Part V

Youth and Career Development

The Effects of Context and Experience on the Scientific Career Choices of Canadian Adolescents

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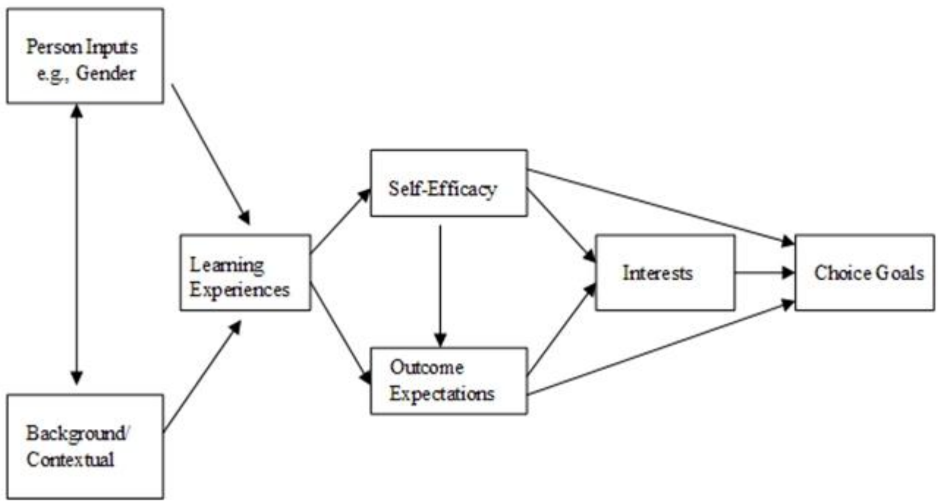
Advances in theory and a growing body of empirical literature have characterized vocational-counseling psychology in recent years (Lent, 2001). Career process explanations have evolved through the development of new theoretical approaches (e.g., Gottfredson, 1996) and the refinement/expansion of foundational works (e.g., Dawis, 1996; Super, Savickas, & Super, 1996). Investigators have cited the utility of consolidating the various perspectives guiding career development research and practice (e.g., Walsh, 2001). Paralleling this trend has been an increase in cross-domain inquiry both within and beyond the field (Lent, 2001). Research has sought to understand commonalities across the many domains that affect career-related behaviour by incorporating constructs from other areas of social science (e.g., cognitive psychology, sociology). A particularly fruitful trend has been the application of Bandura's (1986) social-cognitive theory to career behaviour. An example is the social-cognitive career development framework proposed by Lent, Brown, and Hackett (1994).

The Lent et al. (1994) framework is one of the most recent and comprehensive career development theories. This model integrates person, background / context and experiential factors as antecedent influences on career-related choice behaviour. It emphasizes one of the most influential periods in terms of career choice and commitment – adolescence and youg adulthood – by highlighting mechanisms that may help shape career-related interests and selections. However, occupational choice is a life-long process that starts long before school-leaving age and continues long afterwards (Schoon, 2001). The socio-cognitive processes emphasized as important to career entry are hypothesized to influence subsequent career choices (Lent et al., 1994). Relationships may also be bidirectional at points. A basic version of the social-cognitive career choice model proposed by Lent et al. (1994) is presented in Figure 1.

The Lent et al. (1994) model seeks to explain central, dynamic mechanisms through which young people forge academic and career choices. Person-input variables and background/ context influence the learning experiences of an individual. Person-inputs are comprised of personal characteristics (e.g., gender). Parent and family influences are important contextual features in the model (Lent et al., 1994). The experiential learning sources, such as objective performance and role-modeling experiences, shape and inform career-related self-efficacy (e.g., perceived task competence) and outcome expectancies (e.g., anticipation of certain outcomes, such as self-satisfaction, financial reward). The self-cognition constructs – self-efficacy and outcome expectancies – figure prominently in the formation of interests. Self-cognitions and career-relevant interests, in turn, affect career choice. Choices and performance accomplishments result in subsequent self-efficacy and outcome appraisals, and thus feed back into the model (not shown).

Figure 1

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



This study applied multivariate logistic regression analyses to a partial version of the Lent et al. (1994) model (Figure 1). The differential utility of model constructs in accounting for career choice was analyzed. Examination of the relations between separate constructs and career choice is needed. Prior investigations on social-cognitive theory have tended to focus on self-efficacy beliefs in isolation from other constructs (Lopez, Lent, Brown, & Gore, 1997). There has been relatively less inquiry on the role of the other socio-cognitive mechanisms (e.g., outcome expectations) in the study of educational and career behaviours. Lent and colleagues (1994) have suggested that assessment of their model focus upon content-specific variables. Few studies have examined the theoretical constructs in their model from a domain-specific perspective (Ferry, Fouad, & Smith, 2000) and with samples other than college students. Research on the relations between science education factors and preadolescent/adolescent career aspirations has been limited (Fouad & Smith, 1996; Lopez et al., 1997; Plucker, 1998; Wang & Staver, 1999). The present study builds upon past research by exploring the science domain for a sample of Canadian adolescents.

The primary goal was to examine the added influence of context and experience in the prediction of scientific career choice (yes/no), beyond the personal characteristics of adolescents. Person-inputs in the present study included gender, grade-level, and primary language (English or French). Contextual factors included socio-economic status (SES – parent occupations), family cohesiveness, family social/scientific communication, family career encouragement, and parent scientific expectations/encouragement. Family cohesion has been found to play a role in the development of academic and career cognitions (e.g., academic self-concept) and choice (Glasgow, Dornbusch, Troyer, Steinberg, & Ritter, 1997; Juang & Vondracek, 2001; Wall, Covell, & MacIntyre, 1999). The remaining measures were domain-related. Students identify parents as the largest influence on career decisions (Bleeker & Jacobs, 2004) especially when choosing careers in science and engineering (Dick & Rallis, 1991). Parent SES was also considered a relevant domain factor. Children's educational and career aspirations are found to be related to parental SES (as measured by parents' income, education, and occupation) (Schoon, 2001; Trice & Knapp, 1992; Wahl & Blackhurst, 2000). Occupations requiring science and math skills also tend to be higher in status (Ferry et al., 2000).

Learning experiences included science/math grades, perceptions of science/math teachers, and friends interested in science. These factors reflect the documented influence of objective scientific performance and the school environment on academic and career processes (e.g., Burkham, Lee, & Smerdon, 1997; Plucker, 1998; Schoon, 2001; Wall et al., 1999). The academic competencies of adolescents play an important role in capability beliefs, which contribute to career decision-making (Bleeker & Jacobs, 2004; Ferry et al., 2000; Hackett, 1995; Juang & Vondracek, 2001; Lapan, Shaughnessy, & Boggs, 1996; Lee, 1998; Lent, Lopez, & Bieschke, 1991; Lent, Lopez, & Bieschke, 1993; Nauta & Epperson, 2003). Perceptions of the school environment, peers, and teachers' beliefs may affect a child's self-efficacy and attitudes towards math and science (Burkham et al., 1997; Plucker, 1998; Schoon, 2001; Wang & Staver, 2001). Teachers act as role models by providing students with scientific learning opportunities and encouragement (Burkham et al., 1997). Likewise, it is possible that adolescents who have peers interested in the sciences may engage in scientific activities themselves, and have similar future aspirations. The remaining experiential constructs were self-efficacy, outcome expectations, and interests. Self-efficacy reflected adolescent perceptions of scientific ability. Outcome expectancies included whether one felt science would be useful to one's future career, and expectations for a scientific occupation. Interests were comprised of interest in scientific concepts, and engagement in extracurricular science activities.

Specific propositions based on the Lent et al. (1994) model were also examined in this study. These included: Self-efficacy beliefs will affect career choice goals both directly, and indirectly through interests (Lent et al.'s Propositions 3A and 3C); Outcome expectations will affect career choice directly and indirectly through interests (Propositions 4A and 4C); and there will be a direct effect of interests on choice goals (Proposition 5A). Research has indicated direct relationships between these experiential constructs with choice goals in the science/math domain (e.g., Ferry et al., 2000; Fouad & Smith, 1996). There is also evidence that the influences of self-efficacy and outcome expectations on choice goals are mediated by interests (Borget & Gilroy, 1994; Ferry et al., 2000; Fouad & Smith, 1996; Lent et al., 1991; Lent et al., 1993; Nauta & Epperson, 2003; Post, Stewart, & Smith, 1991). Investigations of social-cognitive theory have largely focused on the role of self-efficacy (Fouad & Smith, 1996). There has been relatively less examination of the role of scientific outcome expectancies. The current study explores the relations of these three experiential influences – self-efficacy, outcome expectancies, and interests – with scientific career goals.

Method

Sample

Participants were obtained from the National Youth and Science Fair Project Study (NYSPS). The original study sample consisted of 4,034 Canadian students (13-19 years). Eighteen percent (728) of participants were Canada-Wide Science Fair (CWSF) competitors (56% male, 44% female) and 82.0% (3,306), a comparable national sample of students (50% male, 50% female). The present study is based on the comparison subgroup of adolescents.

The science fair participants are a homogeneous sample of high-performing science students. The control sample may be a more typical group of students, or provide better representation in terms of generalizability. Eighty-four percent of these students were Caucasian, 7.0% Native American, 6.4% Asian, and 2.2% represented other racial/ethnic groups (2,430 valid cases). Thirty-two percent were junior-level students, 35.7% intermediate, and 33.2% were seniors (3,185 valid cases). Approximately 76% of the students had English as their first language, and 24%, French (3,079 valid cases).

Procedure

Data collection involved a two-phase, convenience sampling design. In the first phase, the CWSF competitors were invited to participate in the study by completing the National Youth and Science Fair Project (NYSP) 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 NYSP to the comparison sample of students (attending the same schools as CWSF students) by their teachers during regular classroom sessions.

The NYSP 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). 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.

Measures

career choice/goals. Participants indicated the occupation they expected to attain. An overall structure for classifying occupation according to type of work performed was based on the Standard Occupational Codes Index (Statistics Canada, 1991). Scientific career choice in the present study was reflected in a dichotomous career goal score as: 1 (science career, e.g., natural sciences, mathematics, health sciences); and 0 (non-science). This measure was used as the dependent variable.

person input. *Gender*; *Language* – Language first learned to speak, and still spoken (English or French); and *Grade Level* – Junior (grade 8-9), Intermediate (grades 10-11), and Senior (grade 12+).

background/contextual. *Socio-economic Status (SES)* – Paternal and maternal occupation was coded using the SES index developed by Blishen, Carroll, and Moore (1987). A measure of parental occupational status was developed based on the higher index score of either parent; *Family Communication on Social / Scientific Issues* – Ten statements measured the extent to which family members discuss current social and scientific issues (e.g., politics, science). A sample item includes: "How often do you talk to your mother or father about issues involving science or technology?" Responses were rated on five-point scales ("Never" to "Often") and averaged to obtain a single score. The internal consistency reliability (Cronbach alpha) for the scale was .89; *Family Cohesiveness* – Consisted of four items rated on five-point scales ("Very untrue to "Very true") and assessed feelings of "togetherness" and support provided by family members. The reliability for the scale was .78.

Family Career Encouragement measured adolescent perceptions of family encouragement for first choice of career. Students responded to four statements, rated on five-point scales ("None" to "A lot"). Higher scores indicated higher levels of family career encouragement. The reliability was .78; and *Parent Science / Math Expectations and Encouragement* – Perceptions of parental encouragement for, and expectations to excel in science/math were assessed through responses to four, five-point scales ("Never" to "Always"). Items were completed separately for mother and father. Internal consistency coefficients were .91 and .92, respectively. Responses for both parents were averaged to obtain a single score.

learning experiences. *Science/Math Grades* – Students were asked to indicate on an eight-point scale ("Mostly below D" to "Mostly A") their grades within the subject areas of: English, mathematics, science, and social studies. The average of math and science grades was used in all analyses; *Perceptions of Science/Math Teachers* – Students rated each of 11 items (three-point scales) according to perceived science/math teacher encouragement, and expectations for scientific performance and homework. An item includes: "My science teacher expects me to work hard on science." Higher scores indicated higher levels of teacher encouragement/expectations. The items were completed separately for science and math teachers (alpha reliabilities of .74 and .80), and averaged to obtain a total score; and *Friends Interested in Science / Math* – Students were required to rate how many of their friends were interested in science and math. The scale contained five statements (five-point scales – "None" to "All") and the reliability was .84.

self-efficacy. *Science/Math Self-Efficacy* – Consisted of a four-item scale assessing perceived general science and math ability. A sample item is: "I am good at math." Responses were rated on five-point scales ("Strongly disagree" to "Strongly agree"). Reliability of the scale was .81; and *Science Knowledge Confidence* – Assessed confidence in completing a science knowledge test. The items were: "How well do you think you did on this test?" and "How difficult was this test for you?"

Five-point response scales indicated increasing confidence in one's science knowledge. Reliability was .77.

outcome expectations. *Scientific Career Expectancies* – Nineteen statements on three-point scales measured students' perceptions of a scientific career. Higher scores indicated increasingly positive expectations for having a science-related career. Reliability of the scale was .84; and *Science Course Expectations* – Students rated their science courses in terms of the extent to which they expected them to be useful to their future career. Higher scores on six-point scales indicated higher expected course usefulness. Science course ratings were averaged.

interest in science and math. *Scientific Interest* – Students rated three statements on five-point scales ("Strongly disagree" to "Strongly agree") according to their level of scientific interest. A sample statement is: "I like to find out how machinery works." Cronbach's alpha was .86; and *Extracurricular Scientific Interest* – Responses to nine (five-point scale) statements ("Never" to "Always") assessed the frequency with which students engaged in extracurricular scientific activities. Responses were averaged and the reliability for the scale was .83.

Results

Descriptive statistics for the measures comprising the five theoretically-based constructs (person input, background/context, learning experiences, self-efficacy, outcome expectations, interests) by science career choice (yes/no) are presented in Table 1. Preliminary analyses were undertaken to assess the univariate properties of the study measures, impact of missing data, and to verify constructs/scales. There were several significant relations among the predictor variables. However, the magnitude of the correlations (.001-.459) was not sufficiently high as to pose problems with multicollinearity in further analyses.

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) (National Youth and Science Project (NYSP), N=3,306).

Science Career					
	Yes	**n**[1]	**No**	**n**	**Total**
Person Input	**%**		**%**		**N**
Gender					
Male	42.8	565	57.2	756	1,321
Female	37.1	428	62.9	726	1,154
Grade					
Senior (12+)	45.8	370	54.2	438	808
Intermediate (10-11)	39.0	339	61.0	530	869
Junior (8-9)	35.9	264	64.1	472	736
Language					

English	37.3	684	62.7	1,152	1,836
French	47.9	281	52.1	306	587
Background / Contextual	**(Mean(sd))** [2]		**(Mean(sd))**		
Parent Socio-economic Status (SES)	46.25(12.71)	913	44.42(12.74)	1,344	2,257
Family Cohesiveness	3.59(0.91)	918	3.47(0.92)	1,340	2,258
Communication – Social / Scientific Issues	2.43(0.99)	928	2.24(0.97)	1,360	2,288
Family Career Encouragement	3.02(1.09)	988	3.10(1.14)	1,477	2,465
Parent Science / Math Encourage / Expect's	4.18(0.86)	871	3.90(0.96)	1,256	2,127
Learning Experiences					
Science / Math Grades	6.56(1.64)	986	5.79(1.88)	1,452	2,438
Perceptions of Science / Math Teachers	2.21(0.22)	993	2.20(0.24)	1,478	2,471
Friends Interested in Science / Math	2.78(0.69)	910	2.61(0.73)	1,326	2,236
Self-Efficacy					
Science / Math Self-Efficacy	3.88(0.74)	999	3.54(0.78)	1,484	2,483
Science Knowledge Confidence	3.59(0.85)	963	3.43(0.93)	1,410	2,373
Outcome Expectations					
Science Course Expectations	5.30(1.30)	972	4.29(1.86)	1,408	2,380
Scientific Career Expectancies	2.03(0.26)	967	2.05(0.31)	1,411	2,378
Interests					
Scientific Interests	3.94(0.86)	955	3.68(0.95)	1,386	2,341
Extracurricular Scientific Interests	2.08(0.74)	891	1.87(0.71)	1,300	2,191

[1] All n based on valid cases for analyses.
[2] sd=standard deviation; figures for experiential factors are also means and standard deviations.

Logistic regression analysis was performed to explore the contribution of contextual and experiential factors to the prediction of career choice. Adolescent person-input variables were entered into the model first to determine the unique predictive variance of the separate sets of measures in subsequent models. Table 2 shows the multivariate odds ratios (OR) and 95% confidence intervals for the series of regression models.

Table 2

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 (NYSP, N=3,306).[1,2]

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Person Input						
Gender						
Male	**1.23 (1.01-1.49)**	**1.26 (1.03-1.53)**	**1.24 (1.01-1.52)**	**1.38 (1.11-1.71)**	**1.36 (1.09-1.69)**	**1.45 (1.16-1.83)**
Female	ref.	ref.	ref.	ref.	ref.	ref.
Grade						
Senior (12+)	**1.44 (1.12-1.84)**	**1.49 (1.14-1.93)**	**1.66 (1.28-2.17)**	**1.54 (1.17-2.02)**	**1.88 (1.42-2.50)**	**1.91 (1.43-2.54)**
Intermediate (10-11)	1.11 (0.87-1.41)	1.09 (0.86-1.41)	1.19 (0.92-1.54)	1.14 (0.88-1.47)	1.11 (0.85-1.45)	1.16 (0.89-1.52)
Junior (8-9)	ref.	ref.	ref.	ref.	ref.	ref.
Language						
English	**1.48 (1.18-1.86)**	1.21 (0.92-1.59)	1.11 (0.84-1.47)	1.13 (0.86-1.50)	1.25 (0.93-1.68)	1.27 (0.94-1.71)
French	ref.	ref.	ref.	ref.	ref.	ref.
Background / Context						
Parent SES		1.00 (0.99-1.02)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)
Family Cohesiveness		0.96 (0.84-1.09)	0.94 (0.83-1.07)	0.94 (0.82-1.07)	0.94 (0.82-1.08)	0.94 (0.82-1.08)
Family Communication		**1.16 (1.04-1.29)**	1.12 (0.99-1.26)	1.09 (0.97-1.23)	1.06 (0.94-1.20)	1.00 (0.88-1.14)
Family Career Encouragement		0.92 (0.83-1.02)	0.93 (0.84-1.04)	0.93 (0.84-1.04)	0.94 (0.84-1.05)	0.92 (0.82-1.03)
Science Encourage/Expectations		**1.39 (1.22-1.58)**	**1.26 (1.10-1.43)**	**1.22 (1.07-1.40)**	**1.15 (1.01-1.33)**	1.14 (0.99-1.31)

Learning Experiences						
Science/Math Grades			**1.20 (1.13-1.28)**	**1.12 (1.04-1.21)**	**1.12 (1.04-1.21)**	**1.13 (1.04-1.22)**
Percept. Of Science/Math Teachers			0.96 (0.61-1.52)	0.92 (0.58-1.47)	1.00 (0.62-1.63)	0.97 (0.60-1.57)
Friends Interested in Science/Math			**1.22 (1.04-1.43)**	**1.18 (1.01-1.39)**	1.11 (0.94-1.31)	1.06 (0.89-1.25)
Self-Efficacy						
Science/Math Self-Efficacy				**1.30 (1.09-1.55)**	1.11 (0.92-1.34)	1.09 (0.90-1.31)
Science Knowledge Confidence				1.12 (0.99-1.27)	1.13 (0.99-1.28)	1.10 (0.97-1.25)

Multivariate odds ratios (OR's) and 95% CI's, continued.[1,2]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Outcome Expectations						
Science Course Expectations					**1.56 (1.42-1.70)**	**1.52 (1.39-1.66)**
Scientific Career Expectancies					0.72 (0.47-1.08)	0.75 (0.50-1.14)
Interests						
Scientific Interests						**1.16 (1.02-1.32)**
Extracurricular Scientific Interests						**1.22 (1.03-1.45)**
Constant	-0.67	-2.09	-3.00	-3.63	-4.49	-4.88
-2 Log Likelihood	2253.54	2209.96	2165.11	2151.55	2029.0	2018.12
Model Chi-Square [df]	25.61[4]**	69.19[9]**	114.04[12]**	127.59[14]*	250.15[16]**	261.03[18]*
Block Chi-Square [df]		43.58[5]**	44.85[3]**	13.55[2]*	122.56[2]**	10.88[2]*
McFadden's (Pseudo) R^2	0.01	0.03	0.05	0.06	0.11	0.12

[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: *p < .01; **p < .001.

Results of the model comprised of person input variables (Model 1) indicated that gender, senior grade-level, and English as a first language were positively associated with the likelihood of a scientific career. Being male increased the probability of a scientific career choice by 23% as compared to females. Senior-level, and English students had an approximate 50% increased likelihood of choosing a career in the sciences than junior and French students, respectively. Intermediate grade-level was not significantly different from the junior student reference. The overall model was significant ($p < .001$), with a McFadden's (pseudo) R^2 of 0.01 (Table 2).

The addition of the background / contextual set of measures (Model 2) uniquely contributed to the prediction of career choice (block χ^2 =43.58, df =5, $p < .001$, R^2 =0.03) beyond that accounted for by the person-input factors. Students were more likely to want a scientific career with increasing family communication on social/scientific issues, and parental encouragement/expectations to do well in science. The independent effects of gender and grade on career choice held upon adjustment for the contextual influences. Parent SES, family cohesiveness, and family career encouragement had no significant effect on career choice.

A similar pattern for the person input and contextual factors emerged when scientific learning experiences were added to the model (Model 3). Results also showed that students with higher science/math grades and more friends interested in science, were more likely to have preference for a scientific career. Learning experiences significantly added to the prediction of career choice (block χ^2 =44.85, df =3, $p < .001$, R^2 =0.05). The models with scientific self-efficacy (Model 4) (block χ^2 =13.55, df =2, $p < .01$, R^2 =0.06), outcome expectations (Model 5) (block χ^2 =122.56, df =2, $p < .001$, R^2 =0.11), and interest in science/math (Model 6) (block χ^2 =10.88, df =2, $p < .01$, R^2 =0.12) indicated that these separate sets of measures differentially added to the prediction of career choice over prior models.

The individual effects of self-efficacy, outcome expectancy, and interest measures (Models 4-6) mainly supported the model propositions (Lent et al., 1994) with respect to their influences on career choice. Proposition 3 states that self-efficacy will have a direct, positive relation to choice goals (3A). Self-efficacy will also have an indirect positive effect on career choice, through interests (3C). Proposition 3C specifically suggests that the relation of self-efficacy to choice goals will be reduced, but not eliminated when the influence of interests is controlled. Proposition 4 makes the same predictions regarding the relation of outcome expectations to choice goals. Interests will also directly influence career choice (Proposition 5).

Results of Model 4 indicated that science/math self-efficacy had a significant, direct effect on career goals after controlling for person input, contextual factors, and scientific learning experiences. Scientific outcome expectancies also had a direct relation to scientific career choice upon addition to the model (Model 5). Students with scientific career goals were more likely to have confidence in their scientific ability, and to expect their courses to be useful to their future career as compared to those with non-science goals. The latter relationship was attenuated but held after adjusting for scientific interests in the final model.

The relation between scientific self-efficacy and career choice (Model 4) was no longer significant after controlling for outcome expectancies, and scientific interests in subsequent models (Models 5 and 6). The effect of the second self-efficacy measure – science knowledge confidence – was marginally significant across Models 4 and 5. Scientific career expectancies did not have a significant impact on career choice. The full model (Model 6) indicated a significant, direct effect of both scientific interest measures: Students who wanted a science career were more likely to be interested in scientific concepts and activities. Model 6 supported continued individual effects of gender, grade-level, parent science encouragement/expectations (marginally significant), and objective scientific ability on career goals. The probability of choosing a science career was about 50% higher for males than females in the final model. Senior students were just about twice as likely to have scientific career aspirations than juniors.

Discussion

This study examined the impact of person input, family, and self-cognitions on the scientific career aspirations of Canadian adolescents. The primary goal was to explore the differential utility of the Lent et al. (1994) theoretical constructs in explaining career choice after adjustment for personal characteristics. Results indicated that family background, scientific learning experiences, self-efficacy measures, outcome expectancies, and scientific interests contributed unique variance to the prediction of scientific career choice. These findings are consistent with the career choice model (Lent et al., 1994) and other work in the area of scientific educational / vocational outcomes (e.g., Borget & Gilroy, 1994; Ferry et al., 2000; Fouad & Smith, 1996; Lee, 1998; Lent et al., 1993; Nauta & Epperson, 2003; Post et al., 1991; Wang & Staver, 2001;). A number of constructs (e.g., context, self-cognitions) were integrated and examined within one theoretical framework. Important, is the generality of the theoretical presuppositions to domain-related areas – namely the science domain in this study.

Findings from the addition of person-input factors to the logistic regression analyses demonstrated the impact of gender, grade-level, and students' primary language on career aspirations. Adolescents wanting a career in the sciences were more likely male, senior-level students, and those with English as their first language. The gender and grade effects held, even after the addition of contextual and experiential influences. These results accord with prior findings (e.g., Fouad & Smith, 1996; Ferry, et al., 2000; Schoon, 2001). Males have traditionally been socialized, or encouraged more than females to pursue science-related majors and occupations (Haines & Wallace, 2002; Gadalla, 2001). Lent et al. (1994) refer to this as one component of the "structure of opportunity" that may drive sex differences in career-related behaviour. The under-representation of females in high status math and science fields has consistently been identified, and is particularly evident in the physical sciences (Bleeker & Jacobs, 2004; Gadalla, 2001; Jacobs, Finken, Griffin, & Wright, 1998). Multiple causes have been explored, including differences in science course enrollment, science efficacy-beliefs, abilities, and interests (Bleeker & Jacobs, 2004; Nauta & Epperson, 2003). However, there is likely no single reason for the gender gap. A variety of psychological, sociological, institutional, and economic factors may deter females from education and careers within scientific areas (Gadalla, 2002).

The most influential period in terms of career commitment is during adolescence and young adulthood, when important decisions about the future need to be made (Schoon, 2001). Senior high-school students are closer proximally in time to actual career entry and may need to commit to their choice. Here, choice is more immediate for older than for younger adolescents, and can be driven by need (e.g., college, employment). Conventional wisdom suggests that older adolescents have more realistic views of career choices and options (Wahl & Blackhurst, 2000). Despite this suggestion, the career aspirations of adolescents are assumed to be unstable, and to change many times before adulthood (Schoon, 2001). There is also evidence that career development starts well before adolescence (Trice, Hughes, Odom, Woods, & McClellan, 1995). However, choice for the younger students might be more remote and best described as intentions.

Research needs to further explore the nature of the gender and grade-level effects. Examination may reveal additional theoretical mechanisms that could be generating the differences. The development of separate models for males/females, and younger/older students may provide further insight into the measures tested in the current study and elsewhere (e.g., encouragement, interests, science-task efficacy) (Bleeker & Jacobs, 2004; Lopez et al., 1997; Nauta & Epperson, 2003). Fouad and Smith (1996), for example, found a significant negative relationship between age and math/science interests in their study of middle-school students. This indicated less interest in math and science for their sample of younger children. They suggested the increasing challenge of the math and science curriculum in the middle-school years, and a wider scope of academic content as possible reasons for the decline. These findings highlight the critical role individual difference variables assume within the Lent et al. (1994) model. Career mechanisms may be different for children at particular developmental junctures. Such processes are also likely to depend on gender and other demographic variables such as race-ethnicity (Fouad & Smith, 1996).

Examination of the independent effects of the context measures indicated that family social/scientific communication and parent science encouragement/expectations had significant effects on career choice. Students were more likely to want a scientific career with increasing family discussion and encouragement by parents to do well in science. The findings for these scientific-specific measures coincide with previous research that has documented the strong influence of family and parental "push" on a child's choice of career (e.g., Wang & Staver, 2001). These contextual characteristics have been found to operate through self-capability beliefs, which in turn contribute to career choice (Bleeker & Jacobs, 2004; Ferry et al., 2000; Hackett, 1995; Juang & Vondracek, 2001; Lopez et al., 1997; Wall et al., 1999). The relationship with choice for the family discussion measure was not significant upon addition of further theoretically derived sets of measures. However, the relation for parental encouragement held upon adjustment for personal factors, learning experiences, self-efficacy, and outcome expectations. It also attained marginal significance in the final model (Model 6). The results of this study seem to confirm both direct and indirect relations of encouragement with scientific career choice.

The remaining family context measures did not perform quite as expected. In particular, family cohesiveness and career encouragement were not predictive of scientific career choice at any stage of adjustment for other measures. These variables also had coefficients/likelihood estimates in a direction that was contraindicative of theoretical expectations. Parent SES was marginally significant across models, but the odds ratios were at baseline. This is somewhat surprising, as those families that are supportive and encouraging tend to promote adolescent decision-making with respect to career choice (Bleeker & Jacobs, 2004; Dick & Rallis, 1991; Glasgow et al., 1997; Lopez et al., 1997; Juang & Vondracek, 2001; Wall et al., 1999). Likewise, children's career aspirations are likely to correspond to their parents' occupational attainment or social status (Trice & Knapp, 1992; Wahl & Blackhurst, 2000). Social background has shown to be a good indicator of the types of learning experiences encountered and interests encouraged in the child, as well as educational achievement and future occupational attainment (Schoon, 2001). Careers requiring expertise in science and math also tend to be higher in status and prestige (Ferry et al., 2000).

The findings for family cohesiveness, career encouragement, and parent SES could indicate more complex relationships between predictors, and/or the effects of these factors on scientific choice may be operating through alternative constructs. They could also be due to the non-scientific nature of the measures. In other words, these variables may influence adolescent career aspirations regardless of whether first choice of career is scientific or non-scientific. Scientific factors may have a stronger role in influencing choice of a career in the sciences. For example, even after adjustment for SES, parent scientific encouragement predicted choice of a career in the sciences. It would be interesting to include specific parent occupations in future studies of the effects of SES and scientific-related factors on adolescent career choice.

Results for the experiential variables showed that students aspiring to a career in the sciences were more likely than their peers to have higher grades in science, more confidence in their scientific ability, more friends interested in science, to expect their science courses to be useful in future, and a larger interest in science themselves. Average science/math grades, expected science course usefulness, and scientific interests remained significant in the final model (Model 6). These results are consistent with prior research (e.g., Ferry et al., 2000; Lapan et al., 1996; Lent et al., 1993; Nauta & Epperson, 2003; Schoon, 2001; Wang & Staver, 2001), and may offer a path-like explanation for the effects of the experiential factors on scientific career choice. It is possible that the grade effect (learning experiences) on career choice is mediated through self-efficacy. This is reflected in the reduced risk estimate for grades upon addition of efficacy beliefs. But the further addition of scientific outcome expectancies and interests did not appreciably affect the estimate. The final model results may thus suggest a significant direct effect of grades on career choice, and an indirect effect largely mediated through self-efficacy.

The relations between experiential constructs and choice outlined here generally coincide with evidence based on the Lent (1994) model (Borget & Gilroy, 1994; Ferry et al., 2000; Fouad & Smith, 1996; Lent et al., 1991; Lent et al., 1993; Nauta & Epperson, 2003; Post et al., 1991). Ferry and colleagues (2000) found that the effect of grades on science/math goals was mediated through both self-efficacy and outcome expectations. Self-efficacy and outcome beliefs were in turn directly associated with choice goals, with indirect effects on goals also mediated through interests. Results for the model propositions in the current study tended to correspond with the Ferry et al. (2000) results. Findings for Model 4 provided support for Proposition 3 – there was a significant direct relationship between efficacy and scientific career choice (3A). Scientific outcome expectancies also had a direct relation to scientific career choice upon addition to the model (Model 5) (4A). The latter relationship was reduced but not eliminated after adjusting for scientific interests in the final model – this offers support for an indirect effect of outcome expectancies on choice (4C). Evidence for an indirect effect of efficacy on choice through interests according to Proposition 3C was not found. This may suggest that efficacy effects are largely mediated through outcome expectancies. These findings are consistent with studies that have used younger children (Fouad & Smith, 1996).

Limitations

The present study has several limitations. The findings represent associations between each construct/measure and scientific career choice. The cross-sectional nature of the research did not permit for tests of causality. There was also the inability to track changes in scientific career development processes with time. Longitudinal work is necessary in order to confirm or clarify the attempts at effect explanation and test the predictive validity of the current results. Multiple assessments of the constructs in an order (e.g., temporal) that is strictly consonant with the Lent et al. (1994) model is needed in order to answer questions about the presumed causal sequence of the social-cognitive factors over time (Nauta & Epperson, 2003).

Data collection involved a convenience sampling design. This alone presents some question as to the representativeness of the sample and generality of the findings. These issues need to be kept in mind with respect to the self-report nature of the instrument upon which the data are based. There is the possibility of subjective bias in the information obtained – the self-report of data may be subject to inflation or underreport. The specificity of data to particular schools should also be considered. The results are specific to school-attending adolescents 13-19 years, and characteristics of the finite number of schools involved may act as ecological (group-level) confounders that cannot be addressed or adjusted for here. Therefore, caution is needed in generalizing the current findings to other groups of adolescents (e.g., home-schooled).

The findings, for the most part, followed the expected pattern and coincided with previous research concerning key theoretical relations (e.g., Ferry et al., 2000). However, future research should use alternative measures to more fully capture specific aspects of the constructs. A replication of our findings with established measures that are based on the social-cognitive career model (see Fouad & Smith, 1996) would be ideal. The degree of domain specificity of the measures and criterion should also be considered in further tests. This may involve using more homogeneous predictors (e.g., separate math and science scales) and various groupings of scientific career (Bleeker & Jacobs, 2004; Lopez et al., 1997).

Implications

This study has theoretical and practical implications for career development and practice. The social-cognitive framework is a comprehensive conceptualization of career and academic developmental processes. The usefulness of the model has been demonstrated for a sample of Canadian adolescents in the context of science career choice. The findings confirm and add empirical validity to several theoretical propositions (Lent et al., 1994). The results are also consistent with prior model testing within the science field (Ferry et al., 2000). This may point towards the robustness of the model in explaining career choice across domains of inquiry. Examining the model relations for selected measures and science career choice facilitates knowledge on the types of variables that may or may not be appropriate to use for the science domain. Further empirical comparisons may promote refinement of existing constructs by the addition of alternative measures. This is important by virtue of the multi-dimensional and complex nature of the career choice process.

The present findings highlight several key variables that could be targets for intervention. Science grades may be one such measure. Counselors and educators can design, implement, and evaluate interventions that promote successful scientific performance, and encourage students to participate in science activities (Burkham et al., 1997; Ferry et al., 2000). Such efforts would, in turn, enhance self-efficacy percepts. This may be particularly useful for those groups that have traditionally been under-represented in scientific fields (e.g., females) (Gadalla, 2001). The current research also demonstrates the important influence of parent science encouragement on adolescent career choice. Schools and communities should develop programs that emphasize the education of parents about the important role they may play in their child's choice of career (Whiston & Sexton, 1998; Wahl & Blackhurst, 2000). Effective training may provide parents with the information they need to foster their children's success in science.

Social-cognitive theory (Bandura, 1986; Lent et al., 1994) suggests that performance accomplishments and family experiences serve as sources of self-efficacy. To the extent that outcome expectancies depend on self-efficacy, interventions that enhance self-efficacy may be appropriate for targeting outcome expectations (Lopez et al., 1997). Other interventions that target outcome beliefs can focus on providing students with scientific role models and information on the positive rewards of a career in the sciences. These methods could further have an impact on the development or maintenance of scientific interests. Early intervention and support of efforts to encourage children in the sciences may facilitate entry into scientific careers.

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

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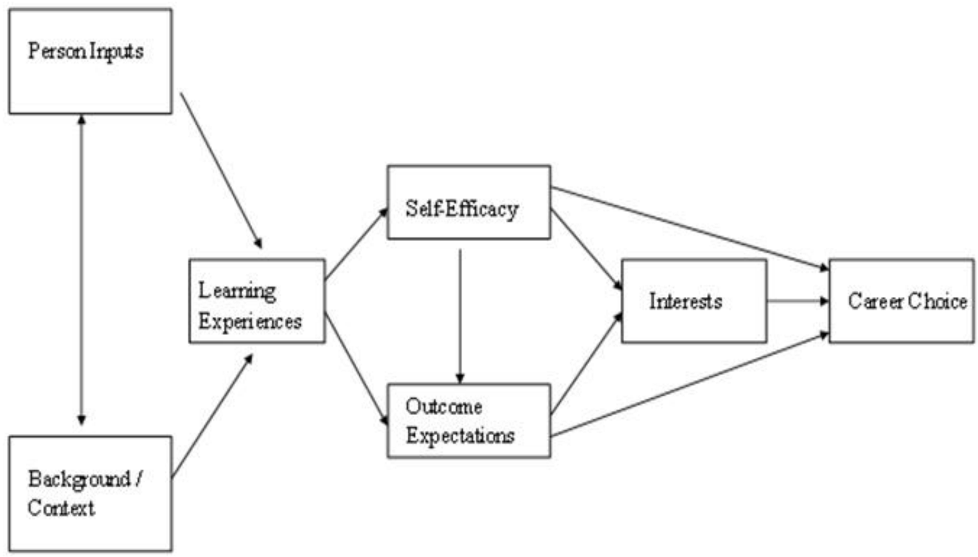
Lent, Brown, and Hackett (1994) formulated a social cognitive model of career development derived from Bandura's (1986) general social cognitive theory that illustrates the interplay among personal, background/contextual, and experiential influences on career development. It focuses on dynamic mechanisms 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.

Figure 1

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



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, science/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.

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.

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.

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	6			
Senior				
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 Females	63			
Science	32	40.60 (13)	59.40 (19)	
Non Science	31	83.90 (26)	16.10 (5)	

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.

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

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 adolescents 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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Integrating Career Development into School-Based Curriculum: Preliminary Results of an Innovative Teacher Training Program

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This study clearly showed that students throughout junior high and high school are actively thinking about their career plans and are interested in exploring and investigating future possibilities. As the researchers noted, students as young as 11 indicated that they have strong career goals and perceive themselves as ready, willing, and able to seriously consider their future career plans. (Bardick, Bernes, Magnusson, & Witco, 2006). Sixty eight percent of junior high and 74% of senior high students said they either had a specific plan or were deciding between a couple of options. Only 9% of students indicated they had no plans. In addition, a majority of the students (55% for junior high and 67% for senior high) thought career planning was either "quite" or "very" important and only 7% and 6% of the respective samples thought it was "not at all important" (Magnusson & Bernes, 2002).

More importantly, this study also showed that although the vast majority of students in junior high and senior high see the value of engaging in career planning they do not perceive those working in the educational system as particularly helpful in assisting them in this endeavor. Students were asked to rank, (first, second, third), who they would most likely approach for career help. Eighty percent of junior high and 75% of senior high students listed parents in their top three. The next highest ranking for both groups were friends (53% and 43%, respectively). Only 12% of junior high students and 36% of senior high students reported counsellors in their top three (Magnusson & Bernes, 2002). Less than 25% of junior and senior high students view their teachers as helpful in providing assistance with their career planning (Magnusson & Bernes, 2001). Students indicated that they perceive their parents and their peers as more helpful than those working in the educational system (teachers, counsellors) in assisting them with their career development needs. Interestingly, despite the fact that students report that they perceive their parents as the most helpful in helping them with their career development, parents indicated that they were unsure of how to best help their children. The results of this research suggest that despite the fact that parents believe it is important to help their children with their career development they are unsure of how to help in an effective manner (Bardick, Bernes, Magnusson & Witko, 2004).

Magnusson & Bernes (2002) argue that the results of this study indicate a need for more effective career development support to be offered within the school system. They state that to improve the quality of career development services available to students through the educational system changes are required. Specifically, teachers need to be provided with specific training in career planning so that they are better able to meet the career development needs of their students (Witco, Bernes, Magnusson & Bardick, 2005).

As a follow up to the recommendations from the Career Needs Research Project, the pilot project discussed in this article (*Career Coaching Across the Curriculum: Integrating Career Development Strategies in Classroom Instruction)* was proposed, and accepted, for implementation in the Faculty of Education teacher training program at the University of Lethbridge. The goal of this pilot project is to train teachers to integrate aspects of career planning in their specialized curriculum. The pilot project involves two main components. First, students in the Faculty of Education will be given the opportunity to take a new elective course entitled Career Education. Following the successful completion of this course, students will then be given the opportunity to function as interns in various schools throughout Southern Alberta where they will be given the opportunity to transmit the knowledge, skills, attributes they acquired in the elective course to their students through specialized curriculum. The students are placed in rural and urban schools.

At the time of this article, the initial phases of this pilot project have been implemented. In December 2008/January 2009 a research team was assembled (i.e., Dr. Kerry Bernes, Dr. Thelma Gunn and Mark Slomp), evaluation tools and an evaluation plan were developed, and an ethics proposal was submitted (and approved). In May/June, 2009 the first offering of the Career Education elective course was implemented and the first round of data collection and analysis was conducted. The remainder of this article contains a description and discussion of the results derived from the first offering of the Career Education elective course.

Method

Evaluation Framework

An evaluation framework (based on key recommendations from the Canadian Research Working Group for Evidence-Based Practice) was developed to investigate the effectiveness of the Career Coaching Across the Curriculum pilot project (Baudouin, Bezanson, Borgen, Goyer, Hiebert, Lalande, Magnusson, Michaud, Renald, & Turcotte, 2007; Lalonde, Hiebert, Magnusson, Bezanson, & Borgen, 2006). According to members of the CRWG, an effective evaluation makes explicit links between the nature of the program, the way in which the program is delivered, the ways in which participants engage with the program, the type of learning the participants experience, and the impact of the program on the lives of the participants (Smith, Schalk, & Redekopp, 2009; Hiebert & Magnusson, 2008). For this study, methods were selected in accordance with these guidelines to ensure that the data gathered could be used to inform and improve practice and demonstrate the value of the program on multiple dimensions.

Procedure

Data were collected in several ways. A pre- and post-test of knowledge and perceptions was administered at the outset and at the conclusion of the Career Education elective course. A formative evaluation of lectures and activities was administered at three separate junctures in the course. As well, a summative assessment was administered after the final class.

Pre- and post-test**.** The pre- and post-test was divided into three sections. They included demographical information, knowledge about career counselling, and perceptions about career counselling. Demographical questions provided information on the course participants (age and gender).

Participant knowledge of career counselling was also gathered before and after the Career Education course was offered. Participants were asked to describe their previous experiences with career counselling (have they taken previous courses in career counselling, or have they accessed career services in the past?). Participants were also asked to define career counselling, to describe the duties of a career counsellor and, to list and describe the main principles of a general counselling experience. Finally, participants were asked to name and describe the importance of career theorists and career counselling instruments/tests.

Participant perceptions were also measured before and after the Career Education elective course was offered. Participants were asked to rate their agreement/disagreement to a number of different statements by following a two-step process. First, participants had to decide on whether they agreed or disagreed with the statement provided, then, they were asked to decide on how strongly they agreed or disagreed. They were provided with the following options: strongly disagree (1), disagree (2), slightly agree (3), agree (4), or strongly agree (5).

Formative evaluation**.** A formative evaluation was also conducted. The Career Education elective course was offered over four weekends (Friday evening and all day Saturday) in May and June 2009. After each weekend participants were asked to evaluate the lecture topics and activities. They were first asked to indicate their level of participation in the activities/topics by identifying whether they didn't participate (1), somewhat participated (2), or fully participated (3). Then they were asked to indicate how useful they found the activities and topics. In rating the usefulness of the activities, participants were asked to follow a two-step process. First, they were asked to decide whether they found the activity/topic useful, then, they were asked to assign an appropriate rating. They were provided with the following options: not useful (0), not really useful (1), minimally useful (2), somewhere between useful and extremely useful (3), or extremely useful (4).

Summative evaluation**.** At the culmination of the Career Education course participants were also asked to complete a summary evaluation. In the summary evaluation participants were prompted to consider a number of outcomes (for example did they develop, "a clear understanding of theories of career development", "a clear understanding of how the theories of career development influence practice", "a clear understanding of how to get students involved in, and excited about, the importance of career planning", "understanding of the importance of lifelong career self-management" and "confidence in my ability to integrate career development concepts into the curriculum"). Then they were prompted to ask themselves the following question as it applied to each item: knowing what you know now, how would you rate yourself before taking this course, and how would you rate yourself now? In rating themselves before and after taking this course they were asked to follow a two-step process. First, they were asked to decide whether they would rate themselves as unacceptable or acceptable (relative to each outcome statement) before and after taking the Career Education course. Then they were asked to indicate whether their knowledge/skill/attitude before and after taking the Career Education course was: unacceptable (1), not really acceptable (2), minimally acceptable (3), somewhere between minimally acceptable and exceptional (4), and exceptional (5).

Data analysis

The data gathered through this evaluation were analyzed in several different ways. Qualitative data were analyzed through the use of content analysis methods. Quantitative data were analyzed through the use of frequency counts, percentages and mean scores. For the pre and post-test of knowledge and perceptions, overall scores (see Table 13) were tabulated through the use of a scoring rubric.

Sample

Participants in this study were self-selected. Advertisements were circulated throughout the Faculty of Education. All pre-service teachers enrolled in the Faculty of Education teacher-training program were eligible to register in the Career Education course. Tables 1 and 2 provide demographic data on the students who enrolled in the May and June 2009 offering of the Career Education course.

Table 1

Age of Participants (N=10)

Age	N	%
20-24	4	40%
25-29	5	50%
30-34	0	0%
35-39	1	10%
40+	0	0%

Table 2

Gender of Participants (N=10)

Gender	N	%
Male	2	20%
Female	8	80%

As Tables 1 and 2 show, the majority of participants were between the ages of 20-29 (90%) and were female (80%).

In the following section the results of the data collected from the May/June 2009 offering of the Career Education elective course will be presented.

Results

The results of the study will be presented according to the following sections: Pre and post-test of knowledge and perceptions, formative evaluation, and summative evaluation.

Pre and Post-test of Knowledge and Perceptions

Prior experiences with career counselling**.** Participants were asked to identify whether or not they had taken any previous courses in career counselling or whether they had accessed career services in the past. None of the students who took the May and June offering of the Career Education elective course had ever taken a course in career counselling prior to taking the Career Education elective course. All of the participants in our study had had previous personal experience with career services.

The types of personal experiences participants had with career services prior to participating in the Career Education elective course is presented in Table 3.

Table 3

Types of Personal Experiences With Career Services

Types of experience	f	%
Job/career fairs	9	50%
Career counsellor	3	17%
Career tests in high school	2	11%
High school career counsellor	2	11%
Career cruising	1	6%
Career tests	1	6%

As Table 3 suggests, the most frequently cited type of career service experienced by the participants in our sample were job/career fairs (50%) and career counselling with a high school counsellor (17%).

Definitions. In both the pre-test and the post-test participants were asked to provide a definition of career counselling. Table 4 presents the themes that emerged from an analysis of the data from the pre-test.

Table 4

Definition of Career Counselling: Pre-test

Definition of career counselling: Pre-test	f	%
Guiding others towards suitable future career paths	8	50%
Providing career information/resources	3	19%
Helping others to determine their interests/abilities	2	13%
Preparing/coaching people for jobs	1	6%
Setting goals for the future	1	6%
Help people gain career skills	1	6%

As Table 4 shows, prior to taking the Career Education course participants tended to describe career counselling as a process of matching an individual's interests and abilities with career options and providing career information/resources. The following is a sample response that typifies the responses commonly provided: "[Career counselling is] taking individual strengths and interests to determine possible job possibilities for individuals". Table 5 presents the themes that emerged from an analysis of the data from the post-test.

Table 5

Definition of Career Counselling: Post-test

Definition of career counselling: Post-test	f	%
Guide and support people through career development process	6	35%
Help people gain better self awareness (passion, skills, etc.)	3	18%
Helping people achieve optimal career (lifestyle, etc)	3	18%
Help people make meaningful career choices	2	12%
Discover possibilities for the future	2	12%
Encouraging people to follow their passion	1	6%

As Table 5 suggests, after taking the Career Education course participants typically described career counselling as supporting inidividuals through a process of crafting a meaning-filled career/life. The following is a sample response to illustrate a typical response to this item in the post-test: "[Career counselling is] guiding people through the process of career development in order for them to make appropriate and meaningful [choices]".

In both the pre-test and the post-test participants were asked to describe the role of a career counsellor. Table 6 presents the data collected in the pre-test.

As is evident from Table 6, participants described the role of a career counsellor as helping individuals discover interests/strengths, select a career path that coincides with their interests/strengths and prepare and implement a path to achieve the career objective selected. The following is a sample response that reflects the types of comments provided by participants: "A career counsellor assists the individual in finding a career that suits their needs and in implementing a plan to achieve their career goals". Table 7 presents the data collected in the post-test.

Table 6

Role of a Career Counsellor: Pre-test

Role of a career counsellor: Pre-test	f	%
Help individuals discover interests/strengths	4	25%
Help individuals find a suitable career	3	19%
Help individuals prepare and implement plan to achieve career goals	2	13%

Provide career information	2	13%
Help individuals to seek career opportunities	2	13%
Help individuals to prepare for career opportunities	1	6%
Helps individuals gain career/life skills	1	6%
Administer career tests	1	6%

Table 7

Role of a Career Counsellor: Post-test

Role of a career counsellor: Post-test	f	%
Guides individuals through career development process	4	24%
Helps individuals gain self-awareness	3	18%
Guides individuals through career decision making process	2	12%
Helps individuals create career/life plan	2	12%
Helps individuals find suitable career	2	12%
Helps individuals develop career skills	2	12%
Helps individuals discover their passion/personal meaning	2	12%

As shown in Table 7, participants' descriptions of the function of a career counsellor changed after taking the Career Education course. Descriptions contained references to guiding individuals through a process, helping individuals gain self-awareness and helping individuals determine passion/personal meaning as the foundation for building their life/career. One response that typifies the definitions provided by participants in the post-test was provided by one respondent who commented: "A career counsellor guides the client through the five stages to help the client make decisions which best suit their life, goals and dreams".

In both the pre-test and the post-test participants were asked to describe the main principles of a general counselling experience. Table 8 presents the data collected in the pre-test.

Table 8

Main Principles of a General Counselling Experience: Pre-test

Main principles of general counselling experience: Pre-test	f	%
Set goals and make plans to achieve them	3	25%
Understanding the individual (skills, strengths, etc)	3	25%
Help individuals find solutions to problems	2	17%
Guiding/assisting client	2	17%
Assist others with lifestyle choices	1	8%
Gain client's trust	1	8%

According to the themes presented in Table 8, participants described the main components of a general counselling experience as: understanding client strengths, setting goals, and guiding clients to find solutions to problems. For example, one participant defined the main principles of a general counselling experience as: "[Determining] what is wanted out of the counselling experience, setting goals, discussing how to achieve those goals". Table 9 presents the data collected through the post-test.

As Table 9 demonstrates, although participants' responses in the post-test contain some of the same element as the responses in the pre-test, the definitions provided contained a wider array of factors such as the importance of creating hope and building support. For example, one participant defined the main principles of general counselling experience as, "Establish trust, overcome barriers, discuss salient issues, create hope, generate possible ideas/possible solutions, create support groups".

Career Theorists**.** In both the pre-test and the post-test, participants were asked to identify and describe the contribution of various career theorists. In the pre-test, none of the participants were able to identify any career theorists.

Table 9

Main Principles of a Counselling Experience: Post-test

Main principles of a general counselling experience: Post-test	f	%
Assist client in finding solutions to problems	6	23%
Support/guide client	4	15%
Explore client issues	4	15%
Build trust/supportive relationship	3	12%
Determine client strengths	2	8%
Provision of emotional/psychological support	2	8%
Set goals	1	4%
Understand client	1	4%
Enhance client wellbeing	1	4%
Create hope	1	4%
Assist client in building support	1	4%

In the post-test participants were able to identify a number of career theorists (and describe their main contributions). Table 10 presents the data associated with this item.

As Table 10 illustrates, participants' knowledge of career theorists was enhanced significantly through taking the Career Education course. Whereas in the pre-test participants were unable to identify any theorist, they were able to identify many theorists in the post-test.

Career Tests**.** In both the pre-test and the post-test participants were asked to identify, and describe the function of, various career test/instruments. Table 11 presents the data associated with the pre-test.

Table 10

Career Theorists: Post-test

Career Theorists: Post-test	f	%
John Holland	9	27%
Donald Super	6	18%
Frank Parsons	5	15%
John Krumboltz	5	15%
David and Anna Miller-Tiedeman	5	15%
William Bridges	4	12%

Table 11

Career Tests/Instruments: Pre-test

Career Tests/Instruments: Post-test	f	%
Myers-Briggs Type Indicator	5	39%
Strong Interest Inventory	4	31%
General Aptitude Test Battery	1	8%
Differential Aptitude Test	1	8%
Holland Self Directed Search	1	8%
Kiersey Temperment Indicator	1	8%
Jackson Vocational Interest Survey	0	0%

As Table 11 indicates, prior to taking the Career Education elective participants had a limited knowledge of career tests/instruments. Their familiarity with career tests/instruments was mostly limited to the Strong Interest Inventory and the Myers-Briggs Type Indicator.

Table 12 provides a summary of the data collected in the post-test.

Table 12

Career Tests/Instruments: Post-test

Career Tests/Instruments: Post-test	f	%
Myers-Briggs Type Indicator	7	23%
General Aptitude Test Battery	7	23%
Strong Interest Inventory	6	19%
Holland Self Directed Search	6	19%
Jackson Vocational Interest Survey	2	7%
Kiersey Temperment Indicator	2	7%
Differential Aptitude Test	1	3%

As Table 12 demonstrates, participants had a much stronger awareness of career tests/instruments after taking the Career Education course.

Overall Scores on Pre and Post-test**.** Table 13 summarizes the total changes in knowledge experienced by participants from the pre-test to the post-test.

Table 13

Overall Knowledge Change on Pre and Post-test (N=10)

Participant	Pre-test score	Post-test score	Difference
001	9	37	28
002	17.5	35	19.5
003	5	16	11
004	11	27	16
005	7	19	12
006	8	22	14
007	11.5	22	10.5
008	8.5	19	10.5
009	14	26	12
010	11.5	46	35.5
Average	10.3	26.9	16.6

As Table 13 shows, participants' knowledge of career counselling increased greatly from the pre-test to the post-test. The average score change was 16.6 points. Out of a possible total of 58 points, participants had an average score of 10.3 points on the pre-test and 26.9 points on the post-test.

Perspectives**.** In both the pre-test and the post-test participant perspectives on career development were assessed. Participants were first asked to decide whether they agreed or disagreed with the statement provided. Then they were asked to further indicate whether they strongly disagree (1), disagree (2), slightly disagree (3), agree (4), or strongly agree (5) with the statement provided. Table 14 summarizes the data collected in both the pre-test and post-test.

Table 14

Perceptual Changes: Pre and Post-test

Perception	Mean Score (Pre-test)	Mean score (Post-test)
Choosing a career is a one-time activity that remains relevant throughout your life.	1.8 (Disagree)	1.1 (Strongly disagree)
The most effective way to select a career path is to complete a career interest inventory or a career aptitude test.	2.4 (Disagree)	1.5 (Disagree)
The main goal of occupational planning is to determine the perfect occupational match.	2.6 (Slightly agree)	2.6 (Slightly agree)

The most important goal of helping students with career planning is to get students to make a decision about the occupation they want to pursue.	3.2 (Slightly agree)	1.8 (Disagree)
When selecting a career path, the most important consideration is whether there is a high demand for workers in the occupation you are considering.	2.1 (Disagree)	1.6 (Disagree)
Today's world of work is predictable and stable.	1.4 (Strongly disagree)	1.3 (Strongly disagree)
Student should be certain about their career path when they complete Grade 12.	2.0 (Disagree)	1.7 (Disagree)
Your career begins after you complete your college or university education.	2.5 (Slightly agree)	1.6 (Disagree)
Career planning is an important activity.	4.3 (Agree)	5.0 (Strongly agree)
Career planning typically ends by the age of 30 (at the latest).	2.1 (Disagree)	1.4 (Strongly disagree)
Teachers can play a substantial role in assisting their students in their career planning.	4.8 (Strongly agree)	4.8 (Strongly agree)
Schools are currently doing a good job in assisting students in their career development.	2.2 (Disagree)	2.2 (Disagree)
Schools are currently doing an excellent job in helping students develop the skills necessary to manage their career paths in the 21st century.	2.2 (Disagree)	2.2 (Disagree)

As shown in Table 14, participants' perspectives changed between the pre and the post-test. Participants came to believe that career planning is not a one-time activity (but a lifelong process). Therefore, they did not see the primary task of assisting students with their career planning as helping students select one occupation. As a result of taking the Career Education elective course, participants began to perceive their task as much larger in scope. Specifically, they began to view their role as helping students to develop the knowledge, skills and attitudes necessary for effective lifelong career self-management. As a result of taking the course, participants also gained an enhanced appreciation for the importance of career planning.

Formative Evaluation

The Career Education course was offered on four weekends in May and June 2009. After each weekend participants were asked to complete an evaluation of the weekend's topics and activities. Participants were first asked to indicate their level of participation in each of the topics and activities by indicating whether they didn't participate (1), somewhat participated (2) or fully participated (3). Then they were asked to indicate whether they found the topics and activities useful. Participants were first asked to indicate whether they found the topic or activity useful. Then they were further asked to identify whether they found the activity not useful (0), not really useful, but almost there (1), minimally useful (2), somewhere between minimally useful and extremely useful (3), or extremely useful (4). Table 15 provides a description of the data collected after the first weekend.

Table 15

Formative Evaluation of Topics and Activities Weekend #1

Topics	Participation			Not useful		Useful			
	Didn't	Somewhat	Fully	0	1	2	3	4	Average
Career theorists	0	2	8	0	0	0	4	6	3.6
Career counselling skills	0	0	10	0	0	0	3	7	3.0
General counselling process	0	0	10	0	0	0	2	8	3.8
Career counselling skills triad	0	0	10	0	0	0	0	10	4.0
World of work	0	2	8	0	0	3	1	6	3.3
Career counselling outcomes	0	1	9	0	0	0	5	5	3.5
Career counselling process	0	0	10	0	0	0	4	6	3.6
Overall participation mean			2.86		Overall usefulness mean				3.5

As indicated by Table 15, participants were highly engaged in the topics and activities during the first weekend. Participants also rated all of the topics and activities highly. The vast majority of topics were rated either useful (3) or extremely useful (4). The highest rated topics/activities were the career counselling triads activity, the lectures/discussions on general counselling process, the lectures/discussions on career theorists and career counselling process. Table 16 presents the data collected after the second weekend.

Table 16

Formative Evaluation of Topics and Activities Weekend #2

Topics	Participation			Not useful		Useful			
	Didn't	Somewhat	Fully	0	1	2	3	4	Average
Initiation strategies	0	0	10	0	0	1	2	7	3.6

Guided imagery exercise	0	1	9	0	0	0	1	9	3.9
99 year old question	0	0	10	0	0	0	3	7	3.7
Pride story exercise	0	0	10	0	0	1	5	4	3.3
Past experiences	0	1	9	0	1	0	1	8	3.6
Formal career assessments	0	0	10	0	0	0	4	6	3.6
Semi-formal career assessments	0	0	10	0	0	0	3	7	3.7
Informal career assessments	0	0	10	0	0	0	1	9	3.9
Overall participation mean			2.98		Overall usefulness mean				3.66

As Table 16 suggests, participants were highly engaged in the topics and activities presented in the second weekend of the Career Education course. Participants also found the topics and activities very useful. The vast majority of topics were rated as either useful (3) or extremely useful (4). The highest rated topics/activities were the guided imagery exercise (3.9), the discussion of informal career assessments (3.9), the 99 year-old question activities (3.7) and the discussion of semi-formal career assessments (3.7). Table 17 presents the data collected after the third weekend.

Table 17

Formative Evaluation of Topics and Activities Weekend #3

Topics	Participation			Not useful		Useful			
	Didn't	Somewhat	Fully	0	1	2	3	4	Average
Self-portraits exercise	1	0	9	0	0	0	1	8	3.9
Decision making process	0	0	10	0	0	0	1	9	3.9
Exploration strategies	0	1	9	0	0	0	5	5	3.5
Decision making strategies	0	0	10	0	0	0	1	9	3.9
Preparation strategies	0	0	10	0	0	1	3	6	3.5

Implementation strategies	0	1	9	0	0	1	3	6	3.5
Overall participation mean			2.93	Overall usefulness mean					3.7

As is indicated by the data in Table 17, participants were highly engaged in the topics and activities presented in the third weekend. The vast majority of topics were rated as either useful (3) or extremely useful (4). The highest rated topics/activities were the self-portraits exercise (3.9), the discussion of decision-making processes (3.9) and the discussion of decision-making strategies (3.9).

Summative Evaluation

At the culmination of the Career Education elective course participants were asked to complete a summary evaluation. In completing the summary evaluation, participants were asked to rate themselves prior to taking the Career Education course and after taking the Career Education course. In doing so, they were asked to first rate whether their knowledge, skills or attitudes (on a number of important outcome items) were acceptable or unacceptable before and after taking the course. Then they were asked to identify whether their knowledge before and after taking the course was unacceptable (1), not really acceptable, but almost there (2), minimally acceptable (3), somewhere between minimally acceptable and exceptional (4), and exceptional (5). Table 18 summarizes the data collected through the summary evaluation.

Table18

Summary Evaluation

Outcomes	Mean Averages Before	After	Difference
A clear understanding of the theories of career development	1.4 (Unacceptable)	4.2 (Excellent)	2.8
A clear understanding of how the theories of career planning influence practice	1.4 (Unacceptable)	4.4 (Excellent)	3.0
A clear understanding of how to get students involved in, and excited about, the importance of career planning	2.1 (Not really acceptable, but almost there)	4.8 (Excellent)	2.7
Knowledge of resources available to students and teachers to assist students in their career planning	1.9 (Not really acceptable, but almost there)	4.4 (Between acceptable and excellent)	2.5
Confidence in my ability to integrate career development	1.8 (Not really acceptable, but	4.7 (Excellent)	2.9

principles into the curriculum	almost there)		
Knowledge of processes involved in effective career self-management	1.6 (Not really acceptable, but almost there)	4.8 (Excellent)	3.2
Understanding of the importance of lifelong career self-management	3.1 (Acceptable)	5.0 (Excellent)	1.9
Understanding of impact a teacher can have on career development of students	2.8 (Acceptable)	5.0 (Excellent)	2.2
Overall means	1.84 (Not really acceptable, but almost there)	4.66 (Excellent)	2.65

As Table 18 clearly shows, participants indicated that they achieved important outcomes. On nearly all of the outcome items, participants rated their knowledge, skills and attitudes as unacceptable before taking the Career Education. In the vast majority of cases participants rated their knowledge, skills and attitudes as either acceptable or exceptional after taking the Career Education course (as shown by mean score differences). The highest differences in mean score changes were found in the following items: "knowledge of processes involved in effective career self-management" (1.6 to 4.8), "a clear understanding of how the theories of career planning influence practice" (1.4 to 4.2), and "confidence in my ability to integrate career development principles into the curriculum" (1.8 to 4.7).

Participants were asked to identify the extent to which the changes reported in the summary evaluation were the result of taking the Career Education elective, or the extent to which the changes reported were a function of other factors in their lives. Specifically, participants were asked to identify whether the changes reported were a result of "mostly other factors", "somewhat other factors", "uncertain", "somewhat this course", and "mostly this course". Table 19 presents the data collected in response to this item.

Table 19 clearly shows that participants attributed the changes they reported to their participation in the Career Education course.

Table 19

Attribution of Outcome Change

Mostly other factors	Somewhat other factors	Uncertain	Somewhat this course	Mostly this course
0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (100%)

As part of the summary evaluation, participants were also given the opportunity to provide comments. The following comments were contributed by participants:

- Great course! Great for personal reasons as well as for integrating into the curriculum. Would have liked a bigger focus on classroom uses rather than adult career counselling. Didn't find the text at all useful.
- I found this course to be an incredibly valuable experience that provides teachers with the knowledge, skills and resources to teach career/life planning effectively!
- This course gave me many skills to develop as a teacher and personally which I feel will greatly improve my effectiveness as a teacher.
- The course was beneficial not only to my own career development, but to the understanding of career planning and career coaching. I feel confident with bringing the aspects of career coaching to the classroom.
- This class was great! So very beneficial to career planning as well as life in general. I continue to find myself using strategies learned in class on a daily basis (all stages of career process). I have and will continue to recommend this class. Very beneficial to all teachers for all areas of the curriculum.
- I found this course especially rewarding and hope to bring my enthusiasm about this new knowledge to others during my internship and teaching years to follow.
- Great class that helped with my career planning as well.
- This was the most impactful, creative, and useful education course I have taken.
- The course material was presented in a way that made it easy to incorporate into curriculum.
- This has been one of the most helpful, interesting, and applicable courses that I have taken in the four years in my university career. Everything I learned in this class can be applied to the classroom environment and is very relevant to students.

As is clear from the comments provided, the pre-service teachers in this study were enthusiastic in their comments regarding the value and utility of the Career Education course. The following section will provide some preliminary conclusions based on an analysis of the data and will suggest future directions for research.

Discussion

The results of this preliminary study allow for some tentative conclusions regarding the *Career Coaching Across the Curriculum* pilot project. It is clear from the results gathered through the use of the pre and post-test of knowledge and perceptions questionnaire and the summative evaluation questionnaire that the pre-service teachers involved in this research study made strong gains in their understanding of career development and how to effectively integrate career development into curriculum. It is also clear from this study that participants found the course to be extremely valuable – they overwhelmingly indicated that, as a result of taking the course, they feel confident in their ability to effectively integrate career education strategies into curriculum and in their ability to provide effective career planning support to students. The data gathered through subjective measures (the formative and summative evaluations) and through objective measures (the pre and post-test of knowledge and perceptions) confirms these conclusions.

Taken together, the results of this study appear to suggest that the Career Education course is highly effective in training teachers to integrate career development into the curriculum and in training them to provide high quality career support to students. However, further investigation is required to confirm this conclusion. Future studies will need to be conducted to determine whether the career education training provided to pre-service teachers is in fact contributing to the attainment of important career development outcomes for students in the K-12 educational system. As part of the second component of the *Career Coaching Across the Curriculum* pilot project, pre-service teachers will complete a practicum in elementary or secondary schools throughout Southern Alberta. Future studies will need to be conducted to investigate the impacts of the career development interventions implemented by the pre-service teachers in their role as interns on the career planning knowledge, skills and attitudes of students.

Summary

This article described an innovative pilot project designed to train teachers to integrate career education into Kindergarten-Grade 12 curriculum. It also described the preliminary research results associated with an evaluation of effectiveness of this pilot project. It is hoped that through the implementation of this pilot project, students in the K-12 educational system will have better access to high quality career planning support. Preliminary results suggest that the training provided by this pilot project is effective in preparing pre-service teachers to positively influence the career planning skills, knowledge and attitudes of students. However, further studies will need to be conducted to confirm this conclusion. Fortunately, these future studies are now in progress.

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