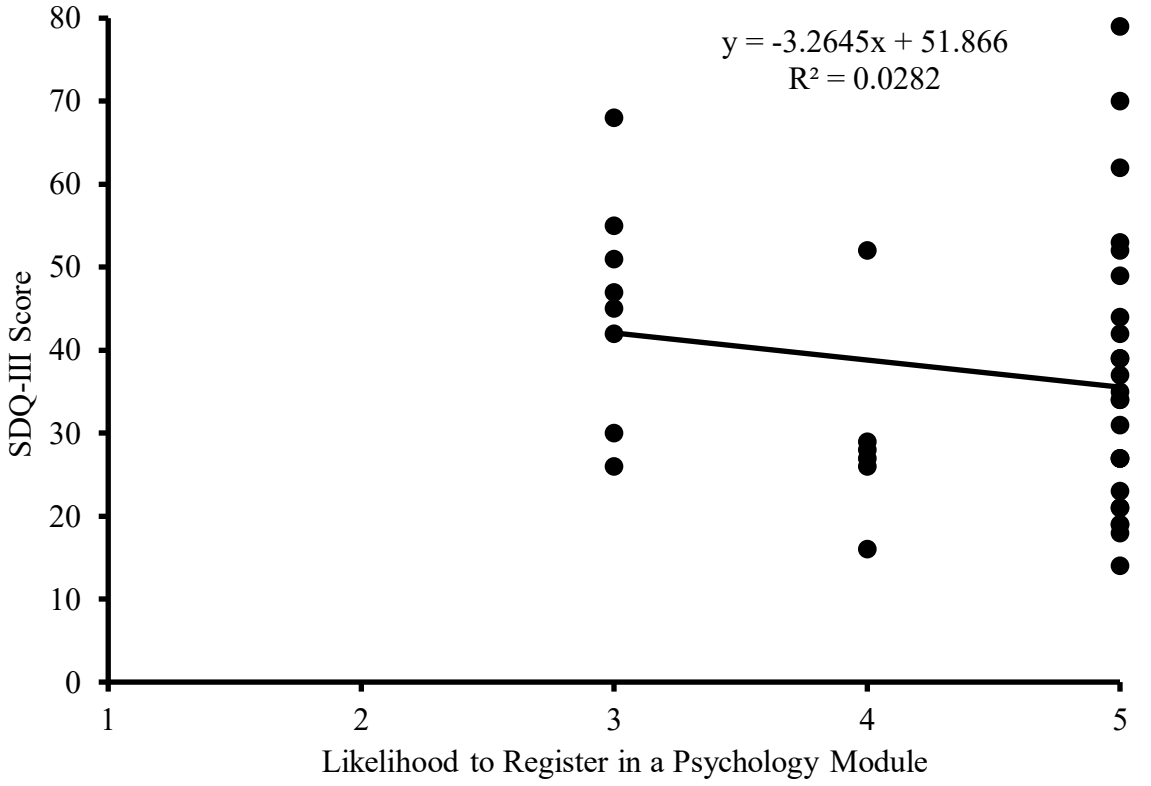
Association Between FSMAS-R Score and Likelihood to Register in Psychology for Psychology-Interested Participants



Note. Each dot represents one or more participant's data. There was not a significant relationship between psychology-interested participants' scores on the revised version of the Fennema-Sherman Mathematics Anxiety Scale (FSMAS-R) that measures math anxiety, and likelihood to register in a psychology module.

Figure 2

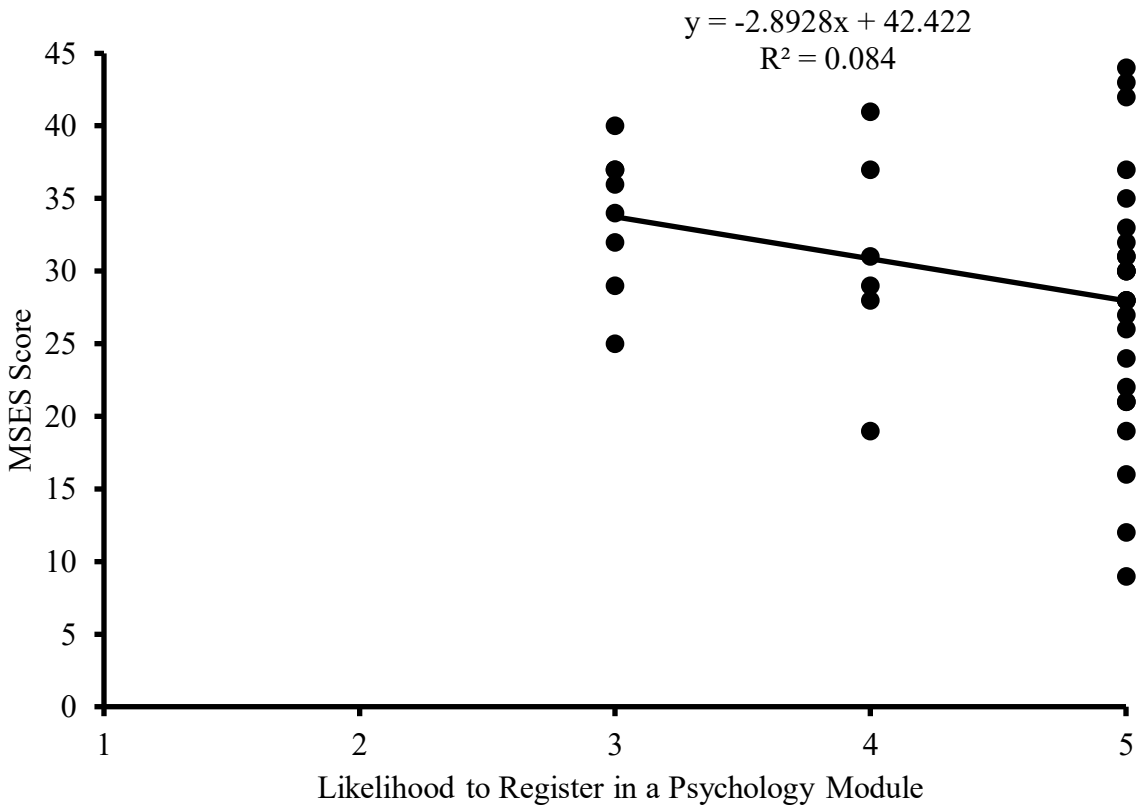
Association Between SDQ-III Score and Likelihood to Register in Psychology for Psychology-Interested Participants



Note. Each dot represents one or more participant's data. There was not a significant relationship between psychology-interested participants' scores on the Self-Description Questionnaire III (SDQ-III) Mathematics Subscale that measures math self-concept, and likelihood to register in a psychology module.

Figure 3

Association Between MSES Score and Likelihood to Register in Psychology for Psychology-Interested Participants



Note. Each dot represents one or more participant's data. There was not a significant relationship between psychology-interested participants' scores on the Math Self-Efficacy Scale (MSES) that measures math self-efficacy, and likelihood to register in a psychology module.

used. Psychology-interested participants' knowledge of the statistics requirement (M = 1.35, SD = 0.48) was not significantly different than non-psychology-interested participants' knowledge of the statistics requirement (M = 1.51, SD = 0.51), Welch's $t(82.55) = 1.50$, $p = .137$, $d = 0.33$, with a small effect size.

Time Since Last Math Course and Math Anxiety, Math Self-Concept, and Math Self-Efficacy Scores

As an exploratory analyses, we were interested in whether participants' time since participation in last math course was associated with participants' scores on the three math scales. We conducted two-tailed Pearson correlations to assess the relationship between all participants' number of years since participation in their last math course (M = 1.66, SD = 2.91) with math anxiety, math self-concept, and math self-efficacy scores. One participant did not respond to the years since last math course question and was excluded from these analyses. The correlation between participants' time since participation in their last math course with math anxiety scores was significant, weak, and negative, $r(84) = -.23$, $p = .033$, indicating that as time since participation in a math course increased, scores for the FSMAS-R math anxiety measure decreased, indicating higher math anxiety. The correlation between participants' time since participation in their last math course and scores for the SDQ-III math self-concept measure was not significant, $r(84) = -.20$, $p = .073$, although the correlation between participants' time since participation in their last math course and MSES math self-efficacy scores was significant, weak, and negative, $r(84) = -.25$, $p = .024$, indicating that as time since participation in a math course increased, scores for the MSES math self-efficacy measure decreased (lower math self-efficacy).

In order to determine whether psychology-interested and non-psychology-interested participants differed in number of years since participation in a math course, an independent

samples *t*-test between the number of years since participation in their last math course was compared for students interested in entering the psychology program and those who were not. Psychology-interested participants' years since their last math course (M = 1.64, SD = 3.83) was not significantly higher than non-psychology-interested participants' time since their last math course (M = 1.67, SD = 1.82), $t(82) = 0.04$, $p = .968$, $d = 0.01$, with a very small effect size.

Finally, to further investigate whether the time since a participant's last math course was associated with their interest in entering the psychology program and their scores on the three math assessments, two-tailed Pearson correlations were conducted between time since participation in last math course for psychology-interested participants (M = 1.64, SD = 3.83) and non-psychology-interested participants (M = 1.67, SD = 1.82) with math anxiety, math self-concept, and math self-efficacy scores. Means and standard deviations for scores of psychology-interested and non-psychology-interested participants are presented in Table 1. The correlation between psychology-interested participants' time since participation in their last math course with FSMAS-R math anxiety scores, SDQ-III math self-concept scores, and MSES math self-efficacy scores, were not significant. However, the correlations between non-psychology-interested participants' time since participation in their last math course and scores on the math scales were all significant. Specifically, the correlations between non-psychology-interested participants' time since last math course with FSMAS-R math anxiety scores were significant, moderate, and negative, $r(45) = -.48$, $p < .001$, while SDQ-III math self-concept scores were significant, moderate, and negative, $r(45) = -.39$, $p = .008$, and similarly MSES math self-efficacy scores were significant, weak, and negative, $r(45) = -.36$, $p = .015$. Thus, as the number of years since participation in last math course increased for non-psychology-interested participants, scores on the FSMAS-R math anxiety measure decreased, showing higher math

anxiety, scores on the SDQ-III math self-concept measure decreased, showing lower math self-concept, and scores on the MSES math self-efficacy measure decreased, showing lower math self-efficacy.

Discussion

The objective of this study was to explore whether math anxiety, math self-concept, and math self-efficacy influence first-year university students' intentions to register in a psychology program. We hypothesized that negative feelings toward math would turn students away from psychology, and that lower math self-concept and math self-efficacy would be associated with lower intention to register in psychology. The results demonstrated that although scores on all three math assessments were correlated with one another, scores on these instruments were not significantly related to students' intentions to declare a module within psychology, indicating that our primary hypothesis was not supported. Additionally, we investigated whether the group of psychology-interested participants showed that likelihood to register in psychology was associated with scores on the three math assessments, whether knowledge of the statistics requirement in psychology was associated with likelihood to register in psychology, and whether time since last math course was associated with scores on the three math assessments for the entire sample and psychology and non-psychology-interested participants separately. Although time since last math course was associated with math anxiety and math self-efficacy scores for the entire sample and time since a participant's last math course was correlated with scores on all three of the math assessments for non-psychology-interested participants, these correlations were weak or moderately related, and all other correlations were not significant.

The result that scores on the three math assessments were not significantly related to students' intention to declare a module within psychology was unexpected given that studies

with other STEM courses beyond psychology find significant associations between math feelings, self-concept, and self-efficacy, and students' intentions and subsequent participation in math courses (e.g., Hembree, 1990, Huang et al., 2018; Cribbs et al., 2021). Specifically, looking at participation in STEM courses in university, Daker et al. (2021) found that first-year students at Western University, an affiliate to Brescia, who measured high in math anxiety in their first semester, participated in significantly fewer STEM courses, including mathematics, throughout their degree. Ahmed (2018) identified similar patterns of avoidance in students throughout secondary and post-secondary education and reported that this avoidance is associated with a lower likelihood of being employed in STEM-based careers after post-secondary. While less is known about these relationships with math self-efficacy and math self-concept, there is evidence that lower math self-concept and math self-efficacy during high school are associated with lower aspiration to participate in STEM careers (Lauerman et al., 2015; Betz & Hackett, 1983; Lin et al., 2018). Therefore, the current study contradicts previous research that emphasizes significant relationships between higher math anxiety and lower math self-concept and math self-efficacy in post-secondary students' intentions and participation in math-inclusive courses and careers. The current study found no association between the three math constructs and intentions to enter psychology.

Given that the primary hypothesis test was not supported, the study explored the possibility that participants' knowledge of the statistics requirement in the psychology curriculum might influence intention to declare a module in psychology. It could be that students do not know about the statistics requirement in psychology modules prior to their ITR, which would result in more participants not selecting "Statistics" when asked to select courses that they believe are offered in the psychology program. Furthermore, if they did not know that statistics

was a part of the psychology curriculum then they would not be using this knowledge as part of their decision to choose to enter psychology. However, participants in the current study did seem to have knowledge of the statistics requirement in psychology as just over half of all participants and 65% of those in the psychology-interested group knew that statistics was a requirement in the psychology program, and this knowledge did not deter their interest to enter psychology. Nevertheless, knowledge of the statistics requirement in psychology was not significantly related to the likelihood of declaring a psychology module, and psychology and non-psychology-interested participants did not differ in their knowledge of the statistics requirement.

The current study found that many psychology-interested participants know that statistics is a part of the curriculum even though other studies contradict this knowledge. For example, Collisson et al. (2021) reported that when students in an introductory psychology course were questioned about the anticipated skills and learning outcomes they wanted and perceived they would acquire from participating in a psychology major, students reported communication and counselling but did not specifically outline quantitative skill, such as statistics (see also McGovern & Hawks, 1986; Holmes & Beins, 2009). Finally, research by Manning et al. (2006) indicated that an incoming bias of psychologists as clinicians instead of researchers was offset only after exposure to Research Methods courses, in which there was an associated loss of interest in scientific and practitioner activities within psychology. Overall, previous research suggests that given the misconceptions that first-year students may have about psychology majors and professions, students entering psychology may not be aware of the course requirements, such as statistics, that are fundamental to research understanding. That many participants in the current study knew about the statistics requirement in psychology may be because they had already spent a semester in university and had time to learn about the statistics

requirement and decide to declare a degree in psychology or not well before ITR at the end of the second semester. Thus, future research should consider time when asking students about their intention to enter psychology, as asking participants earlier, such as during first semester, may indicate different knowledge about the statistics requirement and interest or intention to enter psychology.

In addition, to whether participants knew of the statistics requirement in psychology, we explored the possibility that time since a participant's last math course may have influenced scores on the three math measures. Although the correlations were weak, lower math anxiety scores (high math anxiety) and lower math self-efficacy scores were significantly associated with an increased amount of time since last math course, while scores on math self-concept were not. Interestingly, while psychology-interested and non-psychology-interested participants did not significantly differ in the number of years reported since their last math course, significant correlations were found for non-psychology-interested participants' time since their last math course and scores on the three math assessments. Previous research on time spent away from math courses is often limited to adult learners in comparison to traditional learners. Specifically, Jameson and Fusco (2014) found that adult learners reported higher math anxiety and lower math self-efficacy than traditional students. Additionally, further exploration revealed that as more time passed since participation in a math course, the lower all participants' math self-efficacy became. Overall, the current study is consistent with previous research on math self-efficacy because the more time participants reported since participation in a math course, the lower their math self-efficacy score was. It may be that non-psychology-interested participants are entering academic disciplines, such as English, that did not require them to take math as a prerequisite in high school (Brescia University College, 2022). Thus, students who have been out of math

longer have more negative views of some aspects of math, but this seems to differ in our sample between psychology and non-psychology-interested participants.

Furthermore, there was a lack of variability among participants who reported that they were interested in entering the psychology program and their intention to declare a module in psychology at their upcoming registration. Particularly within this group of psychology-interested participants, no participants reported that they were 1 (Very Unlikely) or 2 (Unlikely) to declare a module in psychology at ITR. The rest of the participants indicated that they were 3 (Neutral), 4 (Likely), or 5 (Very Likely), 63% of which indicated "Very Likely." Thus, many students who claimed they were interested in entering the psychology program were "Very Likely" to declare a module at their upcoming registration. This lack of variability could have reduced our ability to detect an effect that may exist. Consequently, further study should consider the lack of variability in the current study and account for this when determining power and subsequent sample size. Second, the current study asked students to report their intentions for their upcoming module selection at ITR. However, intention does not necessarily translate into behaviour and reflect the program and module participants will select at their ITR. Future research should access ITR data to investigate what participants recorded as their program and module for the following school year to determine if their intentions are representative of their actual behaviours and whether participants do or do not enter psychology. Nevertheless, given the time restrictions of the current researcher, ITR data could not be accessed before thesis submission.

Math anxiety, math self-concept, and math self-efficacy as predictors for future STEM participation have all been studied over the last decade (e.g., Huang et al., 2018; Cribbs et al., 2021; Ahmed., 2021; Daker et al., 2021). Accordingly, negative affectivity and perceptions about

one's ability to learn, perform, and achieve goals in mathematics may lead to student avoidance and prevent capable students from pursuing educational and occupational pathways that require mathematics (Lee, 2009; Hembree, 1990; Ashcraft, 2002). Furthermore, some of these pathways do not always explicitly fall within STEM, such as psychology (Betz, 1978b). While the current study's results do not show that students avoid entering psychology because of their levels of math anxiety, self-concept, self-efficacy, or their knowledge of statistics, this study serves to encourage further research on the three math factors in relation to student participation in educational and occupational fields beyond psychology, which may not be explicitly recognized as requiring mathematics, such as sociology (Western University, 2022). However, as research persists, post-secondary institutions should consider assessing and offering interventions to support math anxiety and improve students' self-concept and self-efficacy with mathematics to ensure those entering all programs are given resources that may support their enrollment decisions and, subsequently, the overall diversity of students within academic disciplines and STEM and non-STEM occupations.

References

Ahmed, W. (2018). Developmental trajectories of math anxiety during adolescence: Associations with STEM career choice. *Journal of Adolescence*, *67*(2018), 158–166. https://doi.org/10.1016/j.adolescence.2018.06.010

Ahmed, W., Minnaert, A., Kuyper, H., & van der Werf, G. (2012). Reciprocal relationships between math self-concept and math anxiety. *Learning and Individual Differences*, *22*(3), 385–389. https://doi.org/10.1016/j.lindif.2011.12.004

American Psychological Association. (2013). *APA guidelines for the undergraduate psychology major: Version 2.0*. Washington, DC: Author. Retrieved October 8, 2021, from http://www.apa.org/ed/precollege/undergrad/index.aspx

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, *11*(5), 181–185. https://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychoeducational Assessment*, *27*(3), 197–205. https://doi.org/10.1177/0734282908330580

Ashcraft, M. H., & Ridley, K. S. (2005). Math anxiety and its cognitive consequences. In J. I. D. Campbell (Ed.), *Handbook of Mathematical Cognition* (1st ed., pp. 315-327). Psychology Press.

Baloğlu, M. (1999). *A comparison of mathematics anxiety and statistics anxiety in relation to general anxiety* (ED436703). U.S. Department of Education, Texas Educational Resources Information Center (ERIC). https://files.eric.ed.gov/fulltext/ED436703.pdf

Baloğlu, M. (2004). Statistics anxiety and mathematics anxiety: Some interesting differences I. *Educational Research Quarterly*, *27*(3), 38–48. https://files.eric.ed.gov/fulltext/EJ792861.pdf

Beilock, S. L., & Maloney, E. A. (2015). Math anxiety: A factor in math achievement not to be ignored. *Policy Insights from the Behavioral and Brain Sciences*, *2*(1), 4–12. https://doi.org/10.1177/2372732215601438

Betancur, L., Rottman, B. M., Votruba-Drzal, E., & Schunn, C. (2019). Analytical assessment of course sequencing: The case of methodological courses in psychology. *Journal of Educational Psychology*, *111*(1), 91–103. https://doi.org/10.1037/edu0000269

Betz, N. E. (1978a). *Fennema-Sherman Mathematics Anxiety Scale—Revised Version (FSMAS)* [Database record]. APA PsycTests. https://dx.doi.org/10.1037/t21089-000

Betz, N. E. (1978b). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Counseling Psychology*, *25*(5), 441–448. https://doi.org/10.1037/0022-0167.25.5.441

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior*, *23*(3), 329–345. https://doi.org/10.1016/0001-8791(83)90046-5

Bhowmick, S., Young, J. A., Clark, P. W., & Bhowmick, N. (2017). Marketing students' mathematics performance: The mediating role of math anxiety on math self-concept and math self-efficacy. *Journal of Higher Education Theory and Practice*, *17*(9), 104–117. https://doi.org/10.33423/jhetp.v17i9.1426

Blotnicky, K. A., Franz-Odendaal, T., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International Journal of STEM Education*, *5*(1), 1–15. https://doi.org/10.1186/s40594-018-0118-3

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, *15*(1), 1–40. https://doi.org/10.1023/A:1021302408382

Brescia University College. (2022). *English*. Retrieved March 25, 2022, from https://brescia.uwo.ca/undergraduate/english.php

Brown, M., Brown, P., & Bibby, T. (2008). "I would rather die": Reasons given by 16-year-olds for not continuing their study of mathematics. *Research in Mathematics Education*, *10*(1), 3–18. https://doi.org/10.1080/14794800801915814

Chamberlin, S. A. (2010). A review of instruments created to assess affect in mathematics. *Journal of Mathematics education*, *3*(1), 167–182. https://educationforatoz.com/images/_14_Scott_A._Chamberlin.pdf

Chernoff, E. J., & Stone, M. (2014). An examination of math anxiety research. *Gazette - Ontario Association for Mathematics*, *52*(4), 29–31. https://www.lib.uwo.ca/cgi-bin/ezpauthn.cgi?url=http://search.proquest.com/scholarly-journals/examination-math-anxiety-research/docview/1563633518/se-2?accountid=15115

Chipman, S. F., Krantz, D. H., & Silver, R. (1992). Mathematics anxiety and science careers among able college women. *Psychological Science*, *3*(5), 292–295. https://doi.org/10.1111/j.1467-9280.1992.tb00675.x

Collisson, B., & Eck, B. E. (2021). “Oh, the places you can go” Gen Z psychology students’ perceived career options and interests. *Teaching of Psychology*, 1–13. https://doi.org/10.1177/00986283211013842

Collisson, B., Eck, B. E., & Harig, T. (2021). Introducing Gen Z psychology majors: Why they choose to major in psychology (and what they expect to learn). *Scholarship of Teaching and Learning in Psychology*, 1–12. https://doi.org/10.1037/stl0000249

Cribbs, J., Huang, X., & Piatek-Jimenez, K. (2021). Relations of mathematics mindset, mathematics anxiety, mathematics identity, and mathematics self-efficacy to STEM career choice: A structural equation modeling approach. *School Science and Mathematics*, *121*(5), 275–287. https://doi.org/10.1111/ssm.12470

Daker, R. J., Gattas, S. U., Sokolowski, H. M., Green, A. E., & Lyons, I. M. (2021). First-year students’ math anxiety predicts STEM avoidance and underperformance throughout university, independently of math ability. *NPJ Science of Learning*, *6*(17), 1–13. https://doi.org/10.1038/s41539-021-00095-7

Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions*, *8*(33), 1–9. https://doi.org/10.1186/1744-9081-8-33

Dew, K. H., Galassi, J. P., & Galassi, M. D. (1984). Math anxiety: Relation with situational test anxiety, performance, physiological arousal, and math avoidance behavior. *Journal of Counseling Psychology*, *31*(4), 580–583. https://doi.org/10.1037/0022-0167.31.4.580

Espino, M., Pereda, J., Recon, J., Perculeza, E., & Umali, C. (2017). Mathematics anxiety and its impact on the course and career choice of grade 11 students. *International Journal of Education, Psychology and Counselling*, *2*(5), 99–119. http://www.ijepc.com/PDF/IJEPC-2017-05-09-08.pdf

Fennema, E. H., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, *7*(5), 324–326. https://doi.org/10.2307/748467

Fennema, E. H., & Sherman, J. A. (1978). Sex-related differences in mathematics achievement and related factors: A further study. *Journal for Research in Mathematics Education*, *9*(3), 189–203. https://doi.org/10.2307/748997

Freng, S., Webber, D., Blatter, J., Wing, A., & Scott, W. D. (2011). The role of statistics and research methods in the academic success of psychology majors: Do performance and enrollment timing matter? *Teaching of Psychology*, *38*(2), 83–88. https://doi.org/10.1177/0098628311401591

Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling Psychology*, *32*(1), 47–56. https://doi.org/10.1037/0022-0167.32.1.47

Hackett, G., & Betz, N. E. (1982). Mathematics self-efficacy expectations, math performance, and the consideration of math-related majors. *U.S. Department of Education, Educational Resources Information Center (ERIC)*, 1–42. https://files.eric.ed.gov/fulltext/ED218089.pdf

Hafni, R. N., Herman, T., Nurlaelah, E., & Mustikasari, L. (2020). The importance of science, technology, engineering, and mathematics (STEM) education to enhance students' critical thinking skill in facing the industry 4.0. *Journal of Physics: Conference Series*, *1521*(4), 2040–2047. https://doi.org/10.1088/1742-6596/1521/4/042040

Hart, S. A., & Ganley, C. M. (2019). The nature of math anxiety in adults: Prevalence and correlates. *Journal of Numerical Cognition*, *5*(2), 122–139. https://doi.org/10.5964/jnc.v5i2.195

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, *21*(1), 33–46. https://doi.org/10.2307/749455

Holmes, J. D., & Beins, B. C. (2009). Psychology is a science: At least some students think so. *Teaching of Psychology*, *36*(1), 5–11. https://doi.org/10.1080/00986280802529350

Hong, P. Y., Lishner, D. A., Ebert, A., Zimmerman, C., Oechsner, M., & McCann, L. I. (2019). Undergraduates' considerations in declaring either a bachelor of science or a bachelor of arts in psychology. *Teaching of Psychology*, *46*(3), 179–186. https://doi.org/10.1177/0098628319848862

Huang, X., Zhang, J., & Hudson, L. (2018). Impact of math self-efficacy, math anxiety, and growth mindset on math and science career interest for middle school students: The gender moderating effect. *European Journal of Psychology of Education*, *34*(3), 621–640. https://doi.org/10.1007/s10212-018-0403-z

Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulation and self-efficacy. *Contemporary Educational Psychology*, *34*(3), 240–249. https://doi.org/10.1016/j.cedpsych.2009.05.004

Jameson, M. M., & Fusco, B. R. (2014). Math anxiety, math self-concept, and math self-efficacy in adult learners compared to traditional undergraduate students. *Adult Education Quarterly*, *64*(4), 306–322. https://doi.org/10.1177/0741713614541461

Lauermann, F., Chow, A., & Eccles, J. S. (2015). Differential effects of adolescents' expectancy and value beliefs about math and english on math/science-related and human services-related career plans. *International Journal of Gender, Science and Technology*, *7*(2), 205–228. http://genderandset.open.ac.uk/index.php/genderandset/article/view/393/674

Lee, J. (2009). Universals and specifics of math self-concept, math self-efficacy, and math anxiety across 41 PISA 2003 participating countries. *Learning and Individual Differences*, *19*(3), 355–365. https://doi.org/10.1016/j.lindif.2008.10.009

Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Discriminant and predictive validity of academic self-concept, academic self-efficacy, and mathematics-specific self-efficacy. *Journal of Counseling Psychology*, *44*(3), 307–315. https://doi.org/10.1037/0022-0167.44.3.307

Lin, L., Lee, T., & Snyder, L. A. (2018). Math self-efficacy and STEM intentions: A person-centered approach. *Frontiers in Psychology*, *9*, 1–13. https://doi.org/10.3389/fpsyg.2018.02033

Li, Q., Cho, H., Cosso, J., & Maeda, Y. (2021). Relations between students' mathematics anxiety and motivation to learn mathematics: A meta-analysis. *Educational Psychology Review*, *33*(3), 1017–1049. https://doi.org/10.1007/s10648-020-09589-z

Malik, S. (2014). Undergraduates' statistics anxiety and mathematics anxiety: Are they similar or different constructs. *JSM Proceedings, Survey Research Methods Section*, 809–815. http://www.asasrms.org/Proceedings/y2014/files/311309_87289.pdf

Manning, K., Zachar, P., Ray, G. E., & LoBello, S. (2006). Research methods courses and the scientist and practitioner interests of psychology majors. *Teaching of Psychology*, *33*(3), 194–196. https://www.academia.edu/21123234/Research_methods_courses_and_the_scientist_and_practitioner_interests_of_psychology_majors

Marsh, H. W., & O'Neill, R. (1984). Self description questionnaire III: The construct validity of multidimensional self-concept ratings by late adolescents. *Journal of Educational Measurement*, *21*(2), 153–174. https://doi.org/10.1111/j.1745-3984.1984.tb00227.x

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior*, *37*(2), 225–238. https://doi.org/10.1016/0001-8791(90)90042-Z

McGovern, T. V., & Hawks, B. K. (1986). The varieties of undergraduate experience. *Teaching of Psychology*, *13*(4), 174–181. https://doi.org/10.1207/s15328023top1304_1

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. *Journal of Educational Psychology*, *82*(1), 60–70. https://doi.org/10.1037/0022-0663.82.1.60

Mitton, D., & Ann, P. (1987). *Locus of control, gender and type of major as correlates to statistics anxiety in college students*. [Doctoral dissertation, The American University] ProQuest Dissertations Publishing. https://www.proquest.com/docview/303553463?pq-origsite=primo&accountid=15115

Morris, L. W., Kellaway, D. S., & Smith, D. H. (1978). Mathematics anxiety rating scale: Predicting anxiety experiences and academic performance in two groups of students. *Journal of Educational Psychology*, *70*(4), 589–594. https://doi.org/10.1037/0022-0663.70.4.589

Nahornick, A. (2016). Math matters: Comparison of the mathematics requirements for bachelor of arts and bachelor of science degrees in Canada. *Canadian Journal of Higher Education*, *46*(1), 109–120. https://www.proquest.com/docview/1788523001/fulltextPDF/41E3EF7C68684C02PQ/1?accountid=15115

Nielsen, I. L., & Moore, K. A. (2003). *Mathematics Self-Efficacy Scale (MSES)* [Database record]. APA PsycTests. https://dx.doi.org/10.1037/t06008-000

Núñez-Peña, M., Suárez-Pellicioni, M., & Bono, R. (2013). Effects of math anxiety on student success in higher education. *International Journal of Educational Research*, *58*, 36–43. https://doi.org/10.1016/j.ijer.2012.12.004

O'brien, V., Martinez-pons, M., & Kopala, M. (1999). Mathematics self-efficacy, ethnic identity, gender, and career interests related to mathematics and science. *The Journal of Educational Research*, *92*(4), 231–235. https://doi.org/10.1080/00220679909597600

Onwuegbuzie, A. J., Da Ros, D., & Ryan, J. M. (1997). The components of statistics anxiety: A phenomenological study. *Focus on Learning Problems in Mathematics*, *19*(4), 11–35. https://eric.ed.gov/?id=EJ558838

Onwuegbuzie, A. J., & Wilson, V. A. (2003). Statistics anxiety: Nature, etiology, antecedents, effects, and treatments--a comprehensive review of the literature. *Teaching in Higher Education*, *8*(2), 195–209. https://doi.org/10.1080/1356251032000052447

Paechter, M., Macher, D., Martskvishvili, K., Wimmer, S., & Papousek, I. (2017). Mathematics anxiety and statistics anxiety. Shared but also unshared components and antagonistic contributions to performance in statistics. *Frontiers in Psychology*, *8*, 1–13. https://doi.org/10.3389/fpsyg.2017.01196

Perlman, B., & McCann, L. (1993). The place of mathematics and science in undergraduate psychology education. *Teaching of Psychology*, *20*(4), 205–208. https://doi.org/10.1207/s15328023top2004_1

Punaro, L., & Reeve, R. (2012). Relationships between 9-year-olds' math and literacy worries and academic abilities. *Child Development Research*, *2012*, 1–11. https://doi.org/10.1155/2012/359089

Rajecki, D. W., Appleby, D., Williams, C. C., Johnson, K., & Jeschke, M. P. (2005). Statistics can wait: Career plans activity and course preferences of American psychology undergraduates. *Psychology Learning and Teaching*, *4*(2), 83–89. https://doi.org/10.2304/plat.2004.4.2.83

Reyes, L. H. (1984). Affective variables and mathematics education. *The Elementary School Journal*, *84*(5), 558–581. https://doi.org/10.1086/461384

Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology*, *19*(6), 551–554. https://doi.org/10.1037/h0033456

Sax, L. J. (1994). Mathematical self-concept: How college reinforces the gender gap. *Research in Higher Education*, *35*(2), 141–166. https://doi.org/10.1007/BF02496699

Sax, L. J., Kanny, M. A., Riggers-Piehl, T. A., Whang, H., & Paulson, L. N. (2015). "But I'm not good at math:" The changing salience of mathematical self-concept in shaping women's and men's STEM aspirations. *Research in Higher Education*, *56*(8), 813–842. https://doi.org/10.1007/s11162-015-9375-x

Stoloff, M., McCarthy, M., Keller, L., Varfolomeeva, V., Lynch, J., Makara, K., Simmons, S., & Smiley, W. (2010). The undergraduate psychology major: An examination of structure and sequence. *Teaching of Psychology*, *37*(1), 4–15. https://doi.org/10.1080/00986280903426274

Thurston, W. P. (1990). Mathematical education. *Notices of the AMS*, *37*(7), 844–850. arXiv:math/0503081v1

Townsend, M. A. R., Moore, D. W., Tuck, B. F., & Wilton, K. M. (1998). Self-concept and anxiety in university students studying social science statistics within a co-operative learning structure. *Educational Psychology*, *18*(1), 41–54. https://doi.org/10.1080/0144341980180103

Western University. (2021a). *Honours Specialization in Psychology*. Academic Calendar - 2021. Retrieved November 20, 2021, from https://www.westerncalendar.uwo.ca/Modules.cfm?ModuleID=20822&SelectedCalendar=Live&ArchiveID=

Western University. (2021b). *Major in Psychology*. Academic Calendar - 2021. Retrieved November 20, 2021, from https://www.westerncalendar.uwo.ca/Modules.cfm?ModuleID=20823&SelectedCalendar=Live&ArchiveID=

Western University. (2021c). *Specialization in Psychology*. Academic Calendar – 2021. Retrieved November 20, 2021, from https://www.westerncalendar.uwo.ca/Modules.cfm?ModuleID=20825&SelectedCalendar=Live&ArchiveID=

Western University. (2022). *Statistics for Sociology*. Academic Calendar – 2022. Retrieved March 5, 2022, from https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=BRESC_019309_3&SelectedCalendar=Live&ArchiveID=

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Wigfield, A., & Meece, J. L. (1988). Math anxiety in elementary and secondary school students. *Journal of Educational Psychology*, *80*(2), 210–216. https://doi.org/10.1037/0022-0663.80.2.210

Appendix A

Demographic and Intent to Register (ITR) Questions

D1. What is your age? (Please type response in the box provided)

D2. What is your gender/ how do you identify?

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other (please specify)

D3. How long has it been since your last math course?

- ○ Less than a year
- ○ 1 Year
- ○ 2 Years
- ○ 3 Years
- ○ More than 3 Years (please specify)

Instructions. **Intent to Register at Brescia**

Intent to Register (ITR) at Brescia begins in February and usually ends March 31st. Around this time, Brescia, the affiliates, and Western often hold information sessions and send out emails reminding students of Intent to Register and how to complete the process.

In summation, Intent to Register is a mandatory process where you log in to your Western Student Centre and complete a form that 1) informs Brescia that you will be coming back for the next academic school year, and 2) which degree and module(s) you plan to enrol in.

D4 . Which of the following course(s) do you think are offered in the psychology program at Brescia? (Select all that apply)

☐ Introduction to Essay Writing	☐ Youth in Conflict with the Law
☐ Introduction to Developmental Psychology	☐ Statistics
☐ Research Methods	☐ Introduction to Families in Canada
☐ Sociology of Mental Health	☐ Introduction to Cognitive Psychology
☐ Human Sexuality	☐ Community Development: Foundations
☐ Professional Perspectives	☐ Introduction to Biological Basis of Behaviour

D5 . Are you interested in going into Brescia's psychology program? (Select Yes or No)

Yes	No
○	○

Display This Question:

If Are you interested in going into Brescia's psychology program? (Select Yes or No) = Yes

D6 . How likely are you to register in a psychology module (i.e., minor, major, specialization, honours specialization) in Brescia's psychology program at your Intent to Register (ITR) this year?

Very Unlikely	Unlikely	Neutral	Likely	Very Likely
○	○	○	○	○

Display This Question:

If Are you interested in going into Brescia's psychology program? (Select Yes or No) = No

D7 . Which program are you interested in registering for at your Intent to Register (ITR) this year? (Please type response in the box provided)