Identifying the Antecedent in the Relation Between Career Interests and Self-Efficacy: Is It One, the Other, or Both?

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One of the most significant theoretical advancements in vocational psychology in recent years was the explication of the social-cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994). A central tenet of SCCT is that vocational interests develop over time, partially as a function of self-efficacy expectations (Bandura, 1977, 1986). In turn, these vocational interests help determine a person’s selection of a career and performance within that career (Lent et al., 1994). A positive relationship between career self-efficacy and interests has been documented in numerous cross-sectional studies (see Lent et al., 1994), but cross-sectional designs do not allow researchers to determine whether self-efficacy is in fact an antecedent of interests. Recently, questions have arisen about the possibility of an interests-to-self-efficacy causal pathway (Lent, Brown, Gover, & Nijjer, 1996; Tracey, 2002), which would mean that the relationship between self-efficacy and interests is more reciprocal than suggested by the SCCT model. Determining the primary antecedent in the interest–efficacy relationship is important not only for theory verification but also because it would help career counselors more accurately predict the possible effects of interventions targeting either self-efficacy or interests. The purpose of this study was to examine the antecedents and consequences between inventoried career self-efficacy and interests using a three-wave longitudinal design.

Career Interest and Self-Efficacy Background

Career interests and self-efficacy are related but theoretically distinct constructs (Donnay & Borgen, 1999). Career interests have been defined as “patterns of likes, dislikes, and indifferences regarding career-relevant activities and occupations” (Lent et al., 1994, p. 88). According to Holland (1985, 1992), there are six distinct vocational interest types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC). This has been the predominant model of the structure of interests in recent decades (Borgen, 1986; Tracey, 1997), and career assessment using instruments designed to measure Holland’s six vocational interest types remains one of the most common forms of career intervention (Isaacson & Brown, 2000). Career interests play an important role in career development because they predict career choices and performance (Lent et al., 1994).

The concept of self-efficacy was introduced by Bandura (1977, 1986) as a fundamental component of his social–cognitive theory. Bandura defined self-efficacy expectations as a person’s belief or confidence in her or his ability to perform a given behavior or set of tasks. Bandura’s theory posits that self-efficacy expectations determine whether or not a person will initiate a behavior, how much effort she or he will expend, and how long he or she will sustain the behavior in the face of obstacles. Self-efficacy is highly relevant to career behavior (Hackett & Betz, 1981). For example, college students’ beliefs about their educational and occupational capabilities are significantly related to the nature and range of career options they consider (Betz & Hackett, 1981). More recent meta-analyses have also strongly supported the role of self-efficacy as a predictor of a variety of academic and vocational choices and behaviors (Lent et al., 1994; Multon, Brown, & Lent, 1991).

Although they are theoretically distinct, career interests and self-efficacy are related; the positive correlation between these variables has been one of the most robust findings in vocational psychology in recent years. This relationship has been demonstrated with numerous adult and college student samples (e.g., Betz, Harmon, & Borgen, 1996; Bieschke, Bishop, & Garcia, 1996; Lapan, Boggs, & Morrill, 1989; Lapan, Shaughnessy, & Boggs, 1996; Lenox & Subich, 1994; Lent, Larkin, & Brown, 1989; Lent, Lopez, & Bieschke, 1991, 1993; Lopez, Lent, Brown, & Gore, 1997; Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999), among samples of children (Bandura & Schunk, 1981; Tracey, ...
Influences on Career Interests and Self-Efficacy

Occupational interests tend to be quite stable in adulthood (Hansen, 1984; Swanson, 1999), although some individuals exhibit a lack of career–interest stability over time (Swanson, 1999), and new experiences may lead to changes in interests even in adulthood (Betz, 1999; Hackett, 1995; Lent & Brown, 1996). In a review of influences believed to play a role in interest development and modification, Savickas (1999) noted that one of the leading views is that interests are largely the result of a person’s self-efficacy expectations. The theoretical explanation for the self-efficacy-to-interests link is that self-efficacy expectations serve as a motivational factor because without a belief that she or he would be at least somewhat successful at a task or career, a person would have little incentive to approach and persist in that task or career (Bandura, 1986).

This hypothesized causal relationship, whereby interests are partially caused by self-efficacy, is central to SCCT. While acknowledging that most relationships in the SCCT model are probably bidirectional to some degree, Lent and colleagues (1994) argued that self-efficacy expectations primarily influence career interests. Bandura (1997) has concurred with this position, stating that “social cognitive theory posits a reciprocal but asymmetric relationship between perceived efficacy and occupational interests, with efficacy playing the stronger determinant role” (p. 242). Most researchers who have investigated the relation between career self-efficacy and interests have examined self-efficacy as a source, or predictor, of interests (e.g., Fouad & Smith, 1996; Lapan et al., 1989, 1996; Lent et al., 1991, 1994), and there is empirical support for this conceptual approach. Kahn (2000) found that among graduate students in applied psychology programs, initial research self-efficacy was predictive of 1-year changes in research interests, whereas initial interest levels were not predictive of 1-year changes in self-efficacy. In addition, self-efficacy manipulations have frequently been found to impact individuals’ interests on associated tasks or areas (e.g., Barak, Shiloh, & Haushner, 1992; Hackett, Betz, O’Halloran, & Romac, 1990; Luzzo et al., 1999).

For example, using an experimentally manipulated task–success paradigm to affect self-efficacy for completing anagram and/or math tasks, Hackett and her colleagues (Campbell & Hackett, 1986; Hackett et al., 1990; Hackett & Campbell, 1986) found stronger correlations between initial self-efficacy and postmanipulation interests than between initial interests and postmanipulation self-efficacy.

More recently, however, there has been reason to question the assumption that the relationship between career interests and self-efficacy is primarily unidirectional from self-efficacy to interests. When Lent and colleagues (1996) asked college students to list reasons for their estimates of their own competence in mathematics, 74% listed their interest in the subject as a basis for their estimates of their ability. Seventeen percent of that sample listed their interest level as the primary basis for their estimate of their math ability, suggesting that for some individuals interests may be a strong influence on self-efficacy. Lent and colleagues (1996) concluded that students may consider their interest level as a motivational factor in estimating how well they can perform a task. As Lent and colleagues (1989) explained, interest may motivate “further interaction with a task, yielding more opportunity for personal and vicarious success experiences, and thus further self-efficacy enhancement” (p. 286). In addition, recent work by Tracey (2002) supports the notion that the relationship between career interests and self-efficacy may be more reciprocal than implied by SCCT. Tracey examined the relationship between career interests and perceptions of competence among children and, using structural equation modeling, determined that a model including a bidirectional relationship between the two constructs was superior to models with unidirectional relations.

Rationale and Purpose of the Present Study

Because of the uncertainty regarding the direction of influence regarding these two important elements of career development, additional examinations of the relationship between career interests and self-efficacy are needed using research designs that are capable of demonstrating causal relationships (Betz, Harmon, & Borgen, 1996; Lent et al., 1989, 1994). Although only true experiments can determine causality, cross-lagged panel designs—in which the same variables are assessed at multiple points in time—can help establish the temporal precedence necessary to conclude that causality exists, although temporal precedence alone is not a sufficient condition of causality (Cook & Campbell, 1979). The verification of SCCT’s hypothesized temporal precedence between career interests and self-efficacy is of critical importance because SCCT has guided much vocational research in recent years. In addition, career intervention programs, such as those designed to increase women’s and minorities’ participation in science and math fields (e.g., Betz & Schifano, 2000), have intervened at the level of self-efficacy to increase math/science self-efficacy and presumably subsequent interests. Exploring the possibility that interests may also predict changes in self-efficacy would open doors for other self-efficacy-enhancing interventions that operate through piquing an individual’s interest in a topic or task.

Tracey (2002) made good progress toward the goal of elucidating the temporal precedence in the relationship between career interests and self-efficacy by determining that a reciprocal model fit his data best. Tracey’s results also intimated that self-efficacy was as strong an antecedent as it was a consequent in this rela-
tionship. However, the specification of his models did not allow for the conclusive determination of whether self-efficacy or interest was the stronger antecedent because several other differences were simultaneously tested. Not only did we want to test whether self-efficacy and interests are antecedents of one another, but we also wanted to explore which was the stronger antecedent. Moreover, we extended this line of research to young adults because this is the developmental period in which people are starting to implement vocational decisions. In addition, given the tendency for young adults’ interests to be more stable than those of children (Swanson, 1999), we wondered if the interest–efficacy relationships Tracey found would be the same among young adults. Finally, although experimental studies that have manipulated self-efficacy to determine its effect on adults’ subsequent interests (e.g., Campbell & Hackett, 1986; Hackett et al., 1990; Hackett & Campbell, 1986; Luzzo et al., 1999) have been useful ways of examining the causal nature of this relationship, they have typically explored the relation between self-efficacy and interests in only one particular area or task (e.g., anagram tasks or math problems) and may not generalize to other areas (Smith & Fouad, 1999). We therefore believed it would be important to address this issue as it relates to broad areas of career interests and self-efficacy. For this reason, we measured interests and efficacy for the RIASEC domains in the way they are most commonly assessed by career counselors who work with young adults.

College students completed the Strong Interest Inventory (SII; Harmon, Hansen, Borgen, & Hammer, 1994) and the Skills Confidence Inventory (SCI; Betz, Borgen, & Harmon, 1996) on three separate occasions (with 4-month and 3-month intervals) over the course of 1 academic year. We included three assessments because there are theoretical and empirical reasons to believe that a temporal lag occurs between newly acquired self-efficacy and subsequent interest in related tasks or activities (Bandura, 1986; Bandura & Schunk, 1981). Luzzo and colleagues (1999) found that a math and science self-efficacy-enhancing intervention had no immediate effect on corresponding interests, but participants who received the treatment did exhibit higher levels of math/science-related career interests 4 weeks later. Accordingly, we wanted to assess the relation between self-efficacy and interests over three different time periods (i.e., at 3 months, at 4 months, and at 7 months) to test this temporal lag hypothesis.

Figure 1 illustrates the general form of the cross-lagged panel models we tested. Within this framework, we tested a model with no relationship between efficacy and interests (to use as a baseline), a model with interests as the antecedent in the relationship (dashed lines), a model with self-efficacy as the antecedent (dotted lines), a model specifying a reciprocal relationship (both dashed and dotted lines), and a model specifying that interests and self-efficacy are equally strong antecedents of one another. We hypothesized that this relationship would in fact be reciprocal. However, we hypothesized stronger relationships between self-efficacy scores that precede interest scores than between interest scores that precede self-efficacy scores, as this is the relationship that appears to be most consistent with SCCT’s formulation.

Method

Participants

Participants were college students at a large Midwestern university. Two hundred fifty-one students completed the first wave of data, 124 completed the first and second waves, and 104 completed all three waves. All of our analyses are based only on the sample of 104 students for whom we had all three waves of data. This sample comprised 22 (21%) men and 82 (79%) women. Eighty-three (80%) of the participants identified themselves as Caucasian, 17 (16%) as African American, 1 (1%) as Hispanic/Latino, and 3 as “other race/ethnicity.” Fifty-one (49%) of the students were classified as freshmen, 30 (29%) were sophomores, 22 (21%) were juniors,
and 1 (1%) was a senior. The sample had a mean age of 18.88 years (SD = 1.03).

We were concerned that students who completed all three waves of data may have differed from those who completed only the first wave or the first two waves, so we compared completers and noncompleters on the six RIASEC interest variables and the six RIASEC self-efficacy variables from the first wave. The t tests revealed no significant differences between the groups on any of the Wave 1 variables (ps > .05).

**Measures**

**SII.** We used the six General Occupational Theme scores (GOTs) of the SII to assess participants’ global vocational interests in each of Holland’s six RIASEC areas. These scales have standard scores with means of 50 and standard deviations of 10. Previous research has revealed internal consistency estimates for the six GOTs ranging from .90 for the Social scale to .94 for the Artistic scale; the test–retest reliabilities for the six scales over 3- to 6-month intervals have ranged from .84 for the Enterprising scale to .92 for the Realistic scale (Harmon et al., 1994). The GOTs have been shown to possess concurrent validity when evaluated against similar interest measures such as the Vocational Preference Inventory (Hansen, 1986), and they appear to separate occupations and college majors in accordance with Holland’s theoretical predictions (Donnay & Borgen, 1996; Harmon et al., 1994), including among diverse racial/ethnic groups (Lattimore & Borgen, 1999). Finally, the GOTs have been shown to fit Holland’s theoretical hexagon (Rounds & Day, 1999).

**SCI.** We assessed self-efficacy using the SCI because of its good psychometric properties, its correspondence with the SII GOT scores, and its widespread use in vocational psychology research and practice (Harmon, Borgen, Berreth, & King, 1996). The SCI is a 60-item measure of self-efficacy, with 10 items assessing self-efficacy for each of the six RIASEC areas, yielding scores on General Confidence Themes (GCTs). Each confidence scale consists of 10 activities, tasks, or school subjects associated with the relevant Holland theme. The GCTs are not standardized but rather are the sum of the 10 items for each scale divided by the number of completed items, with scores ranging from 1 to 5. Previous research has revealed that internal consistency estimates for the six GCTs range from .84 for the Enterprising scale to .88 for the Realistic scale (Betz, Borgen, & Harmon, 1996). Parsons and Betz (1998) reported test–retest reliability coefficients of .83 to .87 over a 3-week period. The concurrent validity of the GCTs has been demonstrated by its ability to separate occupational groups as predicted by Holland’s hexagon (Betz, Borgen, & Harmon, 1996; Harmon et al., 1996), and it has been shown to possess incremental validity over interests in the prediction of occupational membership (Donnay & Borgen, 1999). Previous research has shown moderate-to-strong relationships between SII GOTs and SCI GCTs (Betz, Harmon, & Borgen, 1996; Donnay & Borgen, 1999).

**Procedure**

We invited students to participate in the initial data collection session (September 2000) with a mailed letter or an announcement on the psychology participant pool sign-up board. We primarily targeted freshmen with our recruitment efforts by sending a letter of invitation to a random sample of 400 freshmen across the university. We targeted freshmen because we believed that they would be experiencing greater changes in career interests and self-efficacy because of their exposure to new experiences at college. However, because only 20% of the targeted freshmen responded to this letter, we became concerned that we would not have sufficient statistical power to detect the small effects we anticipated. Therefore, as a compromise between sample composition and sample size, we opened the study to all students if they signed up for research participation through the psychology department participant pool. All students were informed that the study necessitated their continued participation the following semester (which precluded seniors graduating in the fall semester from participating). Of the final sample of 104, 41 (39%) were freshmen who responded to the letter of invitation and the remaining 63 (which included 10 freshmen) signed up to participate in research through the psychology department participant pool.

Students arrived at small group sessions at appointed times and were given a description of the study. They then completed a combined SII/SCI booklet. We also asked students for phone numbers and e-mail addresses so that we could contact them to invite them to participate in the two follow-up sessions later that year. For the second and third sessions (January 2001 and April 2001), we called or e-mailed students to invite them to continue with the study. Students who agreed to do so attended sessions in small groups as before. They were reminded of the purpose of the study, and then they completed SII/SCI booklets. After each of the three sessions, we gave students a $5 honorarium to thank them for their time, and after the third session we gave students a SII/SCI interpretive report based on their responses from the first data collection session. We also gave students information about opportunities for career counseling at their university and where they could get additional career information if they wished.

**Results**

Table 1 contains the correlations, means, and standard deviations for the six RIASEC self-efficacy and interest dimensions for all three test administrations. A visual inspection revealed that the obtained means were comparable to normative data reported previously for college students (Betz, Borgen, & Harmon, 1996; Harmon et al., 1994). Repeated measures analyses of variance (ANOVA), using a Bonferroni-adjusted alpha set at .004, revealed that the only significant change in mean scores over time occurred for the Artistic GCT scale, \( F(2, 102) = 6.24, p = .003, \eta^2 = .11 \), with Artistic confidence increasing over time.

**Overview of Analyses**

We used structural equation modeling with observed variables (Bollen, 1989) to test the hypotheses regarding the temporal nature of the relationship between career interests and self-efficacy. Structural equation modeling with observed variables, also called path analysis, assumes no error in measurement and provides estimates of standardized regression coefficients (i.e., betas) between observed variables. We used the LISREL 8.3 program’s maximum-likelihood procedure (Jöreskog & Sörbom, 1999) to estimate these parameters and to determine which model best reflects the nature of the data. Although this analytic method as applied to correlational data cannot confirm causal relationships, by examining the strength of the coefficients between interest and self-efficacy at different points in time we were able to gain information about temporal precedence that cannot be gained from simple cross-sectional designs.

Structural equation modeling typically requires large samples; this analysis of correlations from 104 cases yielded a lower cases-to-parameters ratio than is often recommended for such analyses (e.g., Bentler & Chou, 1987). However, recent Monte Carlo studies suggest that the maximum-likelihood test statistics we used are not severely biased with samples of at least 100 (Bentler & Yuan, 1999). Moreover, power analyses based on a test of close fit for the root-mean-square error of approximation (RMSEA; MacCallum, Browne, & Sugawara, 1996) revealed a range of statistical power.
from .74 to .77 in this study. Thus, we concluded that we had a sufficient sample for these analyses.

To examine temporal precedence in the self-efficacy-interests relationship, we tested five identical models for each time period: 3 months, 4 months, and 7 months. Model 1 specified the correlations among the 12 scales at Time 1, the correlations among the 12 scales at Time 2, and the autocorrelation between the same scales at two points in time (e.g., initial Realistic interests predicting subsequent Realistic interests). Model 1 did not specify any cross-lagged paths and was therefore the No Relationship model. Model 2, the Interest as Antecedent model, was identical to Model 1 except that we estimated the cross-lagged paths between initial interests and corresponding subsequent self-efficacy scales (e.g., initial Realistic interests predicting subsequent Realistic self-efficacy). Model 2 did not specify any paths between initial self-efficacy scores and subsequent interest scores. Model 3 was the Self-Efficacy as Antecedent model; it specified cross-lagged paths between initial self-efficacy and corresponding subsequent interest scores (e.g., initial Realistic self-efficacy predicting subsequent Realistic interests). Model 4 was a combination of Models 2 and 3, such that interests and self-efficacy were specified as antecedents of one another (e.g., initial Realistic interests predicting subsequent Realistic self-efficacy and initial Realistic self-efficacy predicting subsequent Realistic interests). Thus, Model 4, the Interest and Self-Efficacy as Antecedents model, specified a reciprocal relationship. Finally, Model 5, the Equal Antecedents model, specified that self-efficacy and interests are equally strong antecedents of one another; that is, the strength of the interest-to-efficacy beta for a given theme/type equals the strength of the efficacy-to-interest beta for the same theme/type. For example, the beta for initial Realistic interests predicting subsequent Realistic self-efficacy was constrained to equal the beta from initial Realistic self-efficacy predicting subsequent Realistic interests. Model 4 was a combination of Models 2 and 3, such that interests and self-efficacy were specified as antecedents of one another (e.g., initial Realistic interests predicting subsequent Realistic self-efficacy and initial Realistic self-efficacy predicting subsequent Realistic interests). Thus, Model 4, the Interest and Self-Efficacy as Antecedents model, specified a reciprocal relationship. Finally, Model 5, the Equal Antecedents model, specified that self-efficacy and interests are equally strong antecedents of one another; that is, the strength of the interest-to-efficacy beta for a given theme/type equals the strength of the efficacy-to-interest beta for the same theme/type. For example, the beta for initial Realistic interests predicting subsequent Realistic self-efficacy was constrained to equal the beta from initial Realistic self-efficacy predicting subsequent Realistic interests. Comparing Model 5 with Model 4 allowed us to test the hypothesis that temporal precedence was stronger in one direction than the other.
The goodness of fit of the models was assessed by three fit indices that have a relatively low occurrence of Type I and Type II error rates (Hu & Bentler, 1999). The RMSEA is a measure of fit between the observed correlation matrix and that reproduced by the model per degree of freedom. The standardized root-mean-square residual (SRMR) is the average of the standardized fitted residuals between the observed correlation matrix and that reproduced by the model. The comparative fit index (CFI) is a measure of the improvement in fit of the model compared with a null model. Recent evidence from Monte Carlo studies suggests that values of .08 or lower for the SRMR, .06 or lower for the RMSEA, and .95 or higher for the CFI suggest a good fit to the data (Hu & Bentler, 1999). Although these fit indices are recommended when evaluating overall model fit, none of these fit indices allows for a direct comparison between models. Therefore, the comparative fit of nested models was assessed by the chi-square difference test. The significance of the structural coefficients (i.e., beta weights) was determined by dividing the unstandardized parameter estimate by the estimated standard error; quotients greater than 2 were interpreted as statistically significant parameters at the .05 alpha level.

Tests of 3-Month Time Lag

We first tested the five models on the basis of data from the 3-month lag between Waves 2 and 3. The fit indices are displayed in Table 2. All five models yielded similar overall fit indices and had fairly good model fit (only the RMSEA was outside of the range of good model fit). However, chi-square difference tests revealed that some models fit better than others. Model 2, the Interest as Antecedent model, provided a significantly better fit to the data than Model 1, the No Relationship model, $\Delta \chi^2(6) = 28.02, p < .001, N = 104$ throughout. This improvement in fit suggests that there are significant interest-to-efficacy paths. Model 3, the Self-Efficacy as Antecedent model, also provided a significantly better fit to the data than Model 1, $\Delta \chi^2(6) = 34.07$,
coefficients—cross-lagged paths between interests at Wave 2 and self-efficacy at high, ranging from .77 to .88 (Wave 2 and Wave 3, the autocorrelation for interests was quite parameter estimates most accurately.) For the 3-month lag between well. Thus, results from Model 4 are presented to display the model. (Although Model 5 did not fit significantly worse than Wave 3. These coefficients are based on Model 4, the best-fitting beta weights) for the 3-month time lag between Wave 2 and efficacy paths were specified, it was still necessary to include interest-to-efficacy paths. However, the converse was not true; when interest-to-

to-interest paths were specified, it was not necessary to include the 3-month period, the relationship from initial self-efficacy to our surprise, Model 3, the Self-Efficacy as Antecedent model, failed to provide a significantly better fit to the data than Model 1, $\Delta \chi^2(6) = 25.57, p < .001$, suggesting that a significant interest-to-efficacy relationship exists. However, to our surprise, Model 3, the Self-Efficacy as Antecedent model, provided a significantly better fit to the data than Model 1, the No Relationship model, $\Delta \chi^2(6) = 28.79, p < .001$; and a significantly better fit than Model 3, $\Delta \chi^2(6) = 22.74, p < .001$. These improvements in fit indicate that even when the efficacy-to-interest paths were specified, it was still necessary to include interest-to-efficacy paths, and vice versa. In other words, there appears to be a reciprocal relationship between interests and self-efficacy over this 3-month period. Finally, Model 5, the Equal Antecedents model, assessed whether the interest-to-efficacy paths were of the same magnitude as the efficacy-to-interest paths. However, the converse was not true; when interest-to-

to-interest paths were specified, it was not necessary to include the 3-month period, the relationship from initial self-efficacy to our surprise, Model 3, the Self-Efficacy as Antecedent model, did not provide a significantly worse fit to the data than Model 4, $\Delta \chi^2(6) = 10.40, p > .05$, suggesting that the strength of the cross-lagged paths did not differ. Thus, for the 3-month time lag, the relationship between interests and efficacy appears to be reciprocal, with each variable being an equally strong antecedent of the other.

Table 3 presents the standardized structural coefficients (i.e., beta weights) for the 3-month time lag between Wave 2 and Wave 3. These coefficients are based on Model 4, the best-fitting model. (Although Model 5 did not fit significantly worse than Model 4 for the 3-month time lag, these models did not fit equally well. Thus, results from Model 4 are presented to display the parameter estimates most accurately.) For the 3-month lag between Wave 2 and Wave 3, the autocorrelation for interests was quite high, ranging from .77 to .88 ($M = .83$). Thus, interests remained fairly stable over the 3-month period. The self-efficacy autocorrelation was also fairly high (with the exception of Social self-efficacy), with coefficients ranging from .59 to .89 ($M = .77$). The cross-lagged paths between interests at Wave 2 and self-efficacy at Wave 3 were small in magnitude ($M = .10$), but four of the coefficients—Realistic, Social, Enterprising, and Conventional—were statistically significant. The cross-lagged paths between Wave 2 self-efficacy and Wave 3 interests were also small ($M = .12$), but all six coefficients were statistically significant. All cross-lagged coefficients were positive, with higher initial reports of interest/self-efficacy being associated with an increase in reported interest/self-efficacy over a 3-month period.

Tests of 4-Month Time Lag

We next tested the five models on data from Waves 1 and 2, representing the 4-month time lag. Fit indices for these models are also displayed in Table 2. As with the data from the 3-month time lag, all five models yielded acceptable overall fit indices, with the exception of the RMSEA. Model 2, the Interest as Antecedent model, provided a significantly better fit to the data than Model 1, the No Relationship model, $\Delta \chi^2(6) = 25.57, p < .001$, suggesting that a significant interest-to-efficacy relationship exists. However, to our surprise, Model 3, the Self-Efficacy as Antecedent model, did not provide a significantly better fit to the data than Model 1, $\Delta \chi^2(6) = 12.04, p > .05$. In other words, unlike the results from the 3-month period, the relationship from initial self-efficacy to subsequent interests was not supported over this 4-month period. Model 4, the Interest and Self-Efficacy as Antecedents model, did provide a significantly better fit to the data than Model 1, $\Delta \chi^2(12) = 36.77, p < .001$, and Model 3, $\Delta \chi^2(6) = 24.73, p < .001$, suggesting that even when efficacy-to-interest paths were specified, it was still necessary to include interest-to-efficacy paths. However, the converse was not true; when interest-to-efficacy paths were specified, it was not necessary to include the efficacy-to-interest paths, $\Delta \chi^2(6) = 11.20, p > .05$. Finally, Model 5, the Equal Antecedents model, provided a significantly worse fit to the data than Model 4, $\Delta \chi^2(6) = 18.99, p < .01$, suggesting that the strength of the cross-lagged paths did indeed differ. Thus, for the 4-month time lag, the paths from initial

<table>
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<th>$\chi^2$</th>
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<th>RMSEA</th>
<th>SRMR</th>
<th>CFI</th>
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<td>3. Self-efficacy as antecedent</td>
<td>286.51$^*$</td>
<td>126</td>
<td>.09 (.07–10)</td>
<td>.07</td>
<td>.94</td>
</tr>
<tr>
<td>4. Interest and self-efficacy as antecedents</td>
<td>269.42$^{a,b,c}$</td>
<td>120</td>
<td>.09 (.07–10)</td>
<td>.07</td>
<td>.94</td>
</tr>
<tr>
<td>5. Equal antecedents</td>
<td>287.48$^{a,d}$</td>
<td>126</td>
<td>.09 (.07–11)</td>
<td>.07</td>
<td>.94</td>
</tr>
</tbody>
</table>

Note. RMSEA = root-mean-square error of approximation (includes 90% confidence interval); SRMR = standardized root-mean-square residual; CFI = comparative fit index.

$^{a}$ Significantly different from Model 1, $p < .05$. $^{b}$ Significantly different from Model 2, $p < .05$. $^{c}$ Significantly different from Model 3, $p < .05$. $^{d}$ Significantly different from Model 4, $p < .05$. $^{e}$ Significantly different from Model 3, $p < .05$. $^{f}$ Significantly different from Model 4, $p < .05$.
Table 3
Standardized Structural Coefficients for the Three Time Periods (Model 4)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Autocorrelation</th>
<th>Cross-lagged path</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wave 1</td>
<td>Wave 2</td>
</tr>
<tr>
<td>Wave 2 interests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Realistic</td>
<td>.84*</td>
<td>—</td>
</tr>
<tr>
<td>Investigative</td>
<td>.81*</td>
<td>—</td>
</tr>
<tr>
<td>Artistic</td>
<td>.85*</td>
<td>—</td>
</tr>
<tr>
<td>Social</td>
<td>.75*</td>
<td>—</td>
</tr>
<tr>
<td>Enterprising</td>
<td>.75*</td>
<td>—</td>
</tr>
<tr>
<td>Conventional</td>
<td>.82*</td>
<td>—</td>
</tr>
<tr>
<td>Wave 2 self-efficacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Realistic</td>
<td>.73*</td>
<td>—</td>
</tr>
<tr>
<td>Investigative</td>
<td>.68*</td>
<td>—</td>
</tr>
<tr>
<td>Artistic</td>
<td>.71*</td>
<td>—</td>
</tr>
<tr>
<td>Social</td>
<td>.62*</td>
<td>—</td>
</tr>
<tr>
<td>Enterprising</td>
<td>.85*</td>
<td>—</td>
</tr>
<tr>
<td>Conventional</td>
<td>.77*</td>
<td>—</td>
</tr>
<tr>
<td>Wave 3 interests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Realistic</td>
<td>.91*</td>
<td>.88*</td>
</tr>
<tr>
<td>Investigative</td>
<td>.75*</td>
<td>.77*</td>
</tr>
<tr>
<td>Artistic</td>
<td>.72*</td>
<td>.81*</td>
</tr>
<tr>
<td>Social</td>
<td>.65*</td>
<td>.84*</td>
</tr>
<tr>
<td>Enterprising</td>
<td>.72*</td>
<td>.80*</td>
</tr>
<tr>
<td>Conventional</td>
<td>.76*</td>
<td>.85*</td>
</tr>
<tr>
<td>Wave 3 self-efficacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Realistic</td>
<td>.71*</td>
<td>.76*</td>
</tr>
<tr>
<td>Investigative</td>
<td>.68*</td>
<td>.77*</td>
</tr>
<tr>
<td>Artistic</td>
<td>.80*</td>
<td>.89*</td>
</tr>
<tr>
<td>Social</td>
<td>.43*</td>
<td>.59*</td>
</tr>
<tr>
<td>Enterprising</td>
<td>.77*</td>
<td>.85*</td>
</tr>
<tr>
<td>Conventional</td>
<td>.66*</td>
<td>.75*</td>
</tr>
</tbody>
</table>

Note. Autocorrelation = the structural coefficient between the same constructs at two points in time (e.g., Wave 1 interest and Wave 2 interest, or Wave 2 self-efficacy and Wave 3 self-efficacy). Cross-lagged path = the structural coefficient between two different constructs at two points in time (e.g., Wave 1 interest and Wave 2 self-efficacy, or Wave 2 self-efficacy and Wave 3 interest). *p < .05.

interests to subsequent self-efficacy were stronger than the paths from initial self-efficacy to subsequent interests; these latter paths were (as a whole) not statistically significant.

Beta weights for the 4-month lag between Waves 1 and 2 are displayed in Table 3. The autocorrelation for interests was again quite high, ranging from .75 to .85 (M = .80), indicating a fair amount of stability in interest ratings. The autocorrelation for self-efficacy was comparable to what was found with the 3-month time lag, with coefficients ranging from .62 to .85 (M = .73). All of the cross-lagged paths between Wave 1 self-efficacy and Wave 2 interests were small (M = .06), and only the Enterprising coefficient was significant. For the cross-lagged coefficients between initial interests and subsequent self-efficacy (M = .09), two coefficients—Investigative and Social—were statistically significant. Thus, in general, the cross-lagged paths were weaker across the 4-month period than the 3-month period, particularly when self-efficacy was the antecedent.

Tests of 7-Month Time Lag

Finally, we estimated the same models on the basis of data over the 7-month period (Wave 1 to Wave 3). These tests once again yielded comparable fit indices across the five models, but the fit was not adequate based on the RMSEA and CFI; only the SRMR values were within range of acceptable model fit. A comparison of chi-square values between Models 1 and 2 again indicated the importance of including the interest-to-efficacy paths when compared with a model specifying no cross-lagged paths, $\Delta \chi^2(6) = 21.10, p < .01$. Similarly, Model 3 provided a significantly better fit to the data than Model 1, $\Delta \chi^2(12) = 54.86, p < .001$, and Model 4 also fit better than both Model 2, $\Delta \chi^2(6) = 33.76, p < .001$, and Model 3, $\Delta \chi^2(6) = 17.09, p < .01$. These differences indicate that interest-to-efficacy paths exist even when specifying efficacy-to-interest paths, and vice versa. Model 4 provided a significantly better fit to the data than Model 5, $\Delta \chi^2(6) = 18.06, p < .001$, suggesting that the strength of the cross-lagged paths differed between interest-to-efficacy paths and efficacy-to-interest paths. Thus, for the 7-month time lag, there was a reciprocal relationship, and the temporal precedence differed in strength.

Table 3 reveals that the cross-lagged paths across 7 months were generally stronger for initial self-efficacy predicting a change in interest (M = .12) than for initial interest predicting a change in self-efficacy (M = .08). Specifically, four self-efficacy themes—Artistic, Social, Enterprising, and Conventional—were significant predictors of a change in interest levels. As expected, higher levels of self-efficacy were associated with greater increases in interest. By contrast, only two interest types—Social and Conventional—were significant predictors of changes in self-efficacy, for these two types, higher initial reports of interest were associated with a greater increase in self-efficacy. As with the shorter time lags, the autocorrelation was fairly high for interests, with coefficients ranging from .65 to .91 (M = .76). Autocorrelation coefficients for self-efficacy were somewhat lower, with a range from .43 to .80 (M = .68).

Discussion

The results from our 3-month and 7-month time periods were consistent with Tracey’s (2002) finding among children that the relationship between career interests and self-efficacy is bidirectional or reciprocal. The results from our 4-month lag period were indicative of a significantly stronger interest-to-self-efficacy pathway, but the magnitude of the effect was small. Thus, the most straightforward interpretation of the data is that the relationship between career interests and self-efficacy is largely reciprocal because any difference we noted between the cross-lagged paths was small at best. SCCT (Lent et al., 1994) does allow for the possibility of a reciprocal relationship between the two constructs; thus, SCCT is supported by our data in one sense. However, the diagrams used to illustrate the SCCT model imply a stronger and more immediate efficacy-to-interest path than interest-to-efficacy path, and many researchers have conceptualized self-efficacy exclusively as the source or predictor, rather than outcome, in this relationship. Our data, along with other recent research (Lent et al., 1996; Tracey, 2002), suggest that to assume a primarily efficacy-to-interest path is questionable; to a large extent, initial interests were also a significant predictor of subsequent self-efficacy.
On the basis of these findings, we concur with Lent et al.’s (1989) and Tracey’s (1997, 2002) suggestion that interests may influence self-efficacy development in a motivational capacity. We suspect that, when making self-efficacy judgments, students engage in the meta-cognitive strategy of considering their level of interest because they have found that they are more likely to exert effort when they find a task or area interesting. Perhaps this interest-to-efficacy path is relatively strong among college students because they receive very regular feedback about their performance in the form of grades and have ample opportunity to evaluate the association between their interest in a course, the effort they expend, and their final grade. Likewise, other extracurricular activities that students commonly pursue in college (e.g., participation in Greek organizations or other social clubs and activities) may initially draw students because of their interest and then subsequently impact perceptions of competence as a result of successful experiences. This may help explain our finding that, across all three time periods, initial Social interests were modestly but significantly predictive of subsequent Social self-efficacy. The data from our 7-month time period were more consistent with SCCT’s (Lent et al., 1994) and Bandura’s (1997) supposition of a stronger efficacy-to-interest pathway than interest-to-efficacy pathway, although we remind the reader that this effect was small in magnitude. Although these 7-month data still revealed a reciprocal relationship between interests and self-efficacy overall, for four of the RIASEC types self-efficacy was a significant predictor of interests 7 months later, but for only two of the RIASEC types was interest a significant predictor of subsequent self-efficacy. Neither the data from the 3-month or the 4-month time period revealed a stronger efficacy-to-interest path than an interest-to-efficacy path, suggesting that SCCT becomes a more accurate reflection of the relationship between these two variables as one considers them over longer periods of time.

This finding that self-efficacy was predictive of interests after a time delay also lends some support to Bandura’s (1986) temporal lag hypothesis, but the evidence is far from conclusive. Only one efficacy-to-interest path was significant over a 4-month period, but four efficacy-to-interest paths were significant over a 7-month period, suggesting that the hypothesized efficacy-to-interest relationship becomes stronger over time. However, we were puzzled to note that all six efficacy-to-interest paths were significant across the 3-month period, a finding that runs counter to the temporal lag hypothesis. We suspect this finding was due to the schedule of data collection introducing new learning experiences as a source of variance. Specifically, the 3-month period spanned only one academic semester, whereas the 4-month and 7-month periods spanned two semesters. Perhaps Wave 2 self-efficacy estimates (measured at the start of the semester) were more strongly related to Wave 3 interest reports (measured toward the end of the semester) because the environmental context was constant. The changing contexts that occurred between two different semesters would have probably introduced additional sources of variance in interest changes, such as new learning experiences or role models. Clearly, further replication of our results would be necessary to understand this temporal lag phenomenon more fully. However, the mildly changing nature of the relationship between self-efficacy and interests over time in our study does highlight the need for multiple follow-up assessments in outcome research examining the effects of self-efficacy-enhancing interventions on subsequent interests.

Aside from the results regarding the antecedent and consequent in the relationship between career interests and efficacy, another noteworthy finding in our study was that both the interest and the self-efficacy variables showed considerable stability over 3-, 4-, and 7-month time periods, although this stability appeared to be more pronounced with the interest variables than with the self-efficacy variables. In fact, given this stability it is noteworthy that we detected any cross-lagged effects at all. Because nearly half our sample was made up of college freshmen who were undoubtedly going through many life changes and acquiring many new experiences, this stability in scores seems quite striking. The strong test–retest correlations reflect well on the psychometric properties of the SII and SCI. Although the test–retest reliability of the SII has been soundly established over varying time intervals (Harmon et al., 1994), our data extend the literature on the SCI (Betz, Borgen, & Harmon, 1996) by documenting the stability of its scores over a lengthier time period than has been previously reported. Our findings suggest that counselors who assess clients’ self-efficacy can assure their clients that, as is the case with interests, in the absence of specific intervention their inventoried self-efficacy scores are likely to remain fairly constant over the next several months. Other research (Betz & Schifano, 2000; Luzzo et al., 1999) has shown that self-efficacy expectations may be modified through intervention, however, so it would not be prudent to consider SCI scores as completely unmaalleable.

Limitations and Recommendations for Future Research

The results of our study need to be considered in light of some methodological and conceptual considerations. First, although our sample was similar in racial/ethnic background to the student population in which data were collected, it largely comprised individuals who identified themselves as Caucasian, and the sample was also predominantly female. Previous research has suggested that the structure of career interests is relatively similar among individuals with diverse ethnicities (Lattimore & Borgen, 1999), but we do not know how race/ethnicity may affect the relationship between interests and self-efficacy over time. Likewise, some research (Campbell & Hackett, 1986; Hackett & Campbell, 1986) has detected gender differences in the self-efficacy–interest relationship (depending on the nature of the task being rated), even though the SCI has been shown to be predictive of SII GOTs among both women and men (Betz, Borgen, Kaplan, & Harmon, 1998; Betz, Harmon, & Borgen, 1996). Moreover, Tracey (2002) did not detect gender invariance in the RIASEC interest–efficacy relationships among middle school students. Our small sample size precluded an examination of race/ethnicity and gender as moderators in the efficacy–interest relationship. It is important to exercise caution when considering the generalizability of findings to a larger and more diverse population of college students. Clearly, cross-validation of the results from this study is needed. It would also be useful for future research to examine gender and race as potential moderating variables in self-efficacy–interest relationships.

Additional questions about the generalizability of our sample are raised by the low response rate to our letter of invitation to participate in the research and the substantial dropout rate of participants over the 7-month period of study. Although we did not detect differences between completers and noncompleters of the
study on the Wave 1 variables, we do not know the degree to which our sample was representative of college students at the university they attended or of college students in general. We are not aware of theoretical reasons that suggest the interest–efficacy relation would vary as a function of variables that might have led participants not to complete the study, but it will be important for future research to replicate our findings using procedures that maximize participant completion of multiple data waves (e.g., perhaps by assessing interests and self-efficacy as part of university freshman orientation programs or as part of career exploration courses that span an academic semester).

A final issue regarding generalizability is the age and life circumstances of our participants. We wanted to extend Tracey’s (2002) research on the relation between career interests and self-efficacy to a young adult sample because this is a time when many individuals make crucial career decisions and seek career counseling. Holland (1985, 1992) has argued that interests tend to become relatively stable by late adolescence; our data did suggest stability among the self-efficacy and interest constructs with our sample of college students. Nevertheless, sampling a more mature population might yield even more stable scores on the efficacy and interest types, potentially changing the nature of the relationship between the two variables. It would be useful for future research to examine this relationship among employed adult samples as well.

Another issue to consider is the broad conceptualization of career interests and self-efficacy we used in this study. We were particularly interested in assessing the relationship between interests and self-efficacy using measures widely used by career counselors; the SII and SCI were ideal in this respect (Isaacson & Brown, 2000). Because it was important to assess self-efficacy and interests for analogous domains, we used students’ GOT and GCT scores. (The SCI does not provide self-efficacy indices for specific careers, so there was no companion to the SII Basic Interest Scales or Occupational Scales.) However, GOT and GCT scores reflect students’ efficacy and interests for broad, somewhat varied areas. Bandura (1977) has suggested that the most appropriate way to measure self-efficacy is at the task level. It would be useful for future studies to examine the nature of the relationship between career interests and self-efficacy using a self-efficacy measure that would correspond to the SII Basic Interest Scales or Occupational Scales.

Finally, our study isolated only one of SCCT’s (Lent et al., 1994) central propositions. The complex SCCT model appropriately posits other sources, or predictors, of both self-efficacy and interests. For example, the model suggests that outcome expectations (beliefs about the consequences of engaging in a task or set of behaviors) also play a pivotal role in interest development, and self-efficacy is believed to result from previous success/failure experiences and other sources, such as verbal persuasion, physiological arousal, and vicarious learning (Bandura, 1977, 1986, 1997). Our data allowed us to hold a magnifying glass to the self-efficacy–interest relationship in SCCT, but we were not able to look at this relationship in the context of other variables that may influence both interests and self-efficacy. It is possible that a third variable caused changes in both self-efficacy and interests, and it is also possible that a third variable could account for the different temporal lag effects. For example, exposure to a powerful role model could have immediate positive effects on a student’s interest in an area but have effects on self-efficacy only after a temporal delay. Such a phenomenon could make it appear that initial interests cause a change in self-efficacy when, in fact, this apparently causal relationship is spurious. Likewise, the interest-to-self-efficacy paths in our study could be explained by SCCT in the form of goals and actions. According to SCCT, a person’s goals and actions are determined, in part, by their interests (Lent et al., 1994). The experiences that a person obtains as a result of their actions then provide learning experiences that feed back into the SCCT model in the form of self-efficacy sources. Thus, an interest-to-efficacy path may be indirect through several factors that we did not assess. Again, longitudinal research investigating the association between multiple SCCT constructs, including person and environment variables, assessed over time would be necessary to detect this possibility.

Implications for Career Counseling Practice

In addition to highlighting the need for researchers to consider interests as a consequent as well as an antecedent of self-efficacy expectations, our results also have implications for career counseling. It is important for counselors to have accurate information about how efficacy and interest variables relate to each other so they may make well-informed decisions regarding the counseling needs of clients. In general, our findings suggest that it would be most useful to consider the relationship between career interests and efficacy to be reciprocal, such that increases in one are likely to lead to subsequent increases in the other, although again these relationships are small over a period of a few months. Reports generated from the commonly used Campbell Interest and Skill Survey (Campbell, Hyne, & Nilsen, 1992) and SII/SCI battery provide recommendations regarding career considerations for clients on the basis of their self-efficacy expectations and interests assessed at one point in time. For example, clients are encouraged to pursue careers in areas in which they have high interest and efficacy, and they are encouraged to consider engaging in efficacy-enhancing strategies for areas in which interest is high but efficacy is lower. Our findings suggest that it may be useful for counselors and clients to consider the recent history of these interests and efficacy self-expectations when interpreting test feedback, as any recent changes in one may have subsequent effects on the other that are detectable only after a temporal lag that extends beyond the duration of the counseling relationship. Accordingly, the career counselor is reminded to provide ongoing assessment of interests and self-efficacy in any extended work with clients.

If career counselors and their clients determine that it would be useful to increase self-efficacy or interests in a particular domain, research does support the use of methods such as verbal persuasion and performance accomplishments as mechanisms for doing so (Bandura, 1997; Betz & Schifano, 2000; Lent et al., 1991, 1996; Luzzo et al., 1999; Matsui, Matsui, & Ohnishi, 1990). Our findings, coupled with other research supporting an interest-to-efficacy pathway (Lent et al., 1999; Tracey, 2002), suggest that it also may be possible to modify self-efficacy expectations by intervening at the level of interests. For example, because lower self-efficacy expectations in math and science have been identified as a barrier to women’s and minorities’ participation in science and math (e.g., Betz & Schifano, 2000; Hackett & Betz, 1981), interventions have been developed to increase math/science self-efficacy among such individuals by providing success experiences, opportunities for
vicarious learning, and verbal persuasion (Betz & Schifano, 2000; Hackett et al., 1992; Lent et al., 1993; Luzzo et al., 1999). Perhaps another route to higher self-efficacy expectations would be to increase interests, for example, by providing access to stimulating lectures, demonstrations, or programs in math or science.

In summary, our findings corroborate the notion that young adults’ career interests and self-efficacy are relatively stable over time (Hansen, 1984; Swanson, 1999), although not to such a degree as to negate the cross-lagged paths between the two over the relatively short periods of time we investigated. Our findings are consistent with Tracey’s (2002) findings among children that the interest–self-efficacy relationship is reciprocal, although our data suggest that the reciprocal paths may be unequal depending on the length of time between assessments.

References
Kahn, J. H. (2000, August). *Research training environment changes:


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