A Longitudinal Study of the Effects of Context and Experience on the Scientific Career Choices of Canadian Adolescents*

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*This research was partly supported by Social Sciences and Humanities Research Council (SSHRC) Funding Grant.

Abstract

A longitudinal study was conducted on a sample of Canadian adolescents to track changes in science/math career choice development over a five-year span and to examine the impact of contextual and experiential factors on later choices. A previous study (Urajnik, Garg, Kauppi, & Lewko, 2007) explored the differential utility of contextual and experiential factors in the prediction of scientific career aspirations using data obtained from a national sample (n=3,306) of Canadian adolescents (13-19 years) who participated in the National Youth and Science Project Study (NYSPS). For the current study, five years after the initial data collection, 116 of the original participants were contacted to determine their field of study or nature of work (science or non-science). Results from a cross-tabulation of gender and career choice showed a significant difference between males and females in stability of career choice. Approximately 64% of males, but only 41 % of females, remained with their original science career choice. The main reasons cited by both males and females for moving away from a science career were a change in interests, difficulty with science and math courses, and the influence of work placement. Sequential logistic regression results indicated that measures of learning experiences, self-efficacy, outcome expectations, and interests contributed significant unique variance to the prediction of scientific career choice five years later. Learning experiences had the most influence on the career choice model. It affects career choice both directly and indirectly through self-efficacy, outcome expectations, and interests and explains 28% of the variance.

Introduction

Lent, Brown, and Hackett (1994) formulated a social cognitive model of career development derived from Bandura's (1986) general social cognitive theory that illustrates the interplay among personal, background/contextual, and experiential influences on career development. It focuses on dynamic mechanisms through which young people forge academic and vocational plans. The model includes personal input variables comprising personal characteristics such as gender, background/context variables comprising environmental characteristics such as parent and family influences, and learning experiences comprising variables such as objective performance, school experiences and role-modeling experiences. These variables shape and inform career-related self-efficacy (e.g., perceived task competence) and outcome expectations (e.g., anticipation of certain outcomes, such as self-satisfaction and financial reward). Self-efficacy and outcome expectations along with personal and contextual variables play an important role in the formation of interests and career goals. Figure 1 summarizes the social-cognitive career choice model proposed by Lent et al. (1994).

Relatively few studies have examined the theoretical constructs of the Lent et al. model from a domain-specific perspective (Ferry, Fouad, & Smith, 2000) and with samples other than college students (Fouad & Smith, 1996; Lopez et al., 1997; Plucker, 1998; Wang & Staver, 2001). Urajnik, Garg, Kauppi, and Lewko (2007) investigated the differential utility of contextual and experiential factors from Lent, Brown, and Hackett's (1994) social cognitive model of career choice in the prediction of scientific career aspirations prior to college entry. Data were obtained from a sample of Canadian adolescents (13 to 19 years) randomly selected from schools across Canada. The authors used the following variables in the study: person inputs included gender, grade-level, and primary language (English or French); background/context factors included socio-economic status, family cohesiveness, family social/scientific communication, family career encouragement, and parent scientific expectations/encouragement; learning experiences included science/math grades, perceptions of science/math teachers, and friends' interest in science; experiential constructs were self-efficacy, outcome expectations, and interests. Multivariate logistic regression analyses carried out in the Urajnik et al. (2007) study indicated that family background, scientific learning experiences, self-efficacy measures, outcome expectancies, and scientific interests contributed significant variance to the prediction of aspirations for pursuing a scientific career choice. Results of a final model revealed that students aspiring to a career in the sciences were more likely than their peers to be male, senior students, to have higher grades in science, were more interested in science, and expected their science courses to be useful to their future career.

Although Urajnik et al. (2007) contributed significantly to career development research by demonstrating the usefulness of the Lent et al. (1994) model for a sample of Canadian adolescents in the context of science career choice, their study was cross-sectional in nature and the outcome variable was career aspirations rather than actual career choice. Longitudinal inquiry into career development is useful in that it can provide a theoretical understanding of the role that early aspirations play in determining career-related choices made later on (Rojewski & Yang, 1997; Ferreira et al., 2007). Vocational development is longitudinal in scope (Lent et al., 1994, 2000, 2001, 2002; Super et al., 1996; Schoon, 2001; Athanasou, 2002; Nauta & Epperson, 2003; Lent & Brown, February 2006). It is a process of nurturing interests, making choices, experimenting with and adjusting to those choices, and making more choices. Thus, to gain deeper understanding of this process, tracking changes in career choice over time and investigating the reasons for those changes is essential. It is equally important to identify and understand how proper contextual factors predict future choices. Timely and effective interventions to help challenged individuals overcome barriers and move forward with their choices depend on this knowledge.

Relatively few studies have followed changes in science/math career choice development and examined the later effects of contextual and experiential factors for high school students as they progress into post secondary education or the work place. Nauta and Epperson (2003), exploring gender issues in career choice development, have applied the social cognitive model used by Lent et al. to high school girls' choice of science/math/engineering college majors 3 to 5 years later. They found that high school math and science ability were central to making a choice to pursue a science career.

The present longitudinal study is built upon the earlier work of Urajnik et al. (2007) to track changes in science/math career choice development over a five-year span and to examine the medium-term impact of contextual and experiential variables on science career choices five years after the initial data collection. The current study also explores the stability of contextual and experiential factors in the interdiction of science career aspirations as well as science career choice.

Method

Sample

Participants in the study were obtained from the National Youth Science Project Study (NYSPS) conducted by a group of researchers from the Centre in Human Development a Laurentian University. The original study sample consisted of 3306 Canadian students (13 to 19 years). Five years after the original data collection, a random sample of 300 male and female participants who had participated in a school level science fair were selected to represent all provinces in Canada and all grade levels (grade 8 to senior high school). Given their involvement in a science fair, it was assumed that these participants were originally somewhat interested in science. Due to challenges associated with longitudinal research, the project team was only successful in contacting 116 of the 300 participants selected for the follow-up study. Telephone interviews were conducted to determine their field of study or nature of work (science or non-science). The demographic of the current study are as follows: 46% were males and 54% were females. At the time of the original data collection, 46% were in junior high school (grade 8 and 9), 40% were in intermediate high school level (grades 10 and 11); and 14% were in senior high school level. At the time of current data collection, nearly two-thirds were attending college or university on a full time (60%) or part-time (3%) basis; approximately a third were employed full time (30%) or part-time (5%) and a few (2%) were looking for employment.

Procedure

The original data collection involved a two-phase, convenience sampling design(Urajnik et al., 2007). In the first phase, competitors at the Canada Wide Science Fair (CWSF) were invited to participate in the study by completing the National Youth and Science Project Study (NYSPS) survey while in attendance at the fair. The nature of the study was explained to the students by a member of the research team, and participation was voluntary. The second phase involved the administration of the NYSPS to the comparison sample of students (attending the same schools as CWSF students) by their teachers during regular classroom sessions. The NYSPS is a self-report instrument comprised of items assessing general demographic information, achievement/schoolwork, perceptions of education and schooling, parental background, and family information. Items were adapted from the work of Krahn (1988) (Three City Study of the School to Work Transition), Breakwell, Fife-Shaw, and Devereaux (1988) (Youth, Science, and Technology), and items developed as part of a study conducted on Canadian high school students in the context of science career choices (Hein & Lewko, 1994). Measures included career choice/goals, person input, background/context, .earning experiences, self-efficacy, outcome expectations, and interest in science and math. For a complete description of these measures, see the original study (Urajnik et al., 2007). Participants completed the survey based on language of instruction (English or French), with language appropriate forms distributed to all students. Instrument administration required an average of 50-60 minutes.

Five years after the original data collection, a random sample was selected from the participants of the NYSPS project who had participated in a science fair at the school, regional or national levels with the assumption that these participants were likely to have had some interest in science. A research assistant from the Centre in Human Development at Laurentian University contacted the participants individually by telephone, or spoke with their parents if the participant could not be reached. The purpose of the study was explained to the participants (or their parents) and permission to conduct the follow-up interview was obtained. The interview questions inquired as to what the participants were doing at the time with respect to school or work, and also what they had done over the five years since participating in the NYSPS project. For instance, participants were asked if they graduated from high school, continued on to college or university, and/or gained experience working part-time and/or full-time. If the participants indicated that they were in school, they were asked what type of post secondary program they were in, what their major field of study was, and what level of education they had attained thus far. If they said they had finished school, they were asked what their major field of study had been, and what type of work they were currently engaged in, if any. If the participants had changed from the field of study originally stated in the NYSPS project, they were asked about the reason for that change.

Results

Five years after the NYSPS project, 43 of the 116 participants were pursuing a science career. Of the 43 participants approximately 70% (30) were in school (university or college) full-time in a science program, 26% (11) were working in a science field, and 4% (2) were working part-time and going to school part-time in the science field. Seventy-three participants were pursuing a non-science career. Approximately 51% (37) of these participants were in school full-time (university or college), 37% (27) were working full-time, and 12% (9) were either working part-time and going to school part-time or unemployed. Descriptive statistics for the measures comprising the six theoretical-based constructs (person input, background/context, learning experiences, self-efficacy, outcome expectations, and interests) by science career choice (yes/no) are presented in Table 1. Preliminary analyses were carried out to assess the univariate significance between science career choice (yes/no) for the study measures, as well as correlations between measures. Significant differences as computed by t-tests or Chi-square (for categorical variables) were found for the following variables in favor of science career choice: gender, parental socio-economic status, family cohesiveness, science/ math grades, sci-

Table 1

Descriptive statistics for person input factors, background factors, scientific learning experiences, science/math self-efficacy, outcome expectations, and scientific interests by science career (yes/no) (Follow-up study n=116).

	Science Career				
	Yes	**n[1]**	**No**	**n**	**Total**
Person Input	**%**		**%**		**N**
Gender*					
Male	47.2	25	52.8	28	53
Female	28.6	18	71.4	45	63
Grade					
Senior (12+)	31.3	5	68.8	11	16
Intermediate (10-11)	41.3	19	58.7	27	46
Junior (8-9)	35.2	19	64.8	35	54
Language					
English	39.5	34	60.5	52	86
French	28.6	8	71.4	20	28
Background / Contextual	**(Mean(sd))[2]**		**(Mean(sd))**		
Parent Socio-economic Status (SES)**	55.65(18.55)	42	47.69(14.73)	69	111
Family Cohesiveness*	4.00(0.78)	41	3.68(0.85)	72	113
Communication – Social / Scientific Issues	2.72(1.00)	42	2.51(1.00)	72	114
Family Career Encouragement	3.31(0.98)	43	3.16(1.13)	71	114
Parent Science / Math Encourage / Expect's	4.48(0.76)	39	4.33(0.71)	70	109
Learning Experiences					
Science / Math Grades**	7.78(0.45)	43	6.84(1.60)	73	115
Perceptions of Science / Math Teachers	2.21(0.24)	42	2.26(0.19)	73	115
Friends Interested in Science / Math	3.02(0.61)	42	2.83(0.70)	72	114
Self-Efficacy					
Science / Math Self-Efficacy**	4.44(0.56)	43	3.98(0.72)	73	116
Science Knowledge Confidence	3.69(0.96)	43	3.35(0.94)	72	115
Outcome Expectations					
Science Course Expectations**	5.69(0.71)	41	4.80(1.75)	72	113
Scientific Career Expectancies	2.08(0.25)	42	2.02(0.38)	73	115
Interests					
Scientific Interests*	4.23(0.87)	43	3.88(0.82)	72	115
Extracurricular Scientific Interests**	2.53(0.87)	43	3.88(0.82)	72	115

[1] All n based on valid cases for analyses.
[2] sd = standard deviation; figures for experiential factors are also means and standard deviations.
* Difference between Science Career (Yes/No) significant at P<.05.
** Difference between Science Career (Yes/No) significant at P<.01.

Table 2

Participants who remained with original science career choice and changed science career choice to non-science career choice between the original NYSP study and the Follow-up study by gender and grade level (senior, intermediate and junior high school).

		Actual career choice in the follow-up study		
Gender Grade level Career Choice in NYSP	Total N	Remain with the original choice, % (n)	Change in the career choice, % (n)	Reasons for changing
MALE	**53**			
Senior	10			
Science	3	33.3 (1)	67.7 (2)	Change in interest
Non Science	7	57.1 (4)	42.9 (3)	
Intermediate	16			
Science	7	71.4 (5)	28.6 (2)	Don't remember the original choice
Non Science	9	44.4 (4)	55.6 (5)	
Junior	27			
Science	12	66.67 (8)	33.33 (4)	Too difficult; too much school; don't remember the original choice.
Non Science	15	80.00 (12)	20.00 (3)	
FEMALE	**63**			
Senior	6			
Science	2	100.0 (2)	0.00 (0)	
Non Science	4	75.00 (3)	25.00 (1)	
Intermediate	30			
Science	18	38.89 (7)	61.11 (11)	Change in interest; too difficult; co-op placement influenced the change; work experience influenced the change.
Non Science	12	83.33 (10)	16.67 (2)	
Junior	27			
Science	12	50.00 (6)	50.00 (6)	Change in interest; teacher influenced the change; personal reason.
Non Science	15	86.70 (13)	13.30 (2)	
OVERALL MALE	**53**			
Science	22	63.60 (14)	36.40 (8)	
Non Science	31	64.50 (20)	35.50 (11)	
OVERALL FEMALE	**63**			
Science	32	40.60 (13)	59.40 (19)	
Non Science	31	83.90 (26)	16.10 (5)	

ence/math self-efficacy, science course expectations, scientific interests, and extracurricular scientific interests (see Table 1). There were several significant relationships among the predictor variables. However, the magnitude of the correlations (-.01 to .577) was not sufficiently high as to pose problems with multicolinearity.

Cross tabs for stability of career choice between the originally proposed field of study (science/non-science) and the actual field of study (science/non-science) at follow-up are presented in Table 2. There was a significant difference between males and females in stability of career choice. Approximately 64% (14) of males, while only 41% (13) of females, remained with their original science career choice. The most salient reasons cited by both males and females for moving away from a science career were "change in interest" and "influence of work placement". Participants also noted "difficulty of science and math courses" as a reason for making this change. Statistically significant differences were found between those who remained with science field after five years and those who switched to a non-science field, on two factors reflecting outcome expectations (t_{65} =2.102, p< .05) and interest in science and math. Additionally, regarding career choice changes from non-science to a science, 36% (8) of males and only 20% (3) of females changed from an original non-science career choice to a science career choice. Similar patterns of results were found for participants who were at the intermediate and junior high school level in the original study, but unfortunately there were not enough subjects to establish a pattern for participants who were originally at the senior high school level.

A sequential logistic regression analysis was carried out to explore the contribution of contextual and experiential factors as presented in figure 1 to the prediction of science career choice (yes/no), five years after the original data collection. Table 3 shows the multivariate odds ratio (OR) and 95% confidence intervals for the predictor variables within each pathway (model) shown in figure 1, and the significance and percentage of variance explained by the series of regression models. An alpha level of .05 (one-tailed) was used to test the significance.

Results of the pathway comprised of person input variables (Model 1,figure 1) indicated that gender was positively associated with the likelihood of a scientific career. The results showed that approximately 40% more males chose science careers than females. Intermediate grade level students had 27% higher probability of choosing a science career as compared to junior students, however this difference was not significant. Although the overall person input factor was not found significant, it contributed six percent of the variance in discriminating science (yes/no) career choice (Negelkerke R square = .06).

The addition of the background/ context set of measures (Model 2, figure 1) did not significantly contribute to the prediction of career choice beyond what was accounted for by person input, however, these measures explained six percent of the variance in discriminating science career choice (Negelkerke R square = .12).

Learning experiences (Model 3,figure1) contributed significantly (block χ^2 = 23.48, DF = 3, Negelkerke R square = .40) when added to the model. Results showed that students who pursued scientific careers tended to have higher science/math grades and more friends interested in science compared to students who opted for non-science careers. Learning experiences contributed 28% of the variance to the model over and above what was contributed by person input and background/context factors.

Results of science and math self-efficacy (model 4, figure1) showed a direct positive effect on career goals after controlling for the factors reflecting person input, background/context, and learning experiences. It explained 3% of the variance. Intermediate grade level and family cohesiveness indirectly affected science/math self-efficacy via person input, background/context and learning experiences.

Outcome expectations, more specifically students' science course expectations, (Model 5, figure 5) directly added to the model. Students with scientific career goals were more likely to have confidence in their scientific ability and to expect their courses to be useful in their future career than students with non-science goals. It explained 5% of the variance.

The results indicated positive effect of both interest measures (model 6, figure1), however they were not found to be significant after controlling for person input, background/context, learning experiences, self-efficacy, and outcome expectations. Models 4, 5, and 6 together contributed 11% of the variance to the model of career choice. Learning experiences had the most influence on the career choice model. It explained 28% of the variance and directly and indirectly affected career choice though self-efficacy, outcome expectations and interests.

The correct classification rates, based on all the predictors, were 65.7% for participants who chose science careers, 86.7% for participants who chose non-science careers, and 78.7% overall.

Discussion

The present longitudinal study tracked changes in science/math career choice development for Canadian ado-

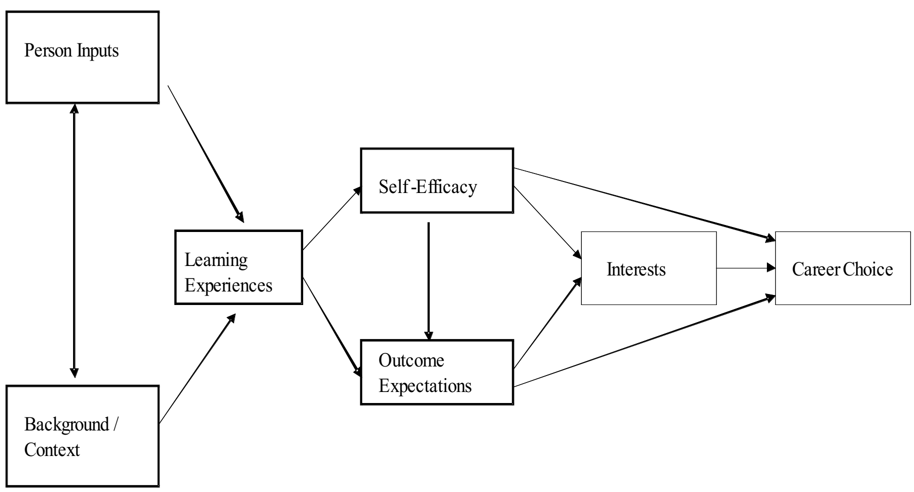

Figure 1: Partial version of the Lent et al. (1994) social-cognitive model of career development.

Table 3

Multivariate odds ratios (OR) and 95% confidence intervals (CI's) for the logistic regression of science career choice on person input factors, background factors, scientific learning experiences, science/math self-efficacy, outcome expectations, and scientific interests (Follow-up Study, N=116).[1,2]

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Person Input						
Gender						
Male	**2.31 (0.95-5.59)** †	1.97 (0.77-5.05)	1.90 (0.67-5.42)	1.58 (.52-4.87)	1.75 (0.54-5.66)	1.69 (0.47-6.15)
Female	ref.	ref.	ref.	ref.	ref.	ref.
Grade						
Senior (12+)	0.71 (0.18-2.80)	0.78 (0.18-3.39)	2.41 (.35-16.85)	2.24 (0.30-16.62)	3.42 (0.38-30.47)	4.90 (0.49-49.46)
Intermediate (10-11)	1.27 (0.49-3.29)	1.56 (0.54-4.49)	2.77 (0.79-9.70)	**3.14 (0.85-11.61)**	**4.25 (0.98-18.47)**	**6.3 (1.17-32.13)**
Junior (8-9)	ref.	ref.	ref.	ref.	ref.	ref.
Language						
English	1.22 (0.42-3.55)	1.78 (0.47-6.81)	3.32 (0.68-16.12)	3.32 (0.66-16.66)	2.93 (0.54-15.86)	3.40 (0.57-20.27)
French	ref.	ref.	ref.	ref.	ref.	ref.
Background/Context						
Parent SES		1.02 (0.99-1.05)†	1.02 (0.99-1.06)	1.02 (0.99-1.06)	1.03 (0.99-1.07)	**1.04 (0.99-1.07)**
Family Cohesiveness		1.53 (0.78-2.93)	2.01 (0.88-4.158)	**2.14 (0.90-5.10)**	2.06 (0.86-4.89)	2.00 (0.81-4.83)
Family Communication		0.96 (0.57-1.60)	0.78 (0.44-1.40)	0.74 (0.41-1.33)	0.65 (0.34-1.23)	**0.51 (0.23-1.09)**
Family Career Encouragement		0.80 (0.47-1.36)	0.68 (0.35-1.31)	0.66 (0.34-1.29)	0.76 (0.38-1.50)	0.68 (0.33-1.41)
Science Encourage/Expectations		0.97 (0.48-1.94)	0.80 (0.35-1.80)	0.60 (0.31-1.55)	0.68 (0.24-1.94)	0.74 (0.25-2.22)
Learning Experiences						
Science/Math Grades			**4.37 (1.29-14.78)**†	**2.82 (0.88-9.08)**	3.30 (0.77-14.17)	**3.90 (0.81-18.78)**
Percept. of Science/ Math Teachers			0.11 (0.01-1.48)	**0.06 (0.00-0.95)**	**0.04 (0.00-0.82)**	**0.05 (0.01-1.34)**
Friends Interested in Science/Math			**2.14 (.89-5.15)**	**2.18 (0.88-11.94)**	2.18 (0.81-5.74)	2.04 (0.75-5.60)
Self-Efficacy						
Science/Math Self-Efficacy				**3.27 (0.90-11.94)**[2]	**3.38 (0.84-13.58)**	3.04 (0.74-12.42)
Science Knowledge Confidence				0.86 (0.45-1.62)	0.88 (0.45--1.69)	0.85 (0.43-1.68-)
Outcome Expectations						
Science Course Expectations					**2.87 (0.96-8.62)**†	**2.58 (0.90-7.39)**
Scientific Career Expectancies					0.56 (0.14-2.18)	0.40 (0.09-1.74)
Interests						
Scientific Interests						1.34 (0.61-2.94)
Extracurricular Scientific Interests						2.13 (0.68-6.67)†
Constant	-1.19	-3.38	-11.98	-15.58	-15.58	-17.31
-2 Log Likelihood	119.18	114.39	90.911	87.43	82.44	79.61
Model Chi-Square [df]	3.85 (4)	8.63 (9)	32.12 (12) **	35.59 (14) **	40.59 (16) **	43.42 (18) **
Block Chi-Square [df]	3.85 (4)	4.79 (5)	23.48 (3) **	3.48 (2)	4.50 (2) ‡	2.83 (2) ‡
Negelkerke R Square	0.06	0.12	0.40	0.43	0.48	0.51

[1] 95% confidence intervals (CI) in parentheses; significant terms are in bold.

[2] Variable significance was tested by Wald distributed chi-square statistics with 1 degree of freedom (the exception was grade-level, with 2df).

Note: (1) *p < .01; **p < .001.

(2) When each category of variables tested individually † P< .05, ‡ P< .01.

P< .05 when a model category tested individually

Table 4

The reasons for changing science career choice to non-science career choice between the original NYSP study and the Follow-up study by gender.

Reasons for changing science career choice to non-science career	Male		Female	
	%	n	%	n
Change in interest	25	2	31.59	6
Find too difficult	12.5	1	5.26	1
Co-op placement			5.26	1
Work experience			21.05	4
Too much school	12.5	1	5.26	1
Do not remember the original choice	50	4	10.53	2
Missing			21.05	4
Total	100	8	100	19

lescents over a five-year span and examined the impact of contextual and experiential factors on their later career choices. It responded to the frequent and longstanding calls from researchers in the field of social cognitive career choice development for longitudinal studies. Relatively few studies have looked at social cognitive career development over time, and no studies were found that tracked changes in science/math career choice development from high school into post secondary education or the work force while also considering the impact of young people's environments and experiences on their career choices.

The findings of the current study provide evidence regarding the stability of science career choice five years after the original data collection, gender differences in stability of science career choice, and the congruence of the findings from the current longitudinal study with those from the cross sectional study conducted by Urajnik, et al. (2007).

Results regarding the stability of career choice five years after the original data collection showed that approximately 50% of students shifted from pursuing a science career to pursuing another field of study or work. A good deal of change in young people's actual career choices over time has also been found by previous researchers (e.g., Athanasou, 2002; Tracey & Robbins, 2005; Tracey et al., 2005). In their studies of college-bound high school students, Tracey and his colleagues (Tracey & Robbins, 2005; Tracey et al., 2005) found that while the students' interest levels remained stable over the four years of high school, there was a drop in clarity about their career choice and interest-career choice congruence in the senior year. Consequently, it was suggested that the senior year of high school may be an important time to explore career choice development. In an Australian study of stability versus instability of young people's early career pathways, Athanasou (2002) found that only 21% of participants remained in their original vocational category after seven years. He argued that, "it is remarkable that there is any stability in careers given the myriad of potential influences likely to destabilize any life" (p. 84). In fact, there is consensus among virtually all researchers in the field that career choice development takes place within a psychosocial context, influenced by many social networks (peer, family, school, community, etc.). Young people navigate input from many "significant others" in their lives as they go through their school to work transition; making career choices, developing occupational skills, and adjusting to work experiences. Thus, it may not be surprising that half of all students in this study were drawn away from their original career choice. Barriers, both intrapersonal (such as low self-esteem) and environmental (such as disapproval of family members) can hinder career progress (Lent & Hackett, 2000). In a qualitative study investigating college students' career choice supports and barriers, Lent et al. (2002) identified financial constraints, negative family/social influences, and role conflict as important contextual factors, and adjustment difficulties and ability limitations as key personal factors. Coping efficacy (confidence in being able to cope with career barriers and make clear decisions) has been studied as a significant factor in students' successfully overcoming barriers (Lent et al., 2000; Creed et al., 2006; Earl & Bright, 2007). Earl and Bright (2007) suggested that with today's "boundary-less careers", being too fixed about a career choice may be an impediment in itself. The students in the present study (both males and females) said they had moved away from a science career mostly because of a change in interest, difficulty of science and math courses, and/or influence of work placement. Further investigation to examine the underlying processes accounting for these reasons would be useful.

The present study showed similar patterns of change for junior and intermediate level high school students; unfortunately, the sample of senior level students was too small to establish a pattern of results for this subgroup. Thus it is not possible to ascertain whether the participation of more senior level students in the study might have increased the percentages of students actually staying with their science/math career choice.

Although a good deal of change may be inevitable, the question remains as to why this effect is more prominent for young women. Results of the study indicated a significant difference between males and females in stability of career choice, with approximately 64% of males, and only 41 % of females, staying with their original science career choice. Regression analysis in the study found that gender was significantly associated with the likelihood of a scientific career choice. Forty percent more males than females had science career goals. And, significantly more young women gave up their original science career choice. The phenomenon that females are underrepresented in the science/math field has been a concern for researchers in the past (Lapan et al., 1996; Gandalla, 2001; Haines & Wallace, 2002; Wai-Ling Packard, & Nguyen, 2003). In a study exploring whether gender socialization, roles, and stereotypes affect the relationship between gender and majoring in science, Haines and Wallace (2002) found that being female reduces the likelihood of pursuing a science career. They suggested that this is because being female is associated with less high school science and math preparation, which is necessary for pursuing science at university. Lapan et al. (1996) had previously found that young women take fewer math courses in high school, show less ability, believe less in their math/science ability, and consequently express less interest in math/science vocational interest than young men. Trusty and Ng (2000) found that perceived mathematics achievement had stronger effects on career choice for men than for women.

Wai-Ling Packard and Nguyen (2003) used a qualitative approach to gain understanding about how young women proceed with their career decisions over time. They found that young women tend to move through their career decision making process by utilizing mentoring relationships and job internships. These experiences allowed young women to imagine their future "possible selves" through role-playing and "trying-on" careers. The authors of the study stressed the importance of mentors and internship programs for young women to ensure that career goals are not discarded because of a lack of information or stereotypical perceptions. Also from a qualitative approach, Whitmarsh, Brown, Cooper, Hawkins-Rodgers, and Wentworth (2007) found that women who venture into non-traditional roles (such as math/science careers) receive their support and mentoring from outside their families (from college classmates, professors, professional mentors, and bosses, for example), and often suspend making their final choice until later in their career development. Additionally, they found that women often change their career goals to enable them to deal better with marriage and family responsibilities. Accordingly, school and workplace mentoring relationships are important to help young women make their choice to pursue a math/science career and balance any real or perceived obstacles that can keep them from doing so. In the present study, work placement was given as a prominent reason for making a career goal change. It would be interesting to know whether mentoring relationships were available to them in their work placement experience.

In the present study, model three of the regression analysis revealed that measures of learning experiences (perceived science/math grades and friends' interest in science/math) contributed significantly to science career choice. Students with higher perceived science/math grades and more friends interested in science were more likely to choose math/science careers. In fact, learning experiences had the most influence on the career choice model, as it explained 28% of the variance in career choice, and directly and indirectly affected career choice through self-efficacy, outcome expectations and interests. Jackson, Potere, and Brobst (2006) also found a significant association between participants' success learning experience and their expressed occupational interests and a positive association between their career self-efficacy beliefs and inventoried occupational interests. Concurring that science/math ability is an important factor in girls' career choice development, in a longitudinal study of high school girls' choices to pursue science/math/engineering (SME) majors in college, Nauta and Epperson (2003) found that high school math/science ability was positively related to SME self-efficacy, which was in turn related to making a choice to pursue a science career. Over time, this was related to higher SME self-efficacy and more positive SME outcome expectations in college. Thus, doing well in high school math and science helped girls to make a choice to pursue science and to stay with it. Studying the school to work transition of teenagers, Pinquart et al. (2003) found that youth with high academic self-efficacy beliefs and better grades were less likely to become unemployed and more likely to be satisfied with their work at age 21. In the present study, students cited difficulty in science/math courses as a reason for changing their goals. Model four of the regression analysis showed that math/science self-efficacy had a direct positive effect on career goals. This essentially means that students with lower math/science confidence may move away from a math/science career choice they had made earlier. Additionally, model five of the regression analysis showed that science course expectations added directly to the model. Students who chose science/math careers were more likely to expect their science courses to be useful. Inversely, those who did not chose science courses were less likely to see the relevance of their science/math courses. Students who moved away from a science career goal, then, may have become unconvinced that their science/math courses were constructive. Thus, early interventions which, first, help students, and particularly girls, realize the importance and usefulness of taking math and science in high school and, second, help them through any difficulties they encounter may assist them to feel empowered to handle future challenges; such interventions therefore could be vital to supporting them as they endeavor to realize their goals.

In comparing the results of the cross-sectional study (Urajnik et al., 2007) and the present longitudinal study on the utility of the Lent et al. (1994) social cognitive model of career choice, both studies tend to support the model. Results of both studies indicated that gender, scientific learning experiences, science self efficacy measures, outcome expectancies, and scientific interests contributed significant variance to the prediction of scientific choice. However, the effects of the constructs in the model (scientific learning experiences, science self-efficacy measures, outcome expectancies, and scientific interests) are much stronger in the longitudinal study than in a cross-sectional study. More specifically, 9% of the variance in scientific career aspirations in the cross-sectional study was accounted by the above four construct where as in the longitudinal study, 39% of the variance in scientific career was explained by the same construct. Learning experience explained the most variance (28%).

In conclusion, given the paucity of longitudinal studies investigating science career choice development, this study gives some intriguing indications of what a larger study might find and should therefore investigate. We would especially recommend the inclusion of a larger number of high school seniors. The results of the present study showed a great deal of change away from students' originally stated career choices. Taken together, 50% of students shifted from pursuing a science career to pursuing another field of study or work. Also, young women were significantly more likely to give up their original science choice (59% changed) than young men (36% changed). Major reasons given by both males and females for moving away from a science career were change in interest, difficulty of science and math courses, and influence of work placement. More can be learned about the underlying reasons. The regression analyses showed that learning experiences (perceived math/science ability and friends' interest in science) had the most influence on later career choice, as it explained 28% of the variance in career choice, and directly and indirectly affected it through self-efficacy, outcome expectations and interests. This result points to the importance of future consideration of learning experiences, such as achievement perceptions, and their effect on aspects of self-efficacy. Ultimately, more extensive and in depth inquiry into students' career choice process is important. Why are so many students, especially young women, abandoning their original science career choices? What is influencing them to do so? What can help them move confidently through the transition from school to work? The contributions of qualitative research (e.g., Wai-Ling Packard & Nguyen, 2003; Whitmarsh et al., 2007) seem particularly useful in gaining a deeper understanding about the subtleties of these issues. Future longitudinal inquiries, then, may benefit from a mixed-methods design, including participants' qualitative views and insights into the inevitable ebbs and flows of their career development process.

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