Journal of Family Psychology
2005, Vol. 19, No. 2, 286–293

0893-3200/05/$12.00 DOI: 10.1037/0893-3200.19.2.286

Perceptions of Parental Involvement and Support as Predictors of College Students' Persistence in a Science Curriculum

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As technological and scientific skills are increasingly needed, finding that science students encounter significant problems in their academic program causes serious concern. The authors examined how perceived parental involvement and support predict college students' persistence in science based on J. P. Connell and J. G. Wellborn's (1991) theoretical model: Perceived parental involvement and support should foster student persistence by promoting students' competence, autonomy, and relatedness. Results suggest that perceived parental autonomy supports predicted scientific persistence partly through students' autonomy. Perceived parental involvement, although unrelated to persistence, was a significant predictor of autonomy and relatedness. Results suggest that perceived parental involvement and support have specific roles in predicting student self-processes and achievement, highlighting the importance of sustaining parents' contribution for college students.

Keywords: self-determination, motivation, persistence, education, parental style

Our society is confronted with a pressing need for graduates of science and technology programs (Statistics Canada, 2001). Indeed, technological and scientific skills and knowledge are increasingly needed for the development and growth of companies in, for example, biochemical and pharmaceutical industries. However, demographic trends suggest that many specialized workers will be leaving the workforce in the near future. Students in science programs encounter several obstacles, often failing courses, changing programs, or even dropping out (Fédération des cégeps, 1999). Canadian and American statistics reveal that 30% to 40% of college students enrolled in a science program abandon science before obtaining their degree (Ministère de l'éducation du Québec, 2003; Seymour & Hewitt, 1997). Given society's growing needs for workers in scientific and technological fields, and given that these programs are difficult and demanding, supporting the academic adjustment and success of science students constitutes a genuine challenge for colleges and universities.

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This research was supported by Grant 00-RS-69987 from Fonds pour la Formation des Chercheurs et l'Aide à la Recherche (FCAR-Québec). We would like to acknowledge the valuable help of Nathalie Soucy and Marylou Harvey in collecting and entering the data as well as the numerous college professors who helped in administering the questionnaires at Time 1. Finally, we thank the participants for agreeing to take part in this project.

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Studies have examined individual factors that can explain how young adults adjust and succeed during the transition to college or university (Deboer, 1985; Johnson & Butts, 1983). Our focus is on how perceived parental involvement and support enhance adaptive processes in the transition to college science programs, which are known for their high level of difficulty. It has been found that parents are important in a student's decision to persist in science studies (Seymour & Hewitt, 1997), but few studies have examined how family and personal factors combine to explain students' persistence in a science program. Thus, the goal of this study was to examine the dynamic interplay between family and personal determinants of persistence in a college science program.

The transition to college or university can be quite challenging for students and can create a significant level of stress, emotional problems, and maladjustment (Cutrona, 1982). Family support can play a tremendous role in helping young adults to successfully adapt to college or university by buffering the negative effects of transition (Holahan & Moos, 1981). Studies have focused mostly on the role of variables such as social support (Holahan, Valentier, & Moos, 1994) and attachment (Kenny & Donaldson, 1991).

Research on parenting has identified two important dimensions that contribute to student achievement and success (see Grolnick, 2003). *Parental involvement* refers to providing resources to their child, in the form of spending time with the child and being interested and attentive to the child, as well as providing emotional resources. Parents' involvement usually benefits student learning and achievement (Soucy & Larose, 2000; Strage & Swanson Brandt, 1999). *Parental autonomy support* refers to the affirmation of the child as a unique, active, and volitional being and is evidenced in behaviors such as acknowledging the child's

perspective, encouraging independent thinking, and providing opportunities to make choices. Parents' support of their child's autonomy predicts self-regulation, competence, and achievement at school (see Grolnick, 2003). For students in science, these two parental dimensions were found to predict important academic outcomes, such as performance and achievement, as well as positive attitudes toward science (George & Kaplan, 1998; Hein & Lewko, 1994; Seymour & Hewitt, 1997).

In line with Connell and Wellborn's (1991) model, we proposed that parents' protective role is explained by the fact that parental behaviors that are perceived as involved and autonomy supportive will contribute to the satisfaction of young adults' developmental needs for autonomy, competence, and relatedness; that is, the satisfaction of these psychological needs mediates the relation between perceived parental involvement and support and students' persistence in science. Connell and Wellborn proposed that individuals have innate psychological needs for autonomy (i.e., the desire to be at the origin of one's behaviors), competence (i.e., the desire to interact with one's environment in an efficient way), and relatedness (i.e., the desire to be accepted by significant others). The satisfaction of these needs, by promoting feelings of autonomy (or self-determination), competence, and relatedness, predict adaptive patterns of cognitions, behaviors, and emotions. Hence, by being perceived as involved and autonomy supportive, parents will promote the satisfaction of students' psychological needs in the school context. Need satisfaction will in turn enhance students' persistence in a science program.

The mediating role of need satisfaction has been supported in studies by Grolnick and her colleagues (e.g., Grolnick, Ryan, & Deci, 1991; Grolnick & Slowiaczek, 1994), where the relation between perceived parental involvement and support and students' school performance was mediated by feelings of autonomy and competence. However, previous attempts at predicting academic success or persistence usually emphasized one, or a subset of, the proposed determinants (e.g., autonomy support), which ignores the interplay among all three variables (competence, autonomy, and relatedness). Furthermore, such a mediational model of academic functioning has not been examined with respect to persistence in science and technology training.

Indirect support for components of our mediation model of persistence in science is provided by a study by Reynolds and Walberg (1992), who found that parental involvement predicted intrinsic motivation and persistence, which in turn predicted achievement in science through their impact on other academic and social variables. However, their study did not examine other self-processes (i.e., feelings of competence and relatedness). We believe that our study will add to the existing literature by providing a more thorough examination of the interplay between family and individual factors and their relation to persistence in science.

In testing our model, which is based on Connell and Wellborn's (1991) theoretical model, we face a potential bias because we used students' perception of parental dimensions instead of parents' self-evaluations. However, Schwartz, Barton-Henry, and Pruzinsky (1985) found that, in evaluating parental autonomy, the validity and reliability of parents' self-reports were lower than those of evaluations by their children or spouse, suggesting that parents are the least objective sources of information. Findings by Gonzalez, Cauce, and Mason (1996) suggested that adolescents' evaluations of maternal support and control were more valid than mothers' self-reports when compared with ratings provided by observers (see also Sessa, Avenevoli, Steinberg, & Morris, 2001). Another important issue relates to the role of variables such as socioeconomic status (SES) and academic achievement when examining relationships among the variables in our model. Because previous research (e.g., Newcomb et al., 2002) has found that low SES and poor academic performance are predictors of academic failure and dropout, an important question is whether perceived parental involvement and support and need satisfaction can predict persistence in science above and beyond the contributions of academic achievement and family SES.

The goal of the present study was to test a model of persistence in science that posits that perceived parental involvement and support predict persistence in science over time because they promote students' feelings of autonomy, competence, and relatedness at school. It is important to note that the mediating role of perceived autonomy, competence, and relatedness is examined while including academic achievement and family SES as control variables. Also, because we wanted to examine the role of perceived parental style on student outcomes, we used the most objective measure of parental involvement and support (i.e., children's perspective).

Method

Participants

Participants were 729 young adults (373 females, 356 males) who were recruited in their last year of high school, throughout the province of Quebec, to take part in a longitudinal study on scientific workforce renewal in Quebec. This article analyzes a portion of the data from that study. Participants' mean age was 17 years (SD = 1.47, range = 16 to 22), and most of them were French speaking (680 participants; 97%). The majority of these students lived with their parents (498 participants; 71%).

Measures

SES: Time 1 (T1). SES is a compound measure of family income and parents' education level. Both measures were scored on a 6-point scale: Answers for income ranged from 1 (*CAN $0–9,999*) to 6 (*CAN $50,000+*), and answers for parents' education ranged from 1 (*uncompleted elementary school*) to 6 (*university studies*). Average income was CAN $20,000–$29,999, and the majority of parents held a high school diploma.

Achievement in science: T1. This measure is a compound of students' self-reported high school marks in chemistry, physics, and biology and was scored on a 7-point scale ranging from 1 (*less than 60%*) to 7 (*95%–100%*). Average achievement in science was between 80% and 84%.

Perceived parental autonomy support: Time 2 (T2). This unidimensional scale assesses students' perceptions of their parents as

autonomy supportive in relation to their decision to pursue studies in science at the college level. Items (eight) were adapted from Paulson, Marchant, and Rothlisberg (1994) and from Robinson et al. (1995). Students indicated on a 5-point scale (1 = *totally disagree*, 5 = *totally agree*) whether they agreed with items such as "My parents allowed me to have my own point of view regarding my choice of program." These scales were found to be reliable in the past, with alphas ranging from .71 to .86 (Chipman, Olsen, Klein, Hart, & Robinson, 2000; Paulson, 1994; Paulson et al., 1994; Robinson et al., 1995), and in the present study, a Cronbach's alpha of .88 was obtained.

Perceived parental involvement: T2. This unidimensional scale assesses students' perceptions of their parents' involvement in their vocational process. This 10-item scale, adapted from Barnes and Olson (1992), was scored on a 5-point scale (1 = *totally disagree*, 5 = *totally agree*) and included items such as "It was easy for me to express my true feelings to my parents when the issue was about my choice of program. " This measure was found to be reliable in the past (αs = .77 to .80; Barnes & Olson, 1992) and, in the present study, yielded a Cronbach's alpha of .90.

Feelings of competence: T2. We used the Perceived Competence Scale (Losier, Vallerand, & Blais, 1993) to assess participants' feelings of competence in their science courses in college. This scale used a 7-point scale ranging from 1 (*totally disagree*) to 7 (*totally agree*) and included items such as "I experience difficulties in doing my schoolwork well." This scale evidenced validity and reliability in the past (i.e., α = .81 and .87; Losier et al., 1993) and in this study (α = .88).

Feelings of autonomy: T2. Autonomy was assessed using the Academic Motivation Scale (AMS; Vallerand, Blais, Brière, & Pelletier, 1989). This multidimensional scale assesses five different types of reasons (four items each) for undertaking a science program, each varying in its level of autonomy. Participants indicated, on a 7-point scale, the extent to which they are pursuing their college science program for intrinsic motivation (e.g., "For the pleasure and satisfaction of learning new things in this program"), identified regulation (e.g., "Because I think that this program will help me better prepare for the career I chose"), introjected regulation (e.g., "To prove to myself that I can succeed in this program"), external regulation (e.g., "Because this program will allow me to get a profitable job later"), and amotivation (e.g., "Honestly, I don't really know; I really have the impression that I'm wasting my time"). The AMS was found to be reliable and valid in the past (αs = .70 to .89; Vallerand et al., 1989). In the present study, Cronbach's alphas ranged from .75 (identified regulation) to .95 (intrinsic motivation). We used the Self-Determination Index, which has been successfully used in past research (Blais, Sabourin, Boucher, & Vallerand, 1990; Grolnick & Ryan, 1987). With the Self-Determination Index, a relative weight is assigned to each motivation subscale and the Weight × Motivation scores for each subscale are combined in a single score that reflects overall self-determination (autonomy) at school. The following formula is used: academic self-determination index = (2[intrinsic motivation]) + (1[identified regulation]) − (introjected regulation + external regulation)/2) – (2[amotivation]).

Feelings of relatedness: T2. Students' feelings of institutional attachment were assessed using the French version (Larose, Soucy, Bernier, & Roy, 1996) of the Student Adaptation to College Questionnaire (Baker & Siryk, 1989). This 10-item scale, scored on a 9-point scale (1 = *does not apply to me at all*, 9 = *perfectly applies to me*), includes items such as "I feel that I fit in well as part of the college environment." This scale was found to be reliable in the past, with alphas ranging between .81 and .91 (Baker & Siryk, 1989). A Cronbach's alpha of .90 was obtained for the present study.

Persistence in a science program: Time 3 (T3). Colleges provided data on the students' continued enrollment in the third year. We found that 31% of the students switched out of science.

Procedure

Several colleges were contacted to participate in a study on scientific workforce renewal. In Quebec, high school students attend college before entering university. College science programs require 2 or 3 years to complete, and the curriculum is composed mostly of science courses. Each college was asked to identify a sample of students that had been accepted to a science program for the following academic year and to mail the T1 questionnaire to them. The T2 and T3 questionnaires were either sent by mail or completed in college in subsequent years. This project was approved by the ethics committee at Laval University, and written consent was obtained at T1 from all participants (and their parents) who were minor at the initial phase of data collection. We provided college officials with each student's name and anonymous code, which was used for the identification of their data, and asked them to return to us a sheet containing anonymous codes matched with data on persistence. We had previously informed participants that we would ask the colleges for this information, and all of them agreed to this request. Of the initial sample (N = 729), we were able to obtain complete data from 262 participants on all measures, which represents a 36% response rate. We performed a multivariate analysis of variance to examine whether students who completed all measures differed from those for which we only have T1 data. A significant multivariate effect suggested that these two groups of participants differed on several measures; Wilks λ (4, 696) = 0.97, $p < .01$. Univariate tests suggested that students who completed all measurement times were mostly female and had higher grades in science (4.35 vs. 3.97) and came from families with higher SES (income: 3.37 vs. 3.07; parents' education level: 4.70 vs. 4.51) than did students who completed only T1 measures (all ps $< .05$). However, the size of these univariate effects was quite small (explaining 1%, 2%, 1%, and 1% of the total variance, respectively; Cohen, 1977).

Results

Preliminary Analyses and Gender Differences

First, results suggested no major violations of statistical assumptions. Some univariate outliers were found, and in line with Tabachnick and Fidell (1996), we brought these cases closer to the mean by assigning to them a value that is within the 3-*SD* boundary. Then, multivariate normality was examined, revealing the presence of 10 outliers, which were deleted.

Second, gender differences were examined using a multivariate analysis of variance where a significant Wilks's Lambda (value = .88, df = 9,260, $p < .05$) suggested that male and female students scored differently on several variables of the model. Univariate tests indicated that female students had less educated parents (M = 4.52), perceived more parental involvement (M = 4.30), and reported higher levels of relatedness (M = 7.42) than did male students (M = 4.71, 4.09, and 7.03, respectively), Fs(1, 268) = 7.70, 12.38, and 9.62 (all ps $< .05$). However, the size of these univariate effects was small (explaining 3%,

4%, and 3% of the total variance, respectively). It might be interesting to test whether the model applies equally to male and female students, but the small magnitude of gender effects suggests that controlling for the variance explained by gender might be unnecessary.

Perceived Parental Style and Student Achievement and Persistence

Before testing the model, we examined the relations among perceived parental involvement and support, student achievement and persistence, and need satisfaction (see Table 1). Perceived parental involvement and support were positively associated with science achievement (rs = .14 and .20, respectively, ps $< .05$). We found that perceptions of parental autonomy support was a positive predictor of persistence almost 2 years later ($r = .23$, $p < .05$) but that perceived involvement was unrelated to persistence in science ($p > .05$). Finally, perceptions of both parental involvement and support were positively associated with feelings of competence, autonomy, and relatedness (rs ranged from .21 to .31; ps $< .05$).

Testing the Model

The proposed model was analyzed by means of a hybrid structural equation model that includes measurement and structural components (Kline, 1998). The model has six latent variables: perceived parental autonomy support, perceived parental involvement, relatedness, competence, and autonomy toward the scientific program. Each factor was scaled by fixing one factor loading to 1.0. Control variables (i.e., achievement and SES) were incorporated into the model. Autonomy was assessed with four autonomy indices (labeled AUT1, AUT2, AUT3, and AUT4 in Figure 1). To compute theses four indices, items for each subscale were weighed to reflect their respective level of self-determination, in line with the formula presented in the Method section. These motivational indices thus represent students' relative level of autonomy, with higher scores indicating higher levels of intrinsic motivation and identified regulation relative to external and introjected regulations and amotivation. A similar approach was adopted for other factors, where items were averaged to create 3–4 indicators per factor, depending on the number of items per scale. This procedure reduces the number of indicators per factor, resulting in a more valid and reliable assessment of indicators (Marsh & Yeung, 1997). Indicators were centered to forego collinearity problems (Kline, 1998).

First, we tested the model without estimating mediation effects where perceived parental involvement and support predict autonomy, competence, and relatedness, which in turn predict persistence. Results revealed a significant chi-square ($p < .001$), and fit indices were satisfactory (nonnormed fit index [NNFI] = .96, comparative fit index [CFI] = .97, root-mean-square error of approximation [RMSEA] = .05; χ^2/df ratio = 1.54). Second, we tested a mediation model that includes direct links from perceived parental involvement and support to persistence, allowing us to determine whether students' need satisfaction mediates the relation between perceived parental style and persistence. A significant chi-square was obtained ($p < .001$), and model fit indices were satisfying (NNFI = .96, CFI = .97, RMSEA = .04; χ^2/df ratio = 1.51). A chi-square difference test was performed to determine whether the mediation model was significantly different from the first one. A significant difference ($\chi^2_{\text{diff}} = 8.50$, $df = 2$, $p = .01$) was obtained, suggesting that the mediation model is more adequate.

The results of this mediation model, with only the significant paths, are presented in Figure 1. For the sake of clarity, paths for control variables (SES and achievement) are not shown, although they were included in the model. Results reveal that indicators loaded positively and strongly on their predicted factor and were all statistically significant (all ps $< .05$). Measures of relatedness, competence, and autonomy were all positively and significantly related (covariances ranged from .26 to .62). In addition, results indicated that perceived parental autonomy support positively predicted students' autonomy ($\beta = .18$, $p < .05$) and competence in science ($\beta = .16$, $p < .10$). Perceived parental involvement positively predicted relatedness ($\beta = .31$, $p < .05$) and autonomy toward the science program

Table 1
Correlations, Means, and Standard Deviations for the Model Variables

Measure	1	2	3	4	5	6	7	8
1. Parental involvement[a]	—	.34***	.28***	.24***	.31***	.03	.14*	.05
2. Parental autonomy-support[a]		—	.21***	.24***	.31***	.23***	.20**	−.14*
3. Relatedness at school[b]			—	.32***	.40***	.27***	.15**	.16**
4. Scientific competence[c]				—	.61***	.30***	.50***	.04
5. Self-determination in program[c]					—	.32***	.26***	.02
6. Persistence in science						—	.31***	.02
7. High school achievement in science[c]							—	.08
8. Family SES[d]								—
M	4.20	4.35	7.24	4.90	7.97	0.79	4.35	4.06
SD	0.59	0.56	1.16	1.32	5.79	0.41	1.35	1.01

Note. $n = 261$. SES = socioeconomic status.
[a] Used a 5-point scale; [b] used a 9-point scale; [c] used a 7-point scale; [d] used a 6-point scale.
* $p < .05$, two-tailed. ** $p < .01$, two-tailed. *** $p < .001$, two-tailed. $p < .05$, one-tailed.

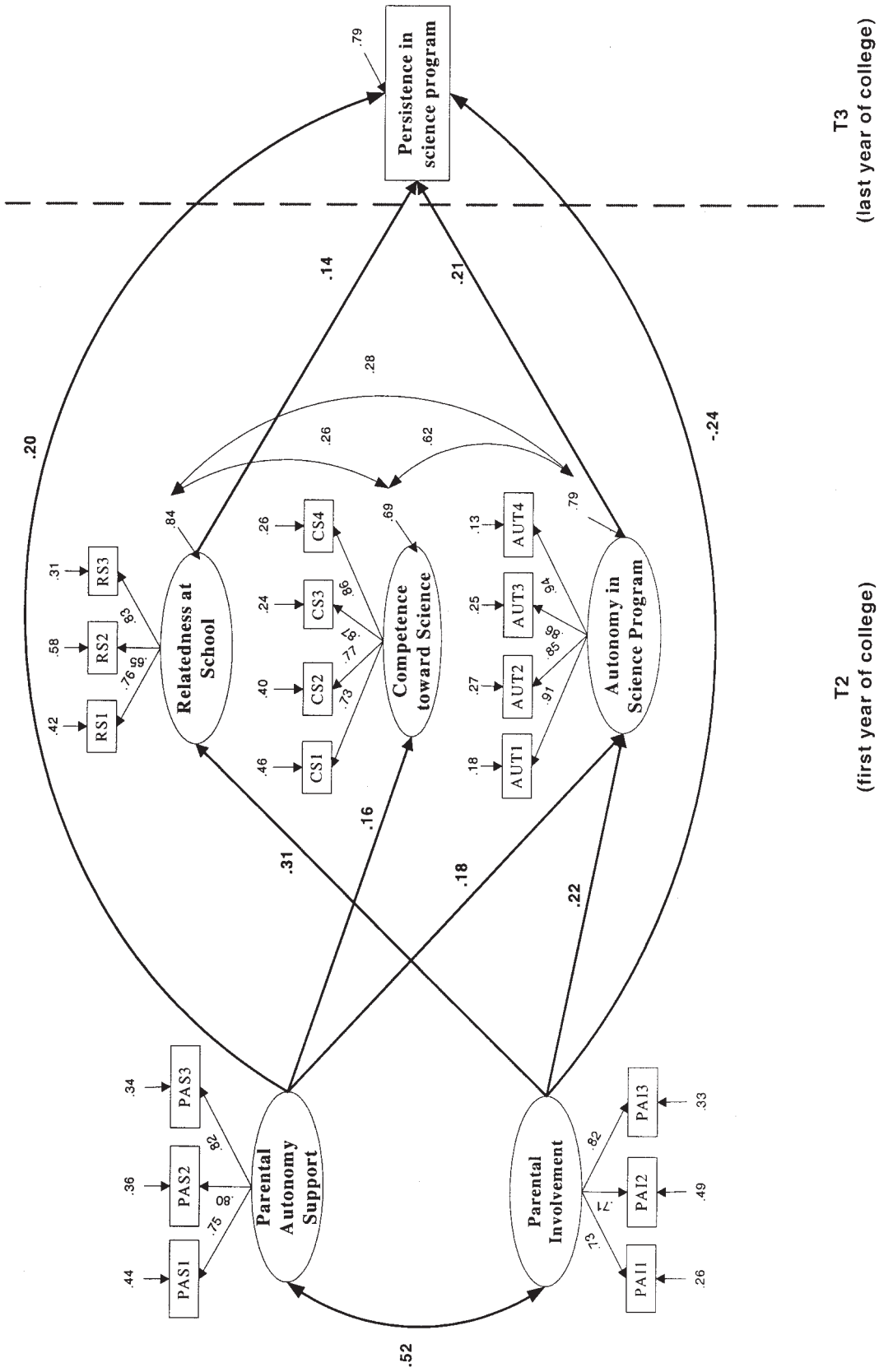

Figure 1. Results obtained for the model. Control variables are not shown in the figure, but they were included in the model as exogenous variables.

($\beta = .22$, $p < .05$). Persistence in a science program was predicted by perceived parental autonomy support ($\beta = .20$), relatedness ($\beta = .14$), autonomy toward the science program ($\beta = .21$), and perceived parental involvement ($\beta = -.24$; all ps $< .05$, except for relatedness, which was marginal).

Interpretation of this last finding should be made with caution, keeping in mind the issue of collinearity between perceived parental autonomy support and involvement, especially given the absence of a direct relation between perceived parental involvement and persistence (see Table 1 for correlation coefficients). Results suggest that perceived parental involvement acted as a suppressor variable in the statistical model. Suppression is a statistical phenomenon that can occur in regression analyses when two predictors are strongly correlated. In such cases, the relation between two variables will be artificially inversed (Cohen & Cohen, 1983). According to Maassen and Bakker (2001), suppression can occur in structural equation modeling, and the probability of occurrence is relatively high in models that have latent variables. The fact that perceived parental involvement was not significantly correlated with persistence at the bivariate level suggests that the negative path from perceived parental involvement to student persistence is a spurious one.

Control variables, used as exogenous variables predicting all variables of the model, were related to some variables. Specifically, both achievement and SES (which were significantly correlated; $r = .21$, $p < .05$) were significantly related to perceived parental autonomy support ($r = .16$ and $-.22$, respectively, ps $< .05$). With respect to the paths from SES and achievement to need satisfaction, we did not find significant relations for SES, but the paths from achievement to competence and autonomy were both positive and significant (βs $= .46$ and $.22$, respectively; ps $< .05$). Finally, achievement predicted persistence ($\beta = .17$, $p < .05$).

Discussion

Results of this study reveal that perceived parental autonomy supports predicted students' persistence in a science program in part through the mediating role of students' feelings of autonomy and competence; that is, students' competence and autonomy *partially mediated* the relation between their perceptions of parental autonomy support and their persistence in a science program. These findings also suggest that perceived parental involvement, while predicting self-processes such as relatedness and autonomy feelings, is not directly related to persistence in science.

The results obtained in this study have important implications for parenting, motivation, and education, especially when it comes to training in science. Whereas a large portion of the parenting literature focuses on childhood and early adolescence (e.g., Grolnick et al., 1991), in line with an emerging literature on the role of parents during late adolescence/young adulthood (Holahan & Moos, 1981), our findings show that parents can still be important in promoting beneficial outcomes in their children's education at the college level. Whereas previous research dealt mainly with the role of parents' social support and attachment (Holahan et al., 1994; Kenny & Donaldson, 1991), we found that perceived involvement and support from parents are also important for student functioning and persistence at school.

Our findings provide a window on the psychological mechanisms underlying parents' role in sustaining students' academic persistence. Connell and Wellborn's (1991) model suggests that outcomes such as academic persistence can be influenced by self-processes of competence, autonomy, and relatedness. A family environment that is perceived as involved and autonomy supportive will promote the satisfaction of students' basic psychological needs, which will increase their perseverance at school. Few studies had previously examined academic persistence using Connell and Wellborn's theoretical framework. In the present study, we provided partial empirical support to this theoretical model, where need satisfaction mediated the relation from perceived parental autonomy support to persistence but not the one from perceived parental involvement to persistence. Thus, perceived parental involvement appears to be a predictor of student self-processes but not of their outcomes (such as persistence).

Although previous research found that self-processes mediate the predicting role of perceived parental support on student outcomes, we found support for partial mediation. This difference might be due to the fact that we used a different indicator of student success (studies by Grolnick et al., 1991, used performance) or that we used a different sample (composed of young adults instead of children). Hence, perceived parental autonomy support might enhance student persistence through means other than feelings of autonomy, competence, and relatedness. Future research is needed to identify other potential mediators such as students' attitudes toward science (see Reynolds & Walberg, 1992).

It is important to consider the limitations of the study when interpreting the findings. First, perceived parental involvement acted as a suppressor in our model, suggesting that the negative link between this construct and persistence is merely a statistical artifact. Although perceived parental involvement was not a direct determinant of persistence in science, our findings nevertheless identified this variable as a predictor of student self-processes. Second, several measures included in this study were self-reported, which may induce bias. By asking students to report how they perceived their parents, we might generate uneasiness in revealing how controlling versus supportive their parents are. However, previous research found children's perspective to be highly reliable and valid (see Gonzalez et al., 1996). Third, perceptions of parents were obtained at T2, retrospective on T1. Even so, Brewin, Andrews, and Gotlib (1993) have shown that using retrospective reports to assess sensitive or negative family information can be reliable and valid. Fourth, it is possible that our sample does not represent the entire student population in science programs. Thus, replication is needed to support such a claim. Fifth, we did not control for variability due to college achievement, which should contribute to college persistence. Fi-

nally, our design is correlational and does not allow the formulation of causal conclusions.

In terms of more practical implications, our findings suggest that educating parents to be supportive of their child's autonomy is an important contribution that college teachers can have in promoting students' persistence. Specifically, parents can be autonomy supportive by acknowledging their child's feelings during this stressful transition period and encouraging them to form their own opinions and to weigh positives and negatives without imposing their own opinion on them. We also found that perceptions of parental involvement are important for student functioning. Parents display their involvement by spending time with their child and showing interest in what is happening in their child's life during this transition period. Perceiving these parental behaviors is important for students to feel autonomous, competent, and connected at school and, ultimately, to persist in a difficult program such as science or technology. Moreover, school officials and professors could provide parents with more information on students' reality (e.g., describing the demands of the program and the students' work load) to make it easier for parents to identify ways to get involved and provide autonomy support during this transition to college. Intervention could also be implemented on a large scale; for example, the Education Bureau could implement campaigns to raise parents' awareness of the importance of continuing to contribute to their children's academic success after adolescence.

Studying science is demanding and requires high levels of abstract thinking. Science students must therefore be highly committed to their program. As such, our findings suggest that students' persistence in science can be greatly reinforced when parents are perceived to be involved and autonomy supportive in relation to their child's commitment to a science program.

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Received October 7, 2003
Revision received June 2, 2004
Accepted June 22, 2004 ■