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Predictive Contribution of Personality Traits in a Sociocognitive Model of Academic Performance in Mathematics

Marcos Cupani[1] and Ricardo Marcos Pautassi[1,2]

Abstract

Social cognitive career theory (SCCT) explains academic performance as a function of conceptually distinct and interrelated cognitive variables. We aimed at extending SCCT's performance model by examining the direct and indirect—through sociocognitive variables—contribution of personality traits on mathematics academic performance. Argentine youths ($N = 543$) were assessed in mathematics self-efficacy, outcome expectations, performance goals, and skills. Personality traits were assessed through the Big Five Questionnaire for Children. Path analyses indicated that the contribution of personality on academic performance was mediated by sociocognitive mechanisms. The results suggested that (a) students who exhibited higher Conscientiousness scores had higher self-efficacy beliefs and more positive outcome expectations and set more demanding performance goals and (b) students who had higher Openness/Intellect scores exhibited higher self-efficacy beliefs. Gender did not moderate the relations among cognitive variables but influenced the association between personality traits and cognitive variables. Implications for teachers and guidance counselors are discussed.

Keywords

self-efficacy, personality traits, performance goals, social cognitive career theory

In the last years, the field of Educational and Vocational Psychology has provided evidence suggesting that self-efficacy (Robbins, Lauver, Le, Davis, & Langley, 2004) and personality traits (Poropat, 2009) are associated with academic success. Yet, there is a scarcity of studies explicitly comparing their predictive contribution (Caprara, Barbaranelli, Pastorelli, & Cervone, 2004), let alone

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assessing potential theoretical relationships between these constructs. Social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994) offers a theoretical framework to link cognitive and personality variables.

SCCT explains career choice, the development of interests, and academic performance using different but interrelated theoretical models (Lent et al., 1994). SCCT emphasizes three components of sociocognitive theory, self-efficacy, outcome expectations, and goals. SCCT also incorporates person inputs (e.g., gender) and contextual variables (e.g., family support) that contribute to learning experiences (e.g., vicarious learning), which are considered experiential sources of corresponding self-efficacy and outcome expectations. SCCT posits that personality traits constitute *person inputs.* Under the theoretical framework of SCCT, the relation between personality traits and interest development, choice making, and educational performance would be largely (if not fully) mediated by sociocognitive mechanisms (Lent et al., 1994).

In the last years, there has been a significant increase in the number of studies assessing the specific contribution of personality traits in SCCT. These studies focused on the development of either career choice (Rogers, Creed, & Glendon, 2008; Rottinghaus, Lindley, Green, & Borgen, 2002) or interests (Schaub & Tokar, 2005) and, recently, job performance (Brown, Lent, Telander, & Selena Tramayne, 2011). To our knowledge, however, there is a surprising lack of studies trying to combine personality traits and SCCT's model of academic performance. The present work aims at extending SCCT's model of academic performance (Lent et al., 1994). We consider the variables originally put forward by SCCT and examine the direct and indirect—through sociocognitive variables—contribution of personality traits.

SCCT's performance model hypothesizes that cognitive ability influence college student performance directly (through academic-related ability) and indirectly (through the mediating paths of self-efficacy and outcome expectations). Outcome expectations and self-efficacy can influence performance indirectly through the mediation of students' performance goals. Students with less positive outcome expectations or weaker self-efficacy will set and work toward less challenging academic goals than those with stronger outcome expectations and self-efficacy. Several studies have provided support for this model. The model was supported by a recent study that combined meta-analytic and structural equation analyses (Brown et al., 2008).

Many key issues, however, have been much less investigated. SCCT research has mainly focused on high school or college students, and few studies have analyzed SCCT hypotheses in middle school students (e.g., Fouad & Smith, 1996). It is important to understand how social cognitive mechanisms influence the development of performance in middle school students, because during this period students begin to acquire academic abilities and make decisions that will have a strong impact on later academic outcomes. Another limitation of contemporary research on SCCT is that the vast majority of studies have sampled U.S. college students. This opens the question as to how well SCCT generalizes to the educational and career development of younger (or older) subjects from diverse national contexts and across different domains of academic and career activity (Lent, Paixao, Da Silva, & Leitao, 2010). Finally, although there are some alternative models that examine the interaction between personality traits in the interest and choice models (e.g., Rogers et al., 2008), relatively few investigations have analyzed how personality traits influence academic performance. Indeed, in the academic performance model Lent, Brown, and Hackett (1994) considered ability only as person inputs. There is, however, some empirical evidence (e.g., Brown et al., 2011) and an adequate theoretical framework to include personality traits within this model.

Recent investigations on the association between personality traits and academic performance worked under the theoretical umbrella of the Five-Factor Model: Neuroticism, Extraversion, Openness/Intellect, Agreeableness, and Conscientiousness (Goldberg, 1993). The relationship between the Five-Factor Model of personality and academic performance has been analyzed in a recent meta-analytic study (Poropat, 2009), which featured samples derived from the primary, secondary, and tertiary levels of education. Conscientiousness was consistently associated with academic achievement, with a population correlation among these variables of .22. The association was fairly similar across the primary (.28), secondary (.21), and tertiary (.23) levels of education. For openness/intellect, the mean population correlation average was.12, which varied across levels of instruction (primary, .24; secondary, .12; tertiary, .07). Finally, for extraversion, agreeableness, and emotional stability (i.e., the inverse of neuroticism), Poropat (2009) found a mean population correlation average of −.01, .07, and .02, respectively. In summary, according to this sample, only conscientiousness and openness/intellect would be directly related to academic performance.

Conceptual considerations also support the integration of personality traits into SCCT. Personality traits could make an indirect contribution on academic performance through its influence on the development of cognitive mechanisms. For example, Rottinghaus, Lindley, Green, and Borgen (2002) examined the incremental role of personality, self-efficacy, and interests in explaining level of educational aspirations and found a gradual contribution of 10%, 26%, and 29% for personality traits, self-efficacy, and interest, respectively. A subsequent study (Schaub & Tokar, 2005) revealed that personality traits contribute to the development of interests through the indirect path of learning experiences and the cognitive variables self-efficacy and outcome expectations. Rogers, Creed, and Glendon (2008) found that personality traits and social support contribute both directly and indirectly to career planning and exploration. The direct effect of personality on career choice was a novel contribution to SCCT. Openness/intellect and conscientiousness were directly associated with career planning and also indirectly through the mediating path of self-efficacy and goals. Conscientiousness and extraversion exhibited an indirect association with career exploration through self-efficacy and goals.

Other studies assessed the interrelationships between personality traits and the key cognitive variables of SCCT and their capability to predict academic performance. Caprara, Barbaranelli, Pastorelli, and Cervone (2004) found that academic achievement on males students was predicted by openness/intellect and self-efficacy in self-regulated learning, but not by academic self-efficacy, a phenomenon possibly related to the redundancy between the latter predictor and openness/intellect ($r = .62$). In female students, all three variables significantly predicted academic achievement. Komarraju and Karau (2005) found, through a multiple regression approach, that consciousness, neuroticism, and openness/intellect explained 34% of the variability in performance goals, with a striking 29% of the variance being explained only by conscientiousness. A fine meta-analysis by Judge and Ilies (2002) assessed the relationship between the Five-Factor Model of personality and three central theories of performance motivation (goal-setting, expectancy, and self-efficacy motivation). Neuroticism ($r = -.31$) and conscientiousness ($r = .24$) exhibited a significant association with the three theories. The remaining factors (extraversion, openness/intellect, and agreeableness) exhibited weaker and more inconsistent associations.

Based on SCCT and the empirical evidence reviewed herein, the aim of the present work was to extend SCTT's original performance model. The model (see Figure 1) considers the main cognitive variables of SCCT and, as *person inputs*, the direct and indirect contribution of personality traits. The rationale for testing the model in 13- to 15-year-old students is that adolescence is a critical stage for learning due to its inherent biological and psychosocial changes (Zimmerman, Bonner, & Kovach, 1996). There is an increasing need for information on the factors predicting academic success in middle school students, particularly in developing countries (Lent et al., 2001) and in the field of science, technology, engineering, and mathematics (STEM).

First, we hypothesized that, consistent with the SCCT's basic academic performance, mathematics abilities, logical-mathematical self-efficacy, and mathematics performance goals would have direct, positive relationships to academic performance in mathematics (Paths 1–3). Second, a positive relationship from logical-mathematical self-efficacy to mathematics outcome expectations was hypothesized, given that SCCT proposes that the former construct partially informs the latter

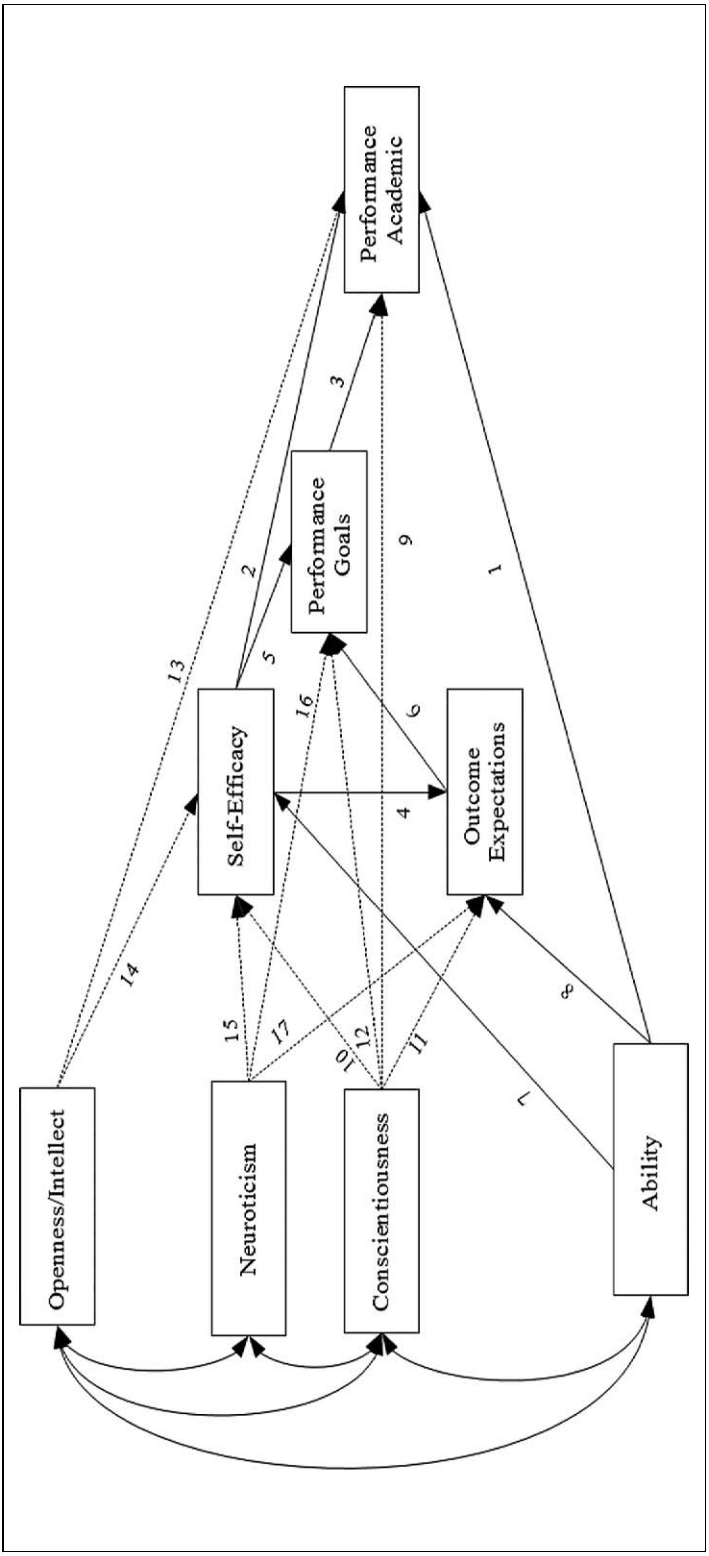

Figure 1. Model of academic performance theorized interrelations among personality trait and social cognitive career theory variables. Thick solid lines indicate paths in the original model (Lent et al., 1994) and thick dashed lines indicate paths added to the current model based on previous research.

construct (Path 4). Third, both logical-mathematical self-efficacy and mathematics outcome expectations were posited to be directly associated with goals (Paths 5 and 6). Fourth, the person input variables mathematics abilities would have direct, positive associations with logical-mathematical self-efficacy and mathematics outcome expectations (Paths 7 and 8).

Finally, we hypothesized that the person input variables personality traits would exhibit a direct and indirect association with academic performance. Conscientiousness has been the personality trait more consistently related with academic performance (Poropat, 2009) and is apparently associated with self-efficacy, outcome expectations, and performance goals (Judge & Ilies, 2002). Based on this rationale, we also propose that Conscientiousness would have direct and positive relationships with academic performance (Path 9), and will be indirectly and positively associated with academic performance through the mediating path of self-efficacy (Path 10), outcome expectations (Path 11), and performance goals (Path 12). Poropat (2009) reported a substantial association between openness/intellect and academic performance, and other studies (e.g., Caprara et al., 2004) suggested that this trait may be associated with self-efficacy. Based on these findings, openness/intellect will be directly and positively associated with academic performance (Path 13) and will be indirectly and positively associated with academic performance through the mediating path of self-efficacy (Path 14). Neuroticism does not seem to have a direct association with academic performance (Poropat, 2009); yet, this trait is associated with self-efficacy, outcome expectations, and goals (Judge & Ilies, 2002). Therefore, we propose that neuroticism will be indirectly and negatively associated with academic performance through the mediating path of self-efficacy (Path 15), outcome expectations (Path 16), and performance goals (Path 17). The model works under the assumption that personality traits are intercorrelated (Goldberg, 1993). **Significant correlations between abilities and both** conscientiousness (Moutafi, Furnham, & Paltiel, 2004) and openness/intellect (Ackerman & Heggestad, 1997) are also expected. It has been suggested (e.g., Lent et al., 2005) that gender can modulate the association between sociocognitive variables. Therefore, we will examine whether gender moderates the relations among variables in model.

Method

Participants

Participants were Argentine adolescents enrolled in six (three public and three private) high schools in Cordoba, Argentina. The study was approved by the General Office of Secondary Education of the City of Cordoba. A note was sent to the parents explaining the aim of the research and requesting a signature for informed consent. A total of 706 surveys were distributed to students; 629 were returned resulting in an 89% overall return rate. Eighty-six of these students, however, declined to participate. Thus, the final sample consisted of 543 subjects, 304 (56%) boys and 239 (44%) girls, aged 12–16 years ($M_{\text{age}} = 13.23$ years, $SD = .83$) and enrolled in state (40%) and private (60%) educational institutions. Participants represented two grade levels of the Argentina high school system: eighth (34%) and ninth grade (66%). Considering the characteristics of the institutions that participated in this study (they belonged to families of skilled workers, large-production farmers, professionals, and local merchants) and the classification given by the National Institute of Statistics and Censuses, the sample was representative of upper-middle and lower-middle socioeconomical classes.

Measures

Math Outcome Expectations Scale (MOES). The MOES is the Spanish adaptation (Cupani, 2010) of the Math/Science Outcome Expectations scale (Fouad, Smith, & Enochs, 1997). The scale consists of 9 items that assess middle school students' beliefs about the potential consequences of math-related courses, activities, and achievements. Participants rated each item (e.g., "If I learn math, I will have more options when choosing my major") on a 5-point scale, ranging from 1 (*totally agree*) to 5 (*totally disagree*). Item scores were summed and divided by 9. Total mean MOES scores ranged from 1 to 5, with high scores representing high levels of math outcome expectations. The Spanish adaptation (Cupani, 2010) followed the recommendations of Lent and Brown (2006). Two follow-up studies (Cupani, 2010) were conducted to improve the psychometric properties of the scale. The first study employed two focus groups and aimed at generating ideas on the student's expectations of results in our cultural setting. The information gathered was used to write 12 items for the outcome expectancies. These items (6 original and 12 new) were then tested for clarity and understandability in a sample of adolescents. On the second study, exploratory and confirmatory factor analyses revealed that a single-factor structure for the scale of Mathematics Outcome Expectancies (9 items) is the most appropriate model for the data gathered (goodness-of-fit index [GFI] .95; comparative fit index [CFI] .96; root mean square error of approximation [RMSEA] .06). The scale had optimal Cronbach's α values ($\alpha = 85$). In summary, MOES allows a contextualized measurement of outcome expectancies on math of teenagers from our cultural area and possess adequate psychometric properties. The present study yielded a Cronbach's α of .83 for MOES scores.

Math Performance Goals scale (MPGS). The MPGS is the Spanish adaptation (Cupani, 2010) of the subscale for Math/Science Intentions and Goals Scale (MSIGS; Fouad et al., 1997). It has 10 items that assess middle school students' intentions to pursue and persist in math-related courses in high school. Participants rated each item (e.g., *This year I propose to get good grades in math*) on a 5-point scale, ranging from 1 (*totally agree*) to 5 (*totally disagree*). Scores were summed and divided by 10. The Spanish adaptation (Cupani, 2010) followed the recommendations of Lent and Brown (2006). Two follow-up studies were conducted (Cupani, 2010) to improve the psychometric properties of the scale. The first study employed two focus groups and aimed at generating ideas on the student's goals on academic achievement in our cultural setting. The information gathered was used to write 7 new items for the goals subscale. These items (4 original and 7 new) were then tested for clarity and understandability in a sample of adolescents. On the second study, exploratory and confirmatory factor analyses revealed that a single-factor structure of 10 items for the scale of performance goals is the most appropriate model for the data gathered (GFI .92; CFI .95; RMSEA .08). The scale had optimal Cronbach's α values ($\alpha = .86$). The study on predictive validity also showed that performance goals, in conjunction the self-efficacy beliefs, explained 32% of the variance of math school performance. In summary, these scales apparently possess adequate psychometric properties, with a clear internal structure, and adequate internal consistence. The present study yielded a Cronbach's α of .86 for MPGS scores.

Logical-Mathematical Self-Efficacy scale (LMSS). The LMSS has 6 items, and participants rated each item (e.g., *Solve math equation*) on a 10-point scale, ranging from 1 (*I am not confident at all in doing this*) to 10 (*I am completely confident about successfully carrying out this activity*). The scores were summed and divided by 6. This score reflected the self-efficacy strength of the individual. The LMSS belongs to the revised version of the Multiple Intelligences Self-Efficacy Inventory (MISEI, Pérez & Cupani, 2008). This instrument measures the adolescents' self-efficacy with regard to academic activities associated with the multiple intelligences model (Gardner, 1999). We are using the last, revised version, because it can be used throughout the adolescent stage of development (i.e., 13–16 yrs). The MISEI-R has adequate reliability ($\alpha = .76$ to .92) and evidence of internal structure validity through exploratory and confirmatory factor analyses. The previous version, multiple intelligences self-efficacy inventory (MISEI), showed good internal consistency ($\alpha = .86$ to .94) stability ($r = .70$ to .82), and predictive validity in terms of academic achievement and career choices intentions (Cupani & Perez, 2008; Pérez, Cupani, & Ayllon, 2005). Thus, the two versions of the inventory (MISEI and MISEI-R) seem to exhibit adequate psychometric properties. The present study yielded a Cronbach's α of .84 for LMSS scores.

Math Abilities. The Numerical Ability subscale of the Differential Aptitude Test, Version 5 (DAT-5) was used (Bennett, Seashore, & Wesman, 2000). DAT-5 is composed by eight group-administered paper-and-pencil tests. The DAT-5 subscales quantify verbal ability (verbal reasoning and language spelling and use), perceptual speed (speed and accuracy), three-dimensional spatial visualization (space relations), arithmetic (numerical ability) and mechanical ability (mechanical reasoning), and figural reasoning (abstract reasoning). The α coefficients for each subtest neared .80 (range = .75 to .92; Bennett et al., 2000). The Numerical Ability subscale measures the ability to use numbers in a logical and efficient way. This 40-item subscale can be administered in 30 min. In the present study, a KR-20 of .83 was found for Numerical Ability scores.

Big Five Questionnaire for Children (BFQ-C). The BFQ-C (Barbaranelli, Caprara, Rabasca, & Pastorelli, 2003) measures the five personality factors in 9- to 15-year-old children, and is composed by 65 items, 13 items for each factors: Extraversion (e.g., *I easily make friends*), Agreeableness (e.g., *I trust in others*), Conscientiousness (e.g., *I like to keep all my school things in a great order*), Neuroticism (e.g., *I easily get angry*), and Openness/Intellect (e.g., *I easily learn what I study at school*). For each of the 65 items, subjects rated on a 5-point scale the occurrence of the behavior reported in the item using a 5-point Likert-type scale ranging from 1 (= *almost never*) to 5 (= *almost always*). The original instrument possesses adequate reliability and validity (Barbaranelli et al., 2003). The Spanish adapted version (Cupani & Ruarte, 2008) employed in the present study has acceptable internal consistency (α = .70 to .78), substantial temporal stability after 2 months (r = .71 to .84) and evidence of internal structure validity through exploratory and confirmatory factor analysis (GFI .91; CFI .90; RMSEA .06). In the present study, the reliability across scales varied between .71 and .80.

Academic Performance in Math (APM). APM was evaluated by accessing the students' high school records for math courses, which were organized according to the format issued by the Argentinean Ministry of Education. In Argentina, students are assessed at midterm (June) and at the end of the academic year (December). Each school subject is evaluated by their respective teachers. Grades are given on a 10-point scale, with 7 the cutoff for passing a course. Midterm and semester-end grades were combined to provide a composite measure of academic achievement. The two assessments (which were highly correlated: $r = .73$, $p < .001$) were summed and divided by 2.

Procedure

Data collection occurred during the first semester of the school year. Student participation was solicited through Math class. Tests were taken collectively during the course of a regular school day and in three different sessions (interval between sessions: approximately 30 days). Math teachers remained in the class to help monitor the behavior of the students. The researcher provided detailed instructions about how to complete the survey, and students had an opportunity to ask questions. The measures were taken following the theoretical and causal links proposed by the SCCT. The BFQ-C and Numerical Ability subtest were administered during the first session (April). Each of these tests was administered with a time limit of 40 min. One month later the MOES and LMSS (second session) was administered with a time limit of 20 min. The MPGS was applied about 3 weeks later (third session) with a time limit of 15 min. Math grade scores for each student were collected directly from school records at the end of the second school term.

Table 1. Reliability Coefficients (α), Means (*M*), Standard Deviations (*SD*), Skewness (Sk), Kurtosis (Ku), and Correlations Among Measures.

	Intercorrelation								
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Numerical ability	1.00	.37**	−.02	−.06	−.04	.19**	−.04	.38**	.09
(2) Logic-mathematics self-efficacy		1.00	.33**	.22**	.29**	.46**	−.03	.47**	.11*
(3) Mathematics performance goals			1.00	.35**	.54**	.34**	.00	.39**	−.14**
(4) Mathematics outcome expectations				1.00	.24**	.26**	−.01	.11*	.08
(5) Conscientiousness					1.00	.53**	.00	.26**	−.10*
(6) Openness/intellect						1.00	.09*	.27**	.03
(7) Neuroticism							1.00	−.08	−.23**
(8) Mathematics performance								1.00	−.06
(9) Sex									1.00
α	.83	.84	.86	.83	.82	.76	.80	.71	—
M	18.26	6.69	3.51	3.70	4.15	41.12	34.70	5.90	—
SD	6.46	1.77	.70	.70	8.62	7.82	8.74	1.86	—
Sk	.12	−.66	−.36	−.36	−.03	−.16	.27	−.21	—
Ku	−.63	.15	.10	.05	−.27	−.04	−.33	−.32	—

$^{*}p \leq .05$. $^{**}p \leq .01$.
For the sex variable, girls and boys were coded 0 and 1, respectively.

Results

Screening of the Data

Data preparation involved three steps. The pattern of missing values was analyzed first (Schlomer, Bauma, & Card, 2010). Two sources of missing data were identified: item nonresponse and participant attrition. Missing data for item nonresponse ranged from 1.5% (logical-mathematical self-efficacy) to 5.7% (conscientiousness). Taking into account that the missing data for the BFQ-C and MPGS was greater than 5% (Tabachnick & Fidell, 2001), we proceeded to verify that the missing data were completely at random (MCAR). Little's (1988) MCAR test ($\chi^2 = 5{,}195.009$, $df = 5{,}149$, $p \geq .323$) supported this assumption. Based on these results, we imputed values through Expectation Maximization, recalculated total scores and subsequently analyzed missing for participant attrition, which ranged from 1.3% (trait personality) to 7.7% (numerical ability). Little's MCAR test ($\chi^2 = 32.607$, $df = 36$, $p \geq .631$) supported MCAR of these missing. Multiple imputation was used to create five imputed data sets. Since there were no significant differences between the bases, we decided to report the results obtained with a single, randomly chosen data set. We then identified univariate and multivariate atypical cases by calculating the standard z score for each variable (z scores > 3.29 were considered atypical) and the Mahalanobis distance measure ($p < .001$), respectively. Twelve cases were discarded based on these analyses. Across variables the values for asymmetry and kurtosis were optimal for the proposed parametric analysis (−.67 to −.18 and −.33 to .37). Multivariate normality was evaluated by the ratio of Mardia (1970), which yielded a ratio of 2.59 and indicated that the distribution is close to normal (Bentler, 2005).

Preliminary Analyses

An examination of zero-order correlations (see Table 1) was conducted to test the strength of the associations among the variables included in the model. All variables, except neuroticism and sex, were significantly correlated with math performance. Additionally, a 2 (sex) × 2 (educational institution: state or private) multivariate analysis of variance (MANOVA) was employed to assess sex- and institution-related differences. The results revealed a significant effect of sex, Wilks's λ .870, $F(8.520) = 9.67$, $p \leq .001$, and type of educational institution, Wilks's λ .891, $F(8, 520) = 7.97$, $p \leq .001$. The two-way interaction also achieved significance, Wilks's λ .961, $F(8,520) = 2.60$, $p \leq .008$. Female students had significantly higher scores than male students in math performance goals, conscientiousness, and neuroticism, whereas male students had significantly higher scores than female students in math outcome expectations and logical-mathematical self-efficacy. Effect sizes, calculated by the eta-squared (η^2), were .01 for math performance goals, conscientiousness, math outcome expectations, and logical-mathematical self-efficacy, and .07 for neuroticism. According to Cohen's (1988) guidelines, the size of these effects ranged from small to moderate.

Private school students exhibited higher numerical ability, logical-mathematical self-efficacy, and openness/intellect than students attending state-based institutions. The latter students had higher math performance goals and higher math outcome expectations. The size of the effect was small to medium: .06 for numerical ability .03 for math outcome expectations, and .01 for the remaining variables. The significant interaction between sex and type of institution was explored using follow-up ANOVAs. These analyses revealed that female students attending state schools had higher neuroticism scores than male private-school students, $F(1, 530) = 8.47$, $p \leq .01$, and male students attending private schools had lower math performance goals in female students attending private schools than in same-sex counterparts attending state schools, $F(1,530) = 7.49$, $p \leq .01$. Effect sizes were small ($\eta^2 = .02$ for neuroticism and $\eta^2 = .02$ for math performance goals).

The present data were collected from different classes from different schools. Thus, the assumption of independence of observations may have been violated. To test this assumption, we used the intraclass correlation coefficient (ICC). According to a simulation study by Julian (2001), values of .05, .15, and .45, reflects low, moderate, and high correspondence among members within cluster groups. In the present study, the ICC measured the proportion of outcome variability that was attributed to school level, and they ranged from .01 for neuroticism, to .05 for math outcome expectations, to a moderate .11 for numerical ability. ICC was also calculated for different courses (8° vs. 9°), and the scores ranged from .00 for math performance goals to .03 for openness/intellect. It has been suggested that intraclass correlations equal to or less than .05, as in all but one of the variables of the present study, indicate that data dependence within multilevel data structures can be ignored without major consequences. Under these circumstances, only a minimal inflation is observed in the χ^2 statistic and model parameters as well as their standard errors can be safely considered unbiased (Julian, 2001).

Full Sample Analysis

AMOS 19 (Arbuckle & Wothke, 1999) software was used to test the hypothesized path model with the raw data imported from statistical package for the social sciences (Version 19). We fit a hypothesized path model to the covariance matrices and fit was estimated through a maximum likelihood. Model fit should be assessed using several indices to ensure more reliable and accurate decisions (Hu & Bentler, 1995). Therefore, the following indices were employed: the χ^2 test of significance, the ratio of the χ^2 statistic to degrees of freedom (χ^2/df), the CFI, the GFI, the standardized root mean square residual (SRMR), and the RMSEA. A small, nonsignificant χ^2 value is expected if a model provides adequate fit to the data. The χ^2 test of significance, however, is sensitive to sample size and is difficult to interpret given its lack of standardization (Kline, 2011). Although the ratio of χ^2 statistic to degrees of freedom is obviously based on the χ^2 statistic, dividing this statistic by its degrees of freedom reduces its sensitivity to sample size. When this ratio is less than 3.0, a good model fit can be inferred (Kline, 2011). According to Hu and Bentler (1995), CFI and GFI values between $\geq .90$ and $\geq .95$ indicate good fit. SRMR and RMSEA values of $\leq .10$ and $\leq .06$, respectively, are

Table 2. Fit Indices for Model and the Multiple-Group Analyses With Different Grouping Variables.

	Fit indices								
Model	χ^2	*df*	CMIN/DF	GFI	CFI	SRMR	RMSEA	90% CI for RMSEA	χ^2 Difference
Model	15.69 *	6	2.62	.99	.99	.02	.06	.02..09	
Grouping variable: Gender									
Model fully unconstrained	21.08*	12	1.76	.99	.99	.03	.04	.00..06	
Model partially constrained	49.56**	31	1.60	.98	.98	.05	.03	.01..05	28.48
Model fully constrained	60.30**	34	1.77	.97	.97	.06	.04	.02..05	39.22
Grouping variable: Educational type									
Model fully unconstrained	24.53*	12	2.04	.99	.99	.04	.04	.02..07	
Model fully constrained	48.73*	34	1.43	.98	.98	.06	.03	.01..05	24.23

Note. χ^2 = chi-square; χ^2 difference = difference in χ^2 between each of the alternative models.
CFI = comparative fit index; CI = confidence interval; CMIN/DF = ratio of chi-square statistic to degrees freedom; *df* = degrees of freedom; GFI = goodness-of-fit index; RMSEA = root mean square error of approximation; SRMR = standardized root-mean-square residual.
**p* <.05. ***p* < .01.

indicative of good model fit, whereas SRMR and RMSEA values of ≤ .08 and ≤ .05 indicate excellent or close fit, respectively. We used bootstrap resampling method to examine the statistical significance of direct, indirect, and total effects (Efron, 1979). Research using simulated data (e.g., MacKinnon, Lockwoo, & Williams, 2004) has shown that this method carefully controls Type I error, and it is a better alternative than the Sobel test. The estimation of the CIs was bias corrected (95%), and 1,000 randomly selected samples were generated from the full data set.

According to these indices (see Table 2), the model had an optimal fitness. Figure 2 depicts the standardized path coefficients and coefficient of determination (R^2) for each endogenous variable in model. The R^2 for math performance, math performance goals, logical-mathematical self-efficacy, and math outcome expectation were .37, .37, .31, and .09, respectively. The SCCT's performance model hypothesizes that cognitive ability, self-efficacy, and performance goals are directly associated with student performance (Paths 1–3). Consistent with this hypothesis, numerical ability (β = .30, p < .001), logical-mathematical self-efficacy (β = .27, p < .001), and math performance goals (β = .29, p < .001) had a significant direct relationship with math performance.

SCCT posits that self-efficacy would be related to outcome expectations (Path 4) and that self-efficacy and outcome expectations will both have a direct relationship with performance goals (Paths 5 and 6). Those performance goals partially mediate the relationship between self-efficacy and outcome expectations to academic performance. Indeed, logical-mathematical self-efficacy predicted math outcome expectations (β = .21, p < .001), and logical-mathematical self-efficacy (β = .16, p < .001) and math outcome expectations (β = .21, p < .001) had a significant direct relationship with math performance goals. Results also revealed that math outcome expectations had a significant indirect association with math performance (indirect effect .06) and that the total effect of logical-mathematical self-efficacy on math performance was .33.

SCCT also posits that cognitive ability influences student performance indirectly through the mediating paths of self-efficacy (Path 7) and outcome expectations (Path 8). Consistent with this hypothesis, numerical ability was associated with logical-mathematical self-efficacy (β = .31, p < .001), but, interestingly, numerical ability exhibited a negative association with math outcome expectations (β = −.13, p < .01). The indirect contribution of numerical ability to math performance was .09 (p < .001). This result supports that self-efficacy serve to partially mediate the relations of ability and outcome expectations to performance academic. The total effect of numerical ability on math performance was .39.

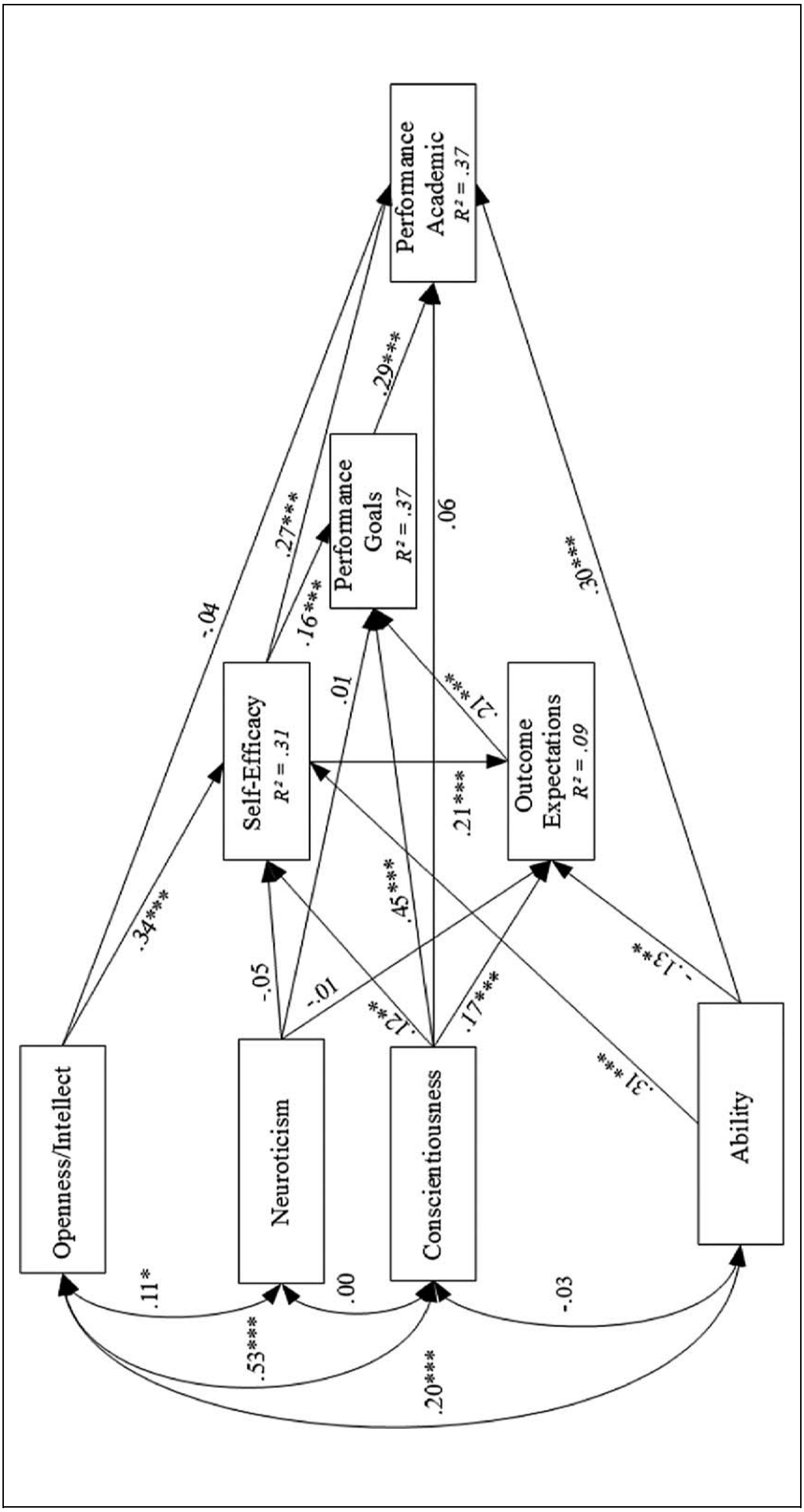

Figure 2. Modified social cognitive career theory relationships tested in the path model. Standardized path coefficients obtained from the combined sample (*Note.* *p < .05. **p < .01. **p < .001).

Table 3. Chi-Square Difference Tests From the Multiple-Groups Model.

Path	χ^2 (1)	p
1. Numerical ability to mathematics performance	.01	.93
2. Logical-mathematical self-efficacy to mathematics performance	1.97	.16
3. Mathematics performance goals to mathematics performance	.61	.44
4. Logical-mathematical self-efficacy to mathematics outcome expectations	3.47	.06
5. Logical-mathematical self-efficacy to mathematics performance goals	.61	.43
6. Mathematics outcome expectations to mathematics performance goals	2.22	.14
7. Numerical ability to logical-mathematical self-efficacy	.36	.55
8. Numerical ability to mathematics outcome expectations	2.46	.12
9. Conscientiousness to mathematics performance	2.82	.09
10. Conscientiousness to logical-mathematical self-efficacy	5.85	.02
11. Conscientiousness to goals to mathematics performance	.05	.83
12. Conscientiousness to mathematics outcome expectations	4.83	.03
13. Openness/intellect to mathematics performance	.19	.66
14. Openness/intellect to logical-mathematical self-efficacy	3.00	.08
15. Neuroticism to logical-mathematical self-efficacy	.22	.64
16. Neuroticism to goals to mathematics performance	4.72	.03
17. Neuroticism to mathematics outcome expectations	.22	.64

Finally, we hypothesized that personality would be directly and indirectly associated with academic performance. Results revealed that conscientiousness and openness/intellect were not directly related with math performance (Paths 9 and 13). However, the hypothesis posing direct paths from conscientiousness to logical-mathematical self-efficacy (Path 10), math outcome expectations (Path 11), and math performance goals (Path 12), was supported. Results revealed that conscientiousness had a direct association with logical-mathematical self-efficacy ($\beta = .12$, $p < .01$), math outcome expectations ($\beta = .17$, $p < .001$), and math performance goals ($\beta = .45$, $p < .001$). The total predictive contribution of conscientiousness was .18. The hypothesis that openness/intellect related to logical-mathematical self-efficacy was supported (Path 14). Openness/intellect had a significant and positive direct association with logical-mathematical self-efficacy ($\beta = .34$, $p < .001$). The total predictive contribution of openness/intellect was .11. The standardized path coefficients for the relationship between neuroticism and logical-mathematical self-efficacy (Path 15), math outcome expectations (Path 16), and math performance goals (Path 17) did not achieve significance.

Multiple Group Analysis: Sex-Related Effects

A multiple group analysis was conducted using separate covariance matrices for girls ($n = 235$) and boys ($n = 296$) and involved running the hypothesized model across both gender groups simultaneously and testing sets of parameters in an increasingly restrictive manner (Kline, 2011). This was accomplished in two steps. First, the analysis was run by comparing girls and boys on the same specified model, without constraining the parameters across groups (model full unconstrained). Second, we compared the two gender groups on the same specified model while constraining the parameters for the 15 path coefficients and 5 covariances to be equal for both girls and boys (model full constrained). Both models exhibited optimal fit values (see Table 2) and the difference between the models was significant (Dif. $\chi^2 = 39.22$, $df = 22$, $p < .01$). These results suggest that at least one of the causal paths proposed in the model vary in male and female students.

Next, we performed χ^2 difference tests for each path by comparing the model unconstrained tested with one in which a path was constrained to invariance across groups. In this way, a series of models were compared in which each path was constrained to equality, one at a time, between the groups (see Table

3). The analysis revealed significant differences across groups in the conscientiousness to math outcome expectations path, the conscientiousness to logical-mathematical self-efficacy path, and the neuroticism to math performance goals path. A subsequent, partially constrained model was fit. All paths, except those found to differ significantly across groups, were constrained to invariance. This model exhibited good overall model fit (see Table 2) and the change in χ^2 between the unconstrained and partially constrained models was not significant (Dif. $\chi^2 = 28.48, df = 19, p \geq .08$). The standardized regression path coefficients for the two groups are displayed in Figure 3, in which only three paths were allowed to vary across the groups.

The analysis revealed that girls had a higher path coefficient than boys in the causal trail connecting conscientiousness and math outcome expectations (girls = .26, boys = .12), although the path coefficient in the boys' sample was not significant. In contrast, males had higher path coefficients than females in the paths connecting conscientiousness and logical-mathematical self-efficacy (girls = .06, boys =.20), although the path coefficient in the girls' sample was not significant. Finally, males had a significant paths connecting neuroticism and math performance goals (girls = .05, boys = −.09), but path coefficient in the girls' sample was not significant. In the girls' sample, the coefficients of determination (R^2) for math performance, math performance goals, logical-mathematical self-efficacy, and math outcome expectation were .39, .38, .29, and .13, respectively. In the boys' sample, the coefficients of determination (R^2) for these variables were .35, .37, .34, and .08, respectively.

Multiple Group Analysis: Effect of the Type of Educational Institution

This analysis was conducted to examine possible differences between students attending state and private schools. The full sample was divided into students who attended state-based ($n = 211$) and private ($n = 320$) educational institutions. We then proposed unconstrained and constrained full models. Although both models exhibited optimal fit values (see Table 2), the difference between the χ^2 indices of both models was not significant ($\chi^2 = 36.65, df = 26, p \geq .08$). These results suggest that the nature of the educational institutional (i.e., public or private) does not moderate the association between the variables.

Discussion

The present work aimed at extending SCCT's model of academic performance (Lent et al., 1994) by incorporating the direct and indirect contributions of personality traits as person inputs (conscientiousness, openness/intellect, and neuroticism). The results indicate optimal data fit model, which explained 37% of the variance in mathematics academic performance of Argentinean middle school students. Consistent with previous research (Lent et al., 1994; Robbins, et al., 2004), the most successful Argentinean middle school students were those that exhibited better math skills and had greater math self-efficacy beliefs. Unlike Brown et al. (2008), we also found that goals were significantly associated with academic performance. This difference may relate to the fact that in Brown et al. (2008), goals were measured as the intention to graduate from college, whereas in the present work they are specifically related to academic performance goals in the math domain.

In accordance with previous work (Brown et al., 2008; Lent et al., 1994), the results suggest that self-efficacy beliefs act as a filter or gateway between skills and academic performance. As previously reported in Hispanic (Fouad & Smith, 1996) and Mexican (Navarro, Flores, &Worthington, 2007) students, we found that self-efficacy and outcome expectations predict performance goals and that self-efficacy are indirectly associated with goals, through outcome expectations. The hypothesis of an indirect contribution of self-efficacy and outcome expectations on academic performance—through the mediating path of performance goals—was also supported. On the other hand, the results

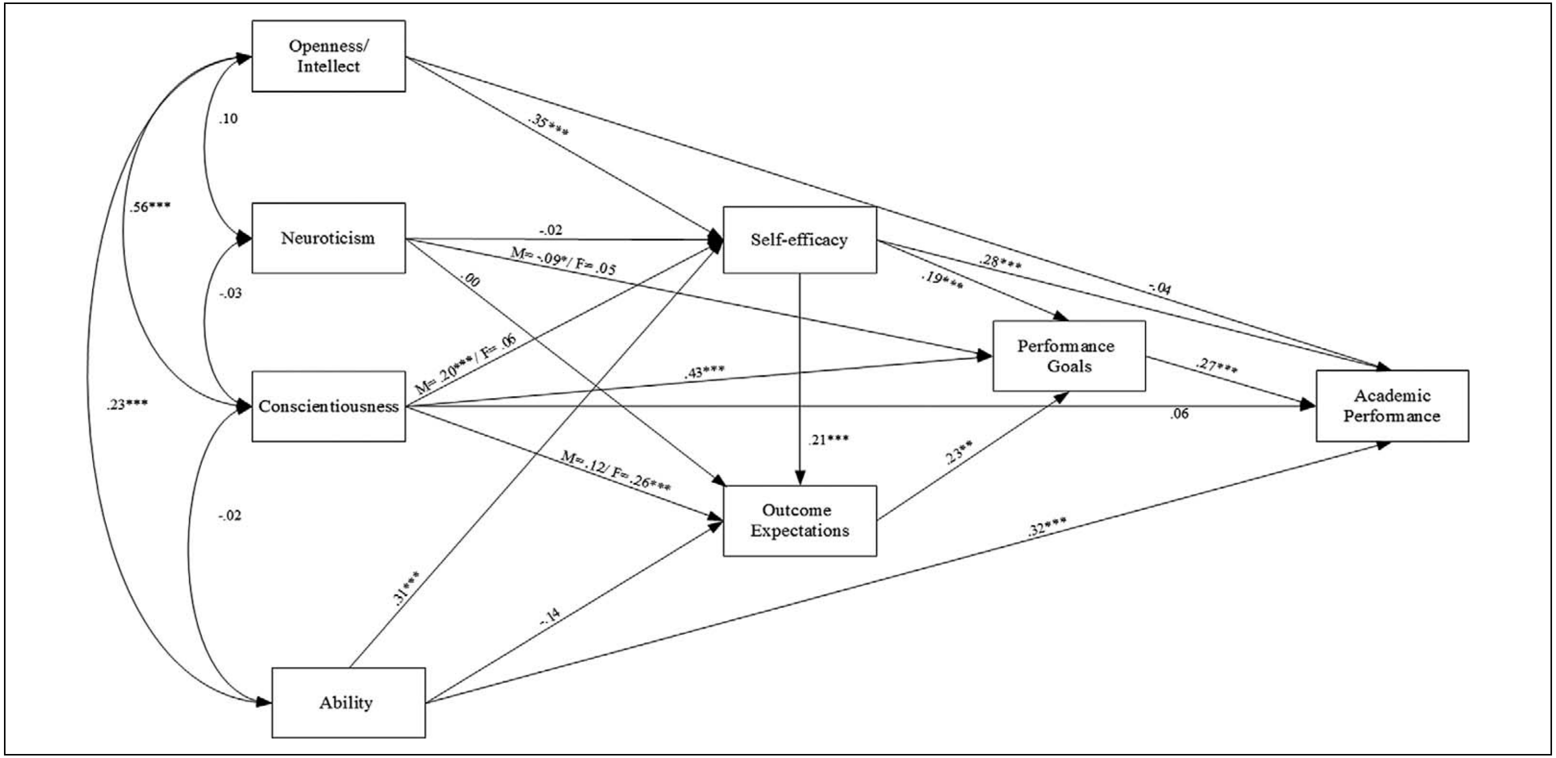

Figure 3. Modified social cognitive career theory relationships tested in the path model. Separate standardized path coefficients for males students (M) and females students (F; *Note.* *$p < .05$. **$p < .01$. ***$p < .001$).

indicate a negative and nonsignificant association between skills and outcome expectations. Previous studies on these variables has yielded inconsistent results, with some reporting significant relationships (Ferry, Fouad, & Smith, 2000), but others not (Cupani, Richaud de Minzi, Pérez, & Pautassi, 2010; Navarro et al., 2007). The social cognitive theory (Bandura, 1986) and the SCCT (Lent et al., 1994) may help account these seemingly contradictory results, as they lack a theoretical link between learning experiences and outcome expectations (Fouad & Guillen, 2006).

We found that personality traits do not have a direct, significant association with academic performance (Paths 9 and 13). The present data, however, are suggestive (also see Rogers et al., 2008; Rottinghaus et al., 2002; Schaub & Tokar, 2005) of an indirect contribution of personality traits through the theoretical paths of SCCT. Indeed, the results suggest that (a) students who exhibited higher conscientiousness scores had higher self-efficacy beliefs, more positive outcome expectations and set more demanding performance goals and (b) students who had higher openness/intellect scores exhibited higher self-efficacy beliefs. It seems that the more responsible and intellectually driven students set higher academic expectations for their performance, had higher confidence in their own abilities, and were likely to achieve better grades because of their persistence in academic activities.

The paths proposed in the model may have varied as a function of sex and type of educational institution. To explore this possibility, the full data set was divided into subsets (for boys and girls, and for students attending private and state-based institutions). Results indicate that, when compared to their boys counterparts, Argentinean high school girls (a) set more demanding math academic goals; (b) are more organized, persistent, and responsible; (c) exhibit higher anxiety, wordiness, and insecurity; (d) have lower outcome expectations in the math domain; and (e) exhibit less confidence in their math skills. The multiple group analysis revealed sex-related differences, although both models exhibited adequate fit. The model explained 34% and 40% of the variance in math academic performance, in the girls and in the boys' sample, respectively. The inspection of the difference between parameters revealed that, as found in previous studies (Lent et al., 2005; Navarro et al., 2007), there was no sex-related differences in the theoretical relationships postulated by SCCT. There were, however, significant sex-related differences in the relationship between personality traits and sociocognitive variables. Argentinean high school girls who are more organized, persistent, and responsible exhibit higher math outcome expectations than their male peers. On the other hand, boys who are more organized, persistent, and responsible have higher math self-efficacy scores. To a lower extent, the more emotionally unstable boys set less demanding academic goals.

A multigroup analysis revealed that the paths proposed in the model did not significantly vary as a function of type of educational institution. The model, however, explained 45% and 28% of the variance in the sample of students attending private- and state-based institutions, respectively. This suggests that academic success in math in public institutions is not as dependent on skills or self-efficacy on those skills as it is on private schools. Further studies will be needed to elucidate which socioenvironmental factors (e.g., paternal support) influence the emergence of academic success in students attending the state-based system.

One limitation of generalizing these findings relates to the representativeness of the sample, which only featured students from lower- and upper-middle class. Therefore, the results should not be generalized to students from low or high socioeconomic status. Likewise, a limitation of the study is the cross-sectional survey design. Future research should examine other populations with the same model to examine its generality across different populations. Another major limitation is that the measurement for academic achievement in mathematics was obtained through nonstandarized class tests, which can be obviously influenced by the idiosyncratic policies of each institution or instructor. Future studies should use a more standardized measure of mathematics academic performance.

The present study has several theoretical and practical implications. It adds to a growing trend that aims at unifying cognitive, social, and personality traits to explain vocational and educational behavior (Rogers et al., 2008; Rottinghaus et al., 2002; Schaub & Tokar, 2005). Moreover, Lent et al. (2001) argued for the need to examine the validity of the SCCT in culturally diverse groups. The study tested SCCT in a new cultural context, thus providing cross-cultural support for the theory. It is also important that the study tested their hypotheses during high school. During this developmental stage, students begin to take academic decisions that shape their professional future, thus rendering it particularly suited for educational interventions (Fouad & Smith, 1996). Research conducted in Western contexts has identified intrapersonal factors associated with academic performance (Robbins et al., 2004). The present results suggest that these factors exert similar influence in Argentinean high school students.

The results have practical implications for the design of research-based educational and vocational interventions. The findings obtained in a sample of Argentinean high school students suggest that skills are necessary, but not sufficient, for students to achieve academic success. They also need to develop a sense of self-efficacy to regulate their learning process and assess the likely consequences of performing particular behaviors. Educational institutions could use this knowledge to screen students who exhibit diminished academic self-efficacy and design interventions to enhance this variable. For example, individuals who exhibit low mathematics self-efficacy could work with peers who excel in mathematical problem solving (vicarious learning) or engage in a sequence of progressively more complicated mathematics tasks (performance accomplishments) while receiving encouragement and support (verbal persuasion). They could also benefit from interventions that decrease the anxiety they may experience when exposed to mathematics-related activities (emotional arousal).

Doubts have been raised about the possibility of personality traits being susceptible to educational intervention (Conard, 2006). Students, however, could be taught the cognitive and behavioral concomitants of exhibiting a given trait (Brown, Ryan, & McFarland, 1996). An even more optimist viewpoint posits that conscientiousness-like behaviors could be trained, as if they were skill clusters. For example, students with low conscientiousness scores could be trained in cognitive strategies aimed at enhancing their abilities to establish goals, make plans to achieve those goals, and monitor progress toward them. In other words, the rationale is to train low-level traits that serve as a foundation for more broad personality traits (McCrae & Costa, 1997). A possible intervention would be to train students in time-management skills through the use of daily planners or software-based organizers (Kaufman, Agars, & Lopez-Wagner, 2008).

In summary, the results are generally consistent with the previous literature and suggest that academic performance is best predicted when intelligence, motivational and personality variables are included as predictors (Lowman, 1991). The results also suggest that SCCT's original theory (Lent et al., 1994) is a flexible model that can easily integrate other important psychological theories, such as the five factors theory of personality.

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