Journal of Counseling Psychology
2009, Vol. 56, No. 3, 392–407

0022-0167/09/$12.00 DOI: 10.1037/a0016407

Interpreting the Interest–Efficacy Association From a RIASEC Perspective

Patrick Ian Armstrong and David L. Vogel
Iowa State University

Social cognitive career theory (SCCT) defines self-efficacy as the critical variable that influences the development of career-related beliefs and attitudes, including interest. In comparison, the authors propose that J. L. Holland's (1997) theory of Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC) types can be interpreted as supporting an alternative model in which both interest and self-efficacy are components of an individual's vocational identity. Meta-analytic research indicates that RIASEC-based measures of interest and self-efficacy are positively correlated, but these results are also interpreted as supporting the distinctness of the two constructs. The present study evaluates links between interest and self-efficacy with occupation- and activity-based measures of interest and self-efficacy. Multidimensional scaling, cluster analysis, and structural equation modeling results suggest that observed correlations between interest and self-efficacy measures can be attributed to shared Holland-type characteristics of the measures. These results support a Holland-based integrated model of individual differences, with both interest and self-efficacy indicators of RIASEC types, thereby raising questions about the ordering of self-efficacy and interest measures in the SCCT model but also highlighting the importance of assessing both constructs in applied settings.

Keywords: Holland's RIASEC types, interests, self-efficacy, social cognitive career theory, structural equation modeling

In recent years, the emergence of social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994), based on Albert Bandura's (1982, 1986, 1997) self-efficacy theory, has served as a catalyst for the development of new measures of career-related self-efficacy beliefs, such as the Skills Confidence Inventory (SCI; Betz, Borgen, & Harmon, 1996, 2005). In SCCT, self-efficacy is the key variable that shapes the development of career aspirations, including vocational interests. Numerous researchers have used the SCCT hypothesis that self-efficacy is the pivotal variable in the career choice and development process as a basis for their work (see, for example, Lent, Brown, & Hackett, 2000; Tokar, Thompson, Plaufcan, & Williams, 2007; Williams & Subich, 2006). However, although self-efficacy measures have been found to be related to interest (Rottinghaus, Larson, & Borgen, 2003) and to provide incremental validity when used jointly with interest measures to assess career choices (Betz & Rottinghaus, 2006), research has not consistently supported the links between interest and self-efficacy proposed in SCCT (Nauta, Kahn, Angell, & Cantarelli, 2002; Tracey, 2002a). As such, other theories may either equally or more effectively account for the relation between self-efficacy and interests.

One theory that provides an alternative model for the interest–efficacy association is the work of Holland (1959, 1997), who proposed that individuals and work environments could be classified on the basis of similarity to the six RIASEC types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Holland, Whitney, Cole, and Richards (1969) proposed a hexagon to represent the interrelations among the types ordered clockwise as R-I-A-S-E-C, with the degree of similarity between any two of the types being inversely proportional to the distance between the two. The cognitive map of occupations created by the spatial model of the six Holland types can be used to help individuals identify occupational choices, with areas of the spatial model where the individual's interests are strongest often identified with the results of an interest inventory (Rayman & Atanasoff, 1999). Holland's (1959, 1997) model currently stands as the dominant interpretive framework for interest measures (Campbell & Borgen, 1999; Rounds & Day, 1999), including the Strong Interest Inventory (SII; Donnay, Morris, Schaubhut, & Thompson, 2005; Harmon, Hansen, Borgen, & Hammer, 1994), and has also been used to develop occupational classification systems (McDaniel & Snell, 1999).

Although Holland (1959, 1997) did not use the term self-efficacy in his writing, we propose that from the perspective of the RIASEC model the association between self-efficacy and interest can be interpreted as a product of shared Holland-type characteristics that underlie measures of each construct. In other words, when examined from a RIASEC-based perspective, the interest–efficacy distinction that is of central importance in SCCT can be recast as a measurement issue secondary to the Holland types. However, this RIASEC-based interpretation of the correlations between interest and self-efficacy measures has not been the focus of interest–efficacy research. Tracey (2002a) and Nauta et al.

Patrick Ian Armstrong and David L. Vogel, Department of Psychology, Iowa State University.

We thank Kate Junk and Wyndolyn Ludwikowski for their assistance with data collection, and we thank Sara Anthoney and James Rounds for their feedback on this article.

Correspondence concerning this article should be addressed to Patrick Ian Armstrong, Department of Psychology, Iowa State University, W112 Lagomarcino Hall, Ames, IA 50010. E-mail: pia@iastate.edu

(2002) have found reciprocal interest–efficacy links that are consistent with the predictions in Holland's (1959, 1997) theory, but a more comprehensive test of the different Holland (1959, 1997) and SCCT perspectives requires comparing a SCCT-based model defining interests and self-efficacy as separate constructs to a Holland-based model that defines the constructs as RIASEC-type indicators. Therefore, in the present study, we examine the extent to which interest–efficacy correlations can be attributed to shared RIASEC characteristics with a Holland-based model and compare this model to an SCCT-based model that treats interests and self-efficacy measures as indicators of distinct interest and self-efficacy constructs.

Holland's RIASEC Model and Career Assessments

The development of Holland's (1959, 1997) theory, and its emergence as the dominant model of career assessment, has been tied primarily to interest measures (Rounds, 1995). Despite the importance of interest constructs as a starting point for the theory, Holland has consistently viewed the RIASEC types as multifaceted constructs, encompassing more than interest.

> Out of his experience, a person develops habitual ways of coping with the tasks presented by his psychological, social, and physical environment, including vocational situations. His biological and social heredity, coupled with his personal history, creates a characteristic set of abilities, perceptual skills and outlook, life goals, values, self-concepts (his image and evaluation of himself), and coping behavior (his typical methods of dealing with the problems of living). A type is then a complex cluster of personal attributes (Holland, 1966, p. 10).

As such, Holland (1966) proposed that a variety of personal attributes become linked together in the RIASEC types. Furthermore, the emergence of the types is seen as a developmental process influenced by interactions among abilities, interests, and experiences. The timing and sequence of the developmental processes in the theory are somewhat vague, but Holland (1966) emphasizes the importance of resolving the multiple and interrelated influences of parents, school-related experiences, understanding of social class and community, and perceptions of skills and interests as part of developing a vocational identity (see Holland, 1966, p. 12).

The complexity of Holland's (1959, 1997) type definitions, reflecting combinations of interests, competency beliefs, and other influences, can be seen in the development of the self-directed search (SDS; Holland, Fritzsche, & Powell, 1997). The SDS includes items measuring interest in activities and occupations, ratings of competency in different activities, and self-estimates of abilities in each of the six RIASEC categories. The scores obtained for the interest, competency, and ability ratings are then added together to produce a total score for each type. Using structural equation modeling (SEM), Dumenci (1995) evaluated the construct validity of the SDS, finding a good fit for a RIASEC model with six correlated trait factors representing the six RIASEC types as combinations of the SDS subscales measuring interest, competency beliefs, and ability self-ratings. Therefore, although Holland (1959, 1997) did not explicitly refer to self-efficacy in his theory, we propose that Holland's (1959, 1997) model can be used as an alternative framework for interpreting the relations between interests and self-efficacy.

As illustrated in Figure 1, Holland et al. (1969) proposed a spatial model of the RIASEC types, using a hexagon to represent the interrelations among the types. Most of the research on the structural validity of the Holland model (1969) has focused on interest measures that were designed to measure interest in the six RIASEC types, including meta-analyses (Rounds & Tracey, 1993, 1996) and studies with large, representative samples of U.S. students and employed adults (Armstrong, Hubert, & Rounds, 2003; Day, Rounds, & Swaney, 1998; Fouad, Harmon, & Borgen, 1997). Also illustrated in Figure 1 is an alternative hierarchical model proposed by Gati (1979, 1991) to represent the interrelations among interest areas. In this model, the RIASEC types represent one level of a more complex multileveled structure ranging from general interest categories to specific occupational titles. Gati's (1979, 1991) claim that a hierarchical structure would be more effective than would a hexagon or a circumplex has received mixed support in large-scale meta-analyses of RIASEC correlation matrices. Tracey and Rounds (1993) analyzed data from 104 published matrices and found the fit of Holland's (1959, 1997) circumplex model to be superior to Gati's (1979, 1991) hierarchical model. In a second meta-analysis of RIASEC data taken from data collected in the United States and 18 different countries,

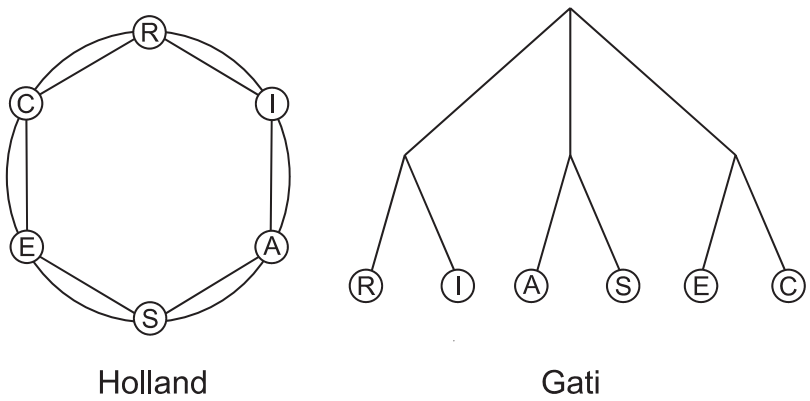

Figure 1. Holland's (1997) circumplex model and Gati's (1991) hierarchical model of interests. R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

Rounds and Tracey (1996) found the fit of Gati's (1979, 1991) model to be superior to Holland's (1959, 1997) for U.S. ethnic group and international samples. Despite these mixed results, one of the potential advantages of using Gati's (1979, 1991) hierarchical model is its capacity to generate hypotheses regarding the interrelations among different sets of assessment scales. For example, Gati (1979) analyzed the intercorrelations between a Holland-based measure and a second interest measure based on Roe's (1956) model and found support for a common interest structure integrating the two sets of interest constructs.

Holland's (1966) proposal that a variety of personal attributes become linked together in the RIASEC types is supported by recent attempts to develop an integrated model of individual differences (Ackerman & Heggestad, 1997; Armstrong, Day, McVay, & Rounds, 2008). Tracey (1997) found that similar dimensional structures could be used to represent individual differences in both interest and self-efficacy, which supports the joint interpretation of interest and efficacy assessment results and also supports our hypothesis that a common set of broad constructs may underlie responses to both interest and self-efficacy measures. Despite the potential usefulness of Holland's (1959, 1997) model for explaining interest–efficacy relations, little research has been conducted that explicitly tests Holland's (1959, 1997) RIASEC theory as an alternative to SCCT. For example, Dennisen, Zarrett, and Eccles (2007) found that couplings emerged among achievement, interest, and efficacy beliefs in a longitudinal study of school-aged children from ages 6 years to 17 years but did not include an assessment of the RIASEC types in their study. As a result, research is still needed that explicitly examines the fit of a Holland-based model to understanding the relations between interest and self-efficacy.

Self-Efficacy, Interest, and SCCT

In comparison with Holland's (1959, 1997) integration of interests, competency beliefs, and other factors as components of the RIASEC types, Bandura's (1982, 1997) theory centers on self-efficacy as the critical determinant of a wide variety of individual differences variables, including cognitive functioning, mental and physical health behaviors, and academic and career-related success. In addition to direct effects, Bandura argues that the early influence of self-efficacy on the development of an individual's self concept can be seen over time, suggesting that social influences that initially contribute to self-efficacy beliefs will continue to promote competencies, values, beliefs, and interests beyond the initial point of influence (see Bandura, 1997, p. 160). Betz and Hackett (1981) evaluated Bandura's model for predicted career-related outcomes by having participants rate 20 occupational titles for self-efficacy beliefs related to completing the educational requirements and work-related tasks for the occupations. The occupational titles used in the Betz and Hackett (1981) study were divided into traditionally masculine and traditionally feminine areas of work on the basis of the gender ratio of employment. The results indicated that men had similar levels of self-efficacy for both types of occupations, but in comparison, women had higher levels of self-efficacy for traditionally feminine occupations than they did for traditionally male occupations.

Following Betz and Hackett's (1981) study, self-efficacy measures have been developed that measure specific topics, such as attitudes toward mathematics (Hackett, Betz, O'Halloran, & Romac, 1990) or science and engineering (Lent, Brown, & Larkin, 1984, 1986). Additionally, general measures covering a wide range of activities and employment options have also been developed for use in career counseling, such as the SCI (Betz, Borgen, & Harmon, 1996, 2005), the Campbell Interests and Skills Inventory (CISS; Campbell, Hyne, & Nilsen, 1992), and the Personal Globe Inventory (PGI; Tracey, 2002b). The SCI was designed to be administered in conjunction with the previously developed SII, and interpretive guidelines were developed on the basis of comparing an individual's level of confidence in the six Holland types as measured by the SCI to his or her level of interest in each type measured by the SII. Other measures, such as the CISS and PGI, were developed with matched sets of interest and self-efficacy scales. Research also suggests that combining information obtained from interest and efficacy measures can be an effective tool for expanding the range of career options considered by counseling clients, as demonstrated by the incremental validity of using both measures to predict career outcomes (Betz & Rottinghaus, 2006; Rottinghaus, Betz, & Borgen, 2003).

As an extension of Bandura's (1982, 1997) model, SCCT positions self-efficacy as the key construct that determines a variety of career related outcomes, including interests. As outlined in Lent et al. (1994), according to SCCT, the academic and career-related interests of individuals are a product of self-efficacy beliefs and outcome expectations, and any relation between abilities and interests is mediated by self-efficacy beliefs. When SCCT is represented in a causal model, self-efficacy and outcome expectations are used to predict interests, and interests are then used as a predictor of career-related behaviors. A number of empirical studies have supported the SCCT model of placing self-efficacy before interest (Lent et al., 1994, 2000), but other studies by Tracey (2002a) and Nauta et al. (2002) suggest that the interest–efficacy links are reciprocal.

In an attempt to clarify the contradictory results of previous SCCT research on the relations between self-efficacy and other career-related constructs, Lent, Sheu, Singley, Schmidt, Schmidt, and Gloster (2008) recently tested a number of alternative models describing the relations among self-efficacy, outcome expectations, interests, and persistence goals in a longitudinal study of engineering students. In this study, Lent et al. (2008) included an efficacy-antecedent model reflecting the order predictions of SCCT: (a) self-efficacy, (b) outcome expectations, (c) interests, and then (d) persistence goals. The first alternative model tested was referred to as the efficacy-consequent model, placing self-efficacy as the fourth and final variable in the sequence. A potential issue with Lent et al.'s (2008) efficacy-consequent model is that it lacks a theoretical basis because none of the major theories of career choice and development suggests that persistence goals are an important determinant of self-efficacy. Not surprisingly, in Lent et al.'s (2008) analyses, the efficacy-consequent model did not fit as well as the SCCT-based efficacy-antecedent model. The second alternative model Lent et al. (2008) tested included bidirectional relations between efficacy and interests, reflecting the results from Nauta et al. (2002). This bidirectional model produced better fit statistics than did the efficacy-antecedent model, but these differences were not statistically significant. Ultimately Lent et al. (2008) concluded that the SCCT-based efficacy-antecedent model is preferable to the bidirectional alternative model because it is more parsimonious.

Interpreting the Interests–Efficacy Association

Both our proposed Holland-based model and SCCT (Lent et al., 1994) predict that there will be positive correlations between interest and self-efficacy beliefs; the difference between the two theories centers on how to interpret these positive correlations. In the proposed Holland-based model, interests and self-efficacy beliefs are correlated because they are both components of the RIASEC types. In the SCCT model, self-efficacy and interests are correlated because an individual's level of self-efficacy influences the development of interests. Rottinghaus, Larson, and Borgen (2003) conducted a meta-analysis on the relations between interest and self-efficacy measures, using data from 60 samples (N = 39,154). Of the data included in the meta-analysis, 53 samples were assessed with interest and efficacy measures with equivalent career-related categories of measurement, such as the RIASEC typology, including joint administrations of the SII and the SCI and administration of the CISS, which was designed with both interest and self-efficacy measures (Campbell et al., 1992). Rottinghaus, Larson, and Borgen (2003) reported an overall correlation of .59 between interests and self-efficacy and observed that the CISS, for which interest and efficacy scales were developed concurrently, tended to produce stronger interest–efficacy correlations than the separately developed SII and SCI scales did. These results were interpreted as being consistent with the SCCT model but also suggest that both interests and self-efficacy measures provide important information that is relevant to the career choice process. A subsequent review, by Betz and Rottinghaus (2006), included additional support for the incremental validity of using both interest and efficacy measures. However, an important limitation of this research is that alternative perspectives on the interest–efficacy association, such as the Holland-based model proposed here, have not been examined.

The Present Study

In the present study, we build on previous research into the interest–efficacy association by evaluating how well Holland's (1959, 1997) RIASEC model can account for correlations between interest and self-efficacy measures in comparison with the SCCT model. Three methods of structural analysis are used to evaluate the interest–efficacy association: multidimensional scaling (MDS), hierarchical clustering, and SEM. MDS is used to test the structural hypothesis that the primary structure emerging from sets of interest and self-efficacy measures is a Holland-based RIASEC structure and that adding a third dimension differentiating between interest and self-efficacy contributes only a small improvement in model fit. Hierarchical clustering is used to evaluate a hierarchical Gati-based model in which the interests and efficacy scales are predicted to cluster together by RIASEC type. With both the dimensional and hierarchical analyses, if the predicted structure is found then support is obtained for the notion that the interest–efficacy distinction is secondary to the RIASEC structure in Holland's (1959, 1997) model.

In the SEM analyses, two models are fit to the data. The first model, illustrated in Figure 2, represents the SCCT perspective that interest and self-efficacy are separate constructs by specifying two sets of latent RIASEC variables, one set representing interest and the other representing self-efficacy beliefs. The second model, illustrated in Figure 3, reflects Holland's (1959, 1997) theory with six latent variables representing the six RIASEC types. In this model, the distinction between interest and self-efficacy beliefs is represented by method factors, that is, latent variables representing response set effects due to the wording of items or to response format (see Russell, 1996; Wei, Russell, Mallinckrodt, & Vogel, 2007).

The full version of the SCCT-based model requires six latent variables to represent interest in each of the six RIASEC types, requires an additional set of six latent variables to represent self-efficacy for each type, and includes two method factors for the occupation- and activity-based item response formats of the survey instruments used in this study. The SCCT-based model also estimates 66 correlations among latent variables representing the RIASEC interest and efficacy constructs. In comparison, the Holland-based model uses a single set of latent RIASEC variables but also has four method factors, including two method factors for the occupation- and activity-based item response formats and the proposed interest and self-efficacy method factors. However, there are only 15 between-type correlations estimated in this model. Therefore, in comparison with the SCCT-based model, the proposed Holland-based model is more parsimonious because there is a net reduction of four latent variables and 51 between-latent-variable correlations. If the fit of the Holland-based model is comparable with the more complex SCCT-based model then it should be retained, thereby supporting the hypothesis that observed correlations between interests and efficacy measures stem from shared RIASEC characteristics that underlie the scales.

Method

Participants

A sample of 608 college students (357 female, 251 male) was recruited from the participant pool of the psychology department at a large Midwestern university. Participants agreed to complete an online survey in exchange for course credit. Completion of this survey was one of a number of options made available to students who were interested in earning extra credit for their psychology courses. The mean age of the participants was 19.5 years (SD = 1.7), with a range from 18 years to 31 years. Of these students, 41.0% reported being enrolled as freshmen, 34.2% reported being enrolled as sophomores, 16.2% reported being enrolled as juniors, and 7.6% reported being enrolled as seniors (1.0% did not report their academic standing); 3.0% self-identified as African American, 5.3% self-identified as Asian American, 1.6% self-identified as Hispanic American, and 88.0% self-identified as White and/or Caucasian (2.1% identified as Native American, identified as multiracial, or did not report an ethnic identity).

Measures

Participants completed a brief demographic questionnaire and a modified version of the Alternate Forms Public Domain (AFPD) RIASEC markers (Armstrong, Allison, & Rounds, 2008). The AFPD consists of two sets of 8-item occupation-based RIASEC scales with job titles selected from the O*NET database (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999) and two sets of 8-item activity-based RIASEC scales selected from the 30-item

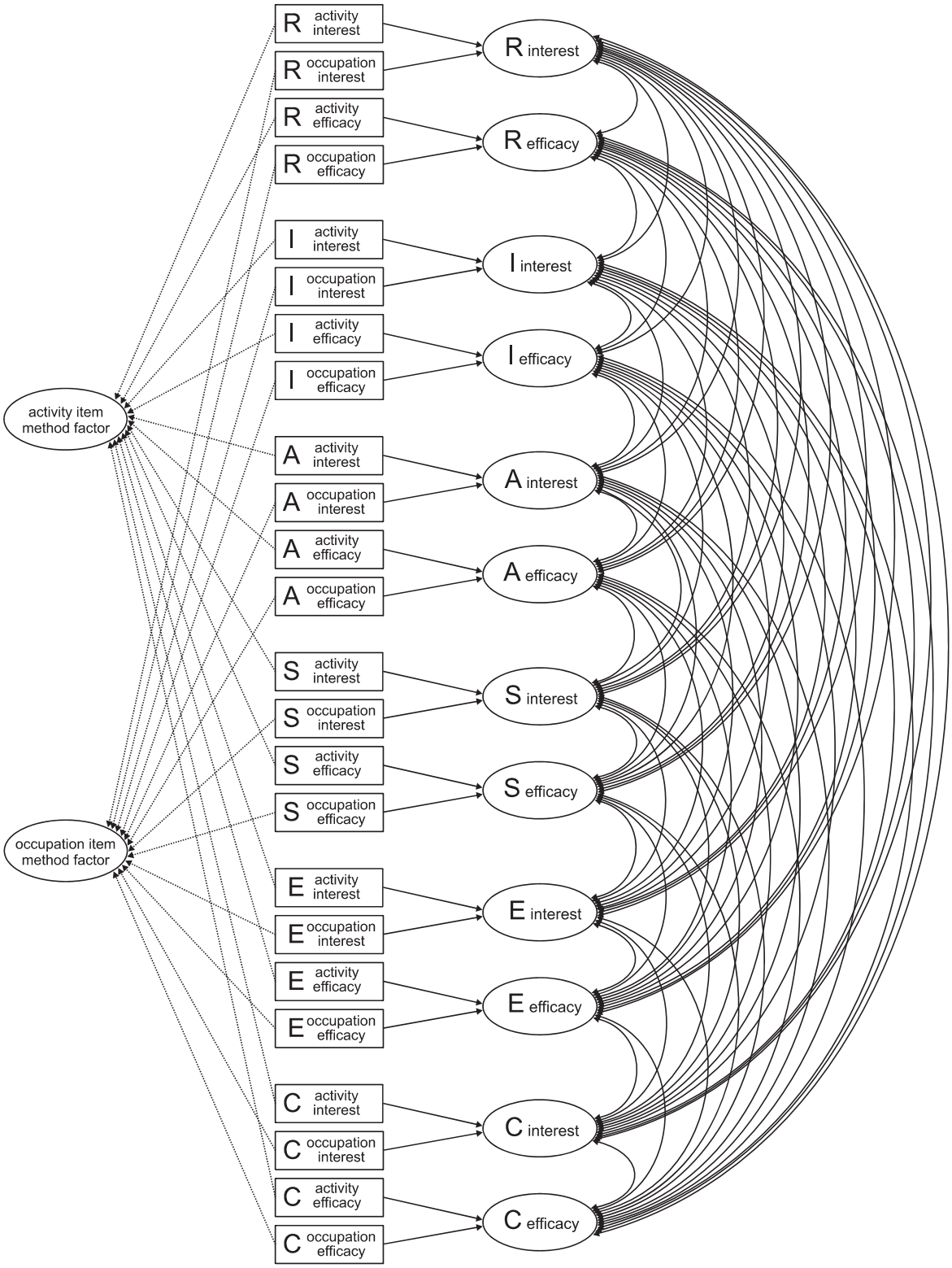

Figure 2. Proposed SCCT-based latent variable model. Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C) types are not illustrated but are included in the analyses. Model 1A (arrows with solid lines) includes paths between observed RIASEC measures and latent RIASEC variables representing interest and self-efficacy in each type. Model 1B (arrows with solid and dotted lines) adds latent method factors for activity- or occupation-based items. SCCT = social cognitive career theory.

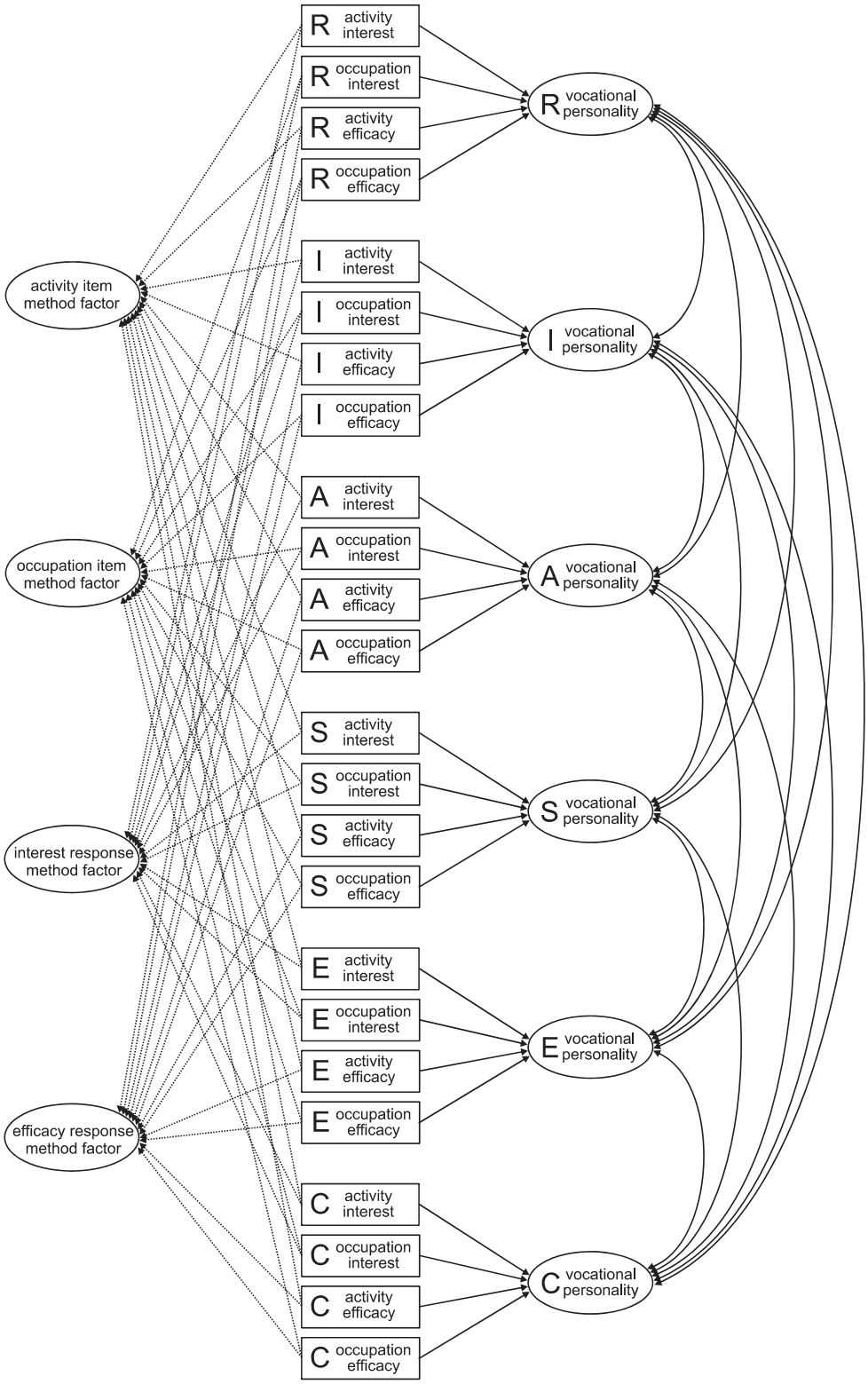

Figure 3. Proposed Holland-based latent variable model Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional(C) types are not illustrated but are included in the analyses. Model 2A (arrows with solid lines) includes paths between each observed RIASEC measure and its corresponding latent RIASEC-type variables. Model 2B (arrows with solid and dotted lines) adds latent method factors for activity- and occupation-based items and for interest and efficacy response formats.

scales in the Interest Profiler (Lewis & Rivkin, 1999). Armstrong et al. (2008) reported that the internal consistency reliabilities for the AFPD activity scales had a coefficient alpha range from .79 to .94, with a mean of .88. and that the occupation scales had a coefficient alpha range from .74 to .88, with a mean of .84. Convergent validity between the 8-item activity-based scales and the SII ranged from .56 to .72, with a mean of .64, and convergent validity between the 8-item occupational scales and the activity scales ranged from .73 to .86, with a mean of .78. Structural analyses of the AFPD scales supported the order predictions in Holland's (1997) model.

As discussed by Armstrong, Allison, and Rounds (2008), there are a number of potential limitations to current measures of interests and self-efficacy, including the length of commercial measures and the confounding of interests and efficacy that occurs in the PGI (Tracey, 2002b) by having individuals rate each item on both response dimensions. The AFPD scales were developed to address limitations of previous measures by providing sets of brief, alternate form RIASEC research scales. In particular, these measures were designed for research requiring sets of multiple indicators for each Holland type, such as investigating issues such as the relation between interest and efficacy.

Interest ratings. The 48 occupational and 48 activity items in Set A of the AFPD were administered with the original interest-based wording; participants were asked to rate how much they like the occupation or would like to perform the work activity, using a 5-point Likert-type response format ranging from 1 (*strongly dislike*) to 5 (*strongly like*). The internal consistency reliabilities for the Set A items with the original interest wordings had a coefficient alpha range from .79 to .93, with a mean of .87.

Efficacy ratings. The occupational and activity items in Set B of the AFPD were administered with an alternative self-efficacy rating scale based on the conversion of PGI interest items for use as a self-efficacy measures (see Tracey, 2002b). Participants were asked to rate how much confidence they had in their ability to work in each occupation or to perform the work-related activity, on a 5-point Likert-type response format ranging from 1 (*very low confidence*) to 5 (*very high confidence*). For the self-efficacy worded items from Set B, the AFPD scales had a coefficient alpha range from .78 to .94, with a mean of .88.

Data Analysis

MDS. Nonmetric MDS (Kruskal & Wish, 1978) was used to evaluate RIASEC order hypotheses across the four sets of measures. MDS techniques are used to try to represent the interest scales in a dimensional space so that for any pair of objects, the interoccupational distance within that space corresponds to the measured similarity (i.e., the correlation) between that pair of scales. This technique provides a framework for understanding and interpreting the shared structure of interests and self-efficacy by distilling the interrelations among scales into a small number of underlying dimensions. To evaluate improvements in fit when adding a third dimension, both two- and three-dimensional models were evaluated. The fit of the data to the MDS solution was assessed with two indices, a stress value, which can range from 0 to 1, with lower values indicating a better fit, and a variance accounted for (VAF) estimate, which can also range from 0 to 1, with higher values indicated a better fit.

Hierarchical clustering. To evaluate the joint structure of interest and self-efficacy from the perspective of Gati's (1979, 1991) model, we used hierarchical cluster analysis to develop a nested structure of interest and efficacy measures in which each cluster can be subsumed as a member of a larger and more inclusive cluster at a higher level of similarity (Aldenderfer, & Blashfield, 1984). There are several clustering algorithms available that produce a hierarchical structure, and it is recommended that one analyze data with two or more methods and synthesize the results (Gordon, 1999). Two of the most commonly used methods, the complete linkage and the average linkage, were used in the present study. Consistent with Gati's (1979, 1991) model, measures are expected to first cluster by RIASEC type and then cluster together in three superordinate categories of RI, AS, and EC. Alternatively, if the interest measures and efficacy measures form separate sets of clusters within a hierarchical structure then the Holland-based model would not be supported.

SEM. SEM analyses were used to evaluate two sets of models representing SCCT-based and Holland-based interpretations of the relations between interest and self-efficacy. The first set of models, illustrated in Figure 2, represents the SCCT perspective on the relations between interest and self-efficacy measures. Model 1A represents a base model with two sets of latent RIASEC variables (12 latent variables in total), one set of 6 latent variables representing self-efficacy beliefs and the second set of 6 representing interests. This model also includes the estimation of 66 correlations between latent variables to represent the interrelations among interest constructs, the interrelations among self-efficacy constructs, and the interrelations among interest and self-efficacy constructs. To control for method effects associated with item design, Model 1B adds method factors for occupation- and activity-based items to the basic SCCT model specified in Model 1A (14 latent variables in total). Adding the method factors of occupation and activity is expected to improve the measurement of the latent interest and self-efficacy RIASEC variables by allowing us to control for measurement associated with responses to activity-based items and knowledge of different job titles. To add these method factors to the model, we specified two method factors that correspond to occupation and activity items, with the occupation items loading on one factor and activity items loading on a second factor.

The second set of models, illustrated in Figure 3, represent the proposed Holland-based model with 6 latent variables representing the six RIASEC types. In Model 2A, all of the interest and self-efficacy scales associated with each Holland type serve as an indicator for a single latent variable representing one of the types (6 latent variables in total). Thus, the Realistic latent variable would have four indicators: the observed variables for occupation- and activity-based Realistic interest measures and the observed variables for occupation- and activity-based Realistic self-efficacy measures. This model also includes the estimation of 15 correlations between latent variables to represent the interrelations among RIASEC constructs. To control for method effects associated with item design and to evaluate the hypothesis that the interest–efficacy distinction in SCCT can be recast as a measurement issue secondary to the Holland structure, in Model 2B we add both the occupation and activity method factors from Model 1A and two additional method factors that correspond to the interest and efficacy items (10 latent variables in total), with the interest items

loading on one factor and the efficacy items loading on a second factor.

To evaluate the fit of the SEM models, we used the maximum likelihood method of estimation in LISREL 8.80. Four indices were used to assess the goodness-of-fit of the models with the following cutoff criteria (Hu & Bentler, 1999; Martens, 2005): the normative fit index (NFI; .90 or greater), the comparative fit index (CFI; .95 or greater), the incremental fit index (IFI; .95 or greater), the standardized root-mean-square residual (SRMR; .08 or less), and the root-mean-square error of approximation (RMSEA; .06 or less).

Results

RIASEC Correlations

Table 1 presents the correlations between the four sets of RIASEC measures, including four measures of within-type correlation between interests and efficacy for each of the six RIASEC types. For example, the correlation between the Realistic Occupational Interest measure and Realistic Occupational Confidence measure is a measure of interest–efficacy correlation based on occupational items. Similarly, the correlation between the Realistic Activity Interest scale and the Activity Confidence scale is a measure of interest–efficacy correlation based on activity items. The remaining two interest–efficacy correlations are obtained by crossing activity and occupation scales (i.e., occupational interest with activity confidence; activity interest with occupational confidence). For the Realistic (R) type, the mean interest–efficacy correlation across these four comparisons was .67. In comparison, Rottinghaus, Larson, and Borgen (2003) reported R-type correlations of .66 for SII–SCI measures and .73 for CISS measures, thus suggesting that the R-type interest–efficacy correlations observed in the current data are comparable with the meta-analytic based estimates of this relation obtained with commercial interest measures.

For the Investigative (I) type, the mean interest–efficacy correlation in the current data was .72. In comparison, Rottinghaus, Larson, and Borgen (2003) reported I-type correlations of .67 for SII–SCI measures and .75 for CISS measures. For the Artistic (A) type, the mean interest–efficacy correlation was .68; Rottinghaus, Larson, and Borgen reported A-type correlations of .63 for the SII–SCI and .68 for the CISS. For the Social (S) type the mean interests–efficacy correlation was .70; Rottinghaus et al. reported S-type correlations of .51 for the SII–SCI and .66 for the CISS. For the Enterprising (E) type the mean interests–efficacy correlation was .55; Rottinghaus, Larson, and Borgen (2003) reported E-type correlations of .42 for the SII–SCI and .76 for the CISS. Finally, for the Conventional (C) type the mean interests–efficacy correlation was .55; Rottinghaus, Larson, and Borgen (2003) reported C-type correlations of .48 for the SII–SCI and .67 for the CISS. Therefore, with the exception of the S type (in which the correlation between interest and efficacy was slightly higher than in the CISS) the interest–efficacy correlations observed for all six RIASEC types being measured by the AFPD scales are consistent with those of established commercial interest measures. This pattern of results provides validity evidence for the AFPD RIASEC scales for use in evaluating the relations between interests and self-efficacy beliefs.

MDS and Clustering Results

MDS. MDS analyses were run fitting a two dimensional model and a three dimensional model. The two-dimensional model stress was .129, with a VAF of .901. The ordering of the RIASEC types in the two dimensional model was consistent with the order predictions in Holland's (1997) theory. The three-dimensional model stress was .080, with a VAF of .944. The correlations between the coordinates in the two models was .998 for Dimension 1 and was −.987 for Dimension 2, which suggests that adding a third dimension did not impact the interrelations among the RIASEC scales on the first two dimensions when comparing the two-dimensional and three-dimensional solutions. Figure 4 presents the MDS results for the three-dimensional solution: plotting Dimensions 1 and 2 and plotting Dimensions 1 and 3. As illustrated in Figure 5, The first two dimensions of the three-dimensional model represent a Holland order prediction model that is consistent with the two-dimensional MDS results. This RIASEC ordering occurs consistently across all four sets of interest and self-efficacy occupation- and activity-based measures in the same space. The third dimension separates the interest measures from the confidence measures. Overall, these results suggest that the Holland model is supported by the data structure but also show that a distinction can be made between interest and confidence responses on a third dimension. However, adding the third dimension separating interest and self-efficacy measures to the MDS solution adds only 4.3% VAF to the overall fit of the model. Therefore, the MDS results indicate that although the interest–efficacy distinction is important, it is also secondary to Holland's RIASEC types and their structure.

Clustering. Figure 5 presents the results obtained with the complete-link clustering algorithm. Overall, these clustering results are consistent with Gati's (1979, 1991) hierarchical model, with separate clusters representing each of the six RIASEC types. Within each of the six RIASEC types, subclusters emerge for the interest and self-efficacy measures. These results suggest that although interest and self-efficacy are differentiated in the hierarchical structure, the dominant organizational structure is the Holland type, not the interest–efficacy distinction. With average-link clustering results, the results for the E and C clusters were somewhat different, with the interest and efficacy measures clustering together across the two types. More individuals have discrepancies between their interests and efficacy beliefs in the E–C range of Holland's model. Individuals may see themselves as being good at organizational tasks and working with numbers but also as having an interest in engineering and science or in teaching and helping careers. Conversely, there may be a greater likelihood of finding individuals with business career interests who have doubts about their organizational or leadership skills.

SEM of RIASEC Interests–Efficacy Models

Table 2 presents a summary of model fit indices for the two sets of models tested. The results indicated that Model 1A (with the two sets of latent RIASEC variables, one set representing interests and the other representing self-efficacy beliefs) did not fit the data well with NFI = .91, CFI = .92, IFI = .92, RMSEA = .13, and SRMR = .053. However, the model fit improved with the inclusion of the occupation and activity method factors (Model 1B; NFI = .94, CFI = .95, IFI = .95, RMSEA = .096, and SRMR =

Table 1
Correlations Between Interest- and Efficacy-Based RIASEC Measures

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Realistic OI	—																							
2. Investigative OI	.57	—																						
3. Artistic OI	.07	.20	—																					
4. Social OI	−.11	.24	−.44	—																				
5. Enterprising OI	.15	.12	.16	.26	—																			
6. Conventional OI	.39	.23	.16	.16	.72	—																		
7. Realistic AI	.76	.30	.04	−.11	.24	.45	—																	
8. Investigative AI	.57	.83	.21	.17	−.03	.12	.35	—																
9. Artistic AI	.07	.20	.85	.36	.11	.10	.08	.28	—															
10. Social AI	−.22	.14	.37	.82	.18	.06	−.17	.10	.34	—														
11. Enterprising AI	.03	.06	.25	.32	.75	.52	.16	−.01	.26	.33	—													
12. Conventional AI	.34	.13	.04	.04	.57	.80	.46	.09	.03	.01	.54	—												
13. Realistic OC	.68	.36	.00	−.16	.07	.21	.62	.38	.05	−.25	.00	.18	—											
14. Investigative OC	.47	.69	.11	.14	−.02	.09	.24	.69	.13	.03	−.04	.03	.65	—										
15. Artistic OC	.02	.13	.62	.28	.14	.07	.02	.13	.66	.21	.25	.00	.25	.33	—									
16. Social OC	−.10	.22	.27	.67	.17	.04	−.14	.15	.28	.64	.31	−.03	.10	.38	.49	—								
17. Enterprising OC	.12	.17	.16	.32	.52	.35	.08	.07	.16	.27	.50	.29	.32	.33	.44	.65	—							
18. Conventional OC	.40	.26	.02	−.02	.42	.54	.36	.19	.02	−.09	.32	.52	.62	.48	.30	.26	.65	—						
19. Realistic AC	.68	.32	.00	−.20	.07	.21	.70	.33	.07	−.25	.02	.20	.79	.41	.14	.02	.26	.53	—					
20. Investigative AC	.55	.73	.08	.04	−.04	.09	.31	.77	.12	−.03	−.07	.07	.59	.87	.21	.22	.21	.42	.49	—				
21. Artistic AC	.08	.16	.67	.21	.09	.03	.06	.21	.74	.18	.17	−.05	.24	.27	.82	.34	.28	.18	.23	.26	—			
22. Social AC	−.22	.11	.29	.72	.13	−.02	−.20	.06	.28	.75	.24	−.08	−.07	.20	.37	.83	.46	.08	−.09	.09	.30	—		
23. Enterprising AC	.04	.07	.18	.17	.57	.30	.06	.00	.21	.15	.62	.26	.21	.16	.46	.43	.71	.49	.24	.13	.40	.34	—	
24. Conventional AC	.33	.20	.00	−.06	.39	.52	.27	.13	.01	−.07	.31	.60	.36	.26	.13	.14	.50	.75	.44	.30	.10	.05	.48	—

Note. OI = Occupational Interest; AI = Activity Interest; OC = Occupational Confidence; AC = Activity Confidence; RIASEC = Realistic, Investigative, Artistic, Social, Enterprising, and Conventional.

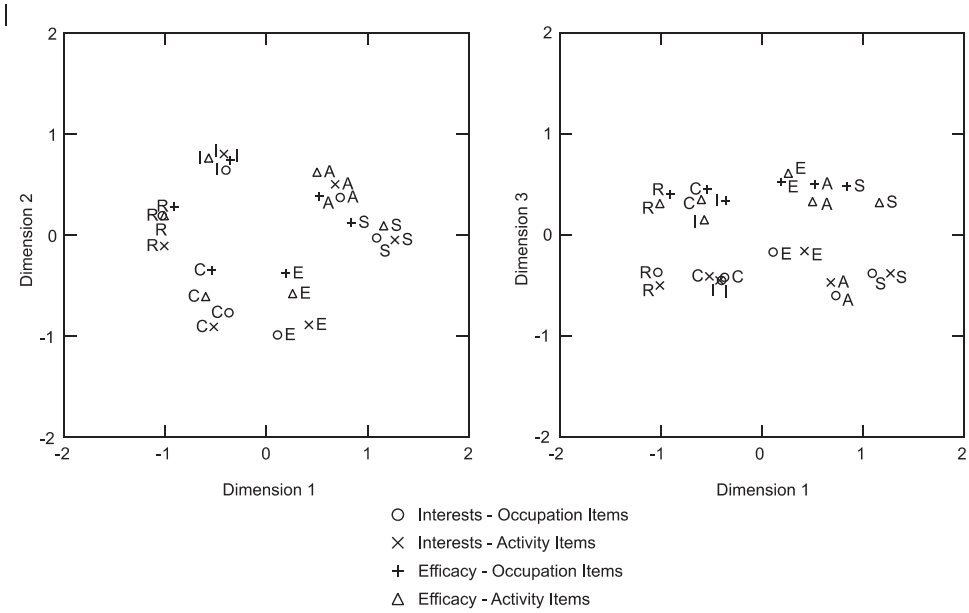

Figure 4. Multidimensional scaling results for the two sets of RIASEC interest and efficacy measures. R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional.

.056). The results obtained in Model 1B provides some support for SCCT theory, as the fit of the data to the model is acceptable once the method effects of occupation and activity item-types are controlled for. Standardized factor loadings for the observed variables on the latent variables and squared multiple correlation measures of variance accounted (R^2) for in the observed measures by Model 1B are presented in Table 3. For all 24 observed variables, factor loadings are higher for the Holland constructs than for the method factors, which is consistent with the hypothesized model. The range of R^2 values was .75 to .93 (M = .85).

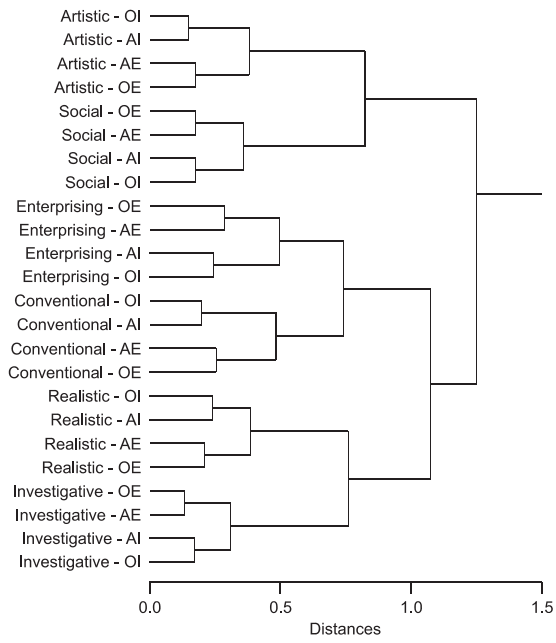

Figure 5. Complete-link hierarchical clustering results for four sets of RIASEC measures. OI = Occupational Interest scales; AI = Activity Interest scales; AE = Activity Efficacy scales; OE = Occupational Efficacy scales.

We next examined whether the more parsimonious Holland-based model with interest and efficacy method factors would fit as well as this SCCT. We first examined the fit of data to the RIASEC types without method factors (Model 2A). A test of Model 2A resulted in a poor fit to the data (NFI = .76, CFI = .77, IFI = .77, RMSEA = .26, and SRMR = .10). However, the inclusion of method factors (Model 2B) for activity- and occupation-based items and the hypothesized interest and self-efficacy method factors improved the model fit to acceptable levels (NFI = .94, CFI = .95, IFI = .95, RMSEA = .098, and SRMR = .055). Additionally, the fit of Model 2B is comparable with Model 1B, suggesting that the Holland-based model with 10 latent variables and 15 between-latent variable correlations is functioning similarly to the more complex to the SCCT-based model with 14 latent variables and 66 correlations. Standardized factor loadings for the observed variables on latent variables and squared multiple correlation measures of variance accounted (R^2) for in the observed measures by Model 2B are presented in Table 4. For 23 of the 24 observed variables, factor loadings are higher for the Holland constructs than for the method factors. The exception to this pattern is for Conventional Occupational Interests, in which the loading on the latent Holland C-factor (.61) is smaller than the loading on the interest method factor (.65). The range of R^2 values for observed measures was .74 to .93 (M = .84).

Discussion

Interpreting the Interests–Efficacy Association

With three distinct methods of structural data analysis, the results obtained in the present study suggest that correlations

Table 2
Summary of SEM Model Fit Indices

Model	χ^2	*df*	RMSEA	RMSEA 90% CI	SRMR	NFI	CFI	IFI
1A. Separate interest and efficacy latent RIASEC variables	2,011.61	186	.13	.12; .13	.053	.91	.92	.92
1B. Model 1A with method factors	1,174.78	162	.096	.091; .10	.056	.94	.95	.95
2A. RIASEC latent variables	9,727.79	237	.26	.25; .26	.10	.76	.77	.77
2B. Model 2A with method factors	2,277.03	213	.13	.12; .13	.081	.89	.89	.89

Note. SEM = structural equation modeling; *df* = degree of freedom; RMSEA = root-mean-square error of approximation; CI = confidence interval; SRMR = standardized root-mean residual; NFI = normed fit index; CFI = comparative fit index; IFI = incremental fit index. RIASEC = Realistic, Investigative, Artistic, Social, Enterprising, and Conventional.

between interests and efficacy measures can be accounted for by a Holland-based RIASEC model. When the correlation matrix of RIASEC interest and self-efficacy measures was analyzed with MDS, the first two dimensions replicated the predicted Holland order predictions. Adding a third dimension to the MDS solution resulted in a structural model that separated the interests and self-efficacy measures, which supports Rottinghaus, Larson, and Borgen's (2003) suggestion that interests and self-efficacy are related by distinct constructs. However, this third dimension added only 4.3% to the VAF by the MDS solution, demonstrating that the interest–efficacy distinction is secondary to the RIASEC typology. Similarly, the complete link clustering analysis results show that interest and efficacy measures form separate clusters, but this occurs with the organizational framework of the RIASEC types.

Table 3
Factor Loadings for Model 1B (Separate Interest and Efficacy RIASEC Latent Variables)

	Holland constructs		Method factors		
RIASEC Scale	Interest	Efficacy	Activity	Occupation	R^2
Realistic OI	.88			.08	.79
Investigative OI	.89			.06	.80
Artistic OI	.91			.03	.82
Social OI	.92			.10	.85
Enterprising OI	.95			−.01	.89
Conventional OI	.94			.05	.89
Realistic AI	.86		.17		.77
Investigative AI	.93		.14		.89
Artistic AI	.94		.16		.91
Social AI	.90		.17		.85
Enterprising AI	.82		.36		.80
Conventional AI	.87		.35		.87
Realistic OC		.87		.37	.89
Investigative OC		.87		.41	.93
Artistic OC		.87		.29	.84
Social OC		.87		.33	.86
Enterprising OC		.81		.32	.76
Conventional OC		.88		.35	.89
Realistic AC		.91	.05		.83
Investigative AC		.96	.03		.93
Artistic AC		.95	−.03		.90
Social AC		.92	.02		.86
Enterprising AC		.86	.10		.76
Conventional AC		.85	.15		.75

Note. OI = Occupational Interest; AI = Activity Interest; OC = Occupational Confidence; AC = Activity Confidence; RIASEC = Realistic, Investigative, Artistic, Social, Enterprising, and Conventional.

Finally, the SEM analysis suggests that the Holland-based model treating the interest–efficacy distinction as a measurement factor had a similar fit to our data as an SCCT-based model with interests and efficacy as separate sets of latent variables, but the Holland model is preferable due to its improved parsimony over the SCCT model. These findings have potential implications for the interpretation of interest and self-efficacy measures in research models and in applied settings such as career counseling, which need to be addressed in future research.

The comparison of Holland-based and SCCT-based models in the current study raises potential questions regarding how to interpret the distinction between interest and efficacy when working with individuals who are making career-related decisions. On one level, the differences between the Holland perspective and the SCCT model are negligible because both approaches suggest that the best career choices are ones in which an individual has both interest and self-efficacy in that area of study or employment. Despite this general agreement on the importance of both interest and self-efficacy in the career choice process and the incremental validity that can be obtained by using both measures in research, the two perspectives do offer somewhat different interpretations regarding the relations between the constructs. In the SCCT model, self-efficacy serves as the lynchpin of the vocational identity development process. Self-efficacy is needed for interest to emerge, interest influences learning experiences, and learning experiences provide feedback on self-efficacy beliefs. In comparison, from the perspective of our Holland-based model, it is not necessary to assume an ordered developmental sequence because both interests and self-efficacy are parts of a larger RIASEC construct. In applied settings such as career counseling, observed discrepancies between interest and self-efficacy may highlight important issues to focus on, related to the client's career development process (Betz & Borgen, 2000; Rottinghaus, Larson, & Borgen, 2003). However, this clinical usefulness of self-efficacy measures for augmenting interest assessment results is also found with measures of more specific interest–efficacy domains (Betz & Rottinghaus, 2006) and is not tied to the developmental order prediction in SCCT.

In the present study, we used multiple indicators of each RIASEC type measuring both interest and self-efficacy in each of the six Holland areas. The observed correlations between interest and self-efficacy measures were consistent with the meta-analytic estimates of interest–efficacy correlations reported by Rottinghaus, Larson, and Borgen (2003), which supports the validity of the current research design with the AFPD marker scales (Armstrong, Allison, & Rounds, 2008) for modeling the results observed with commercial vocational assessment measures used to assess both

Table 4
Factor Loadings for Model 2B (Single Set of RIASEC Latent Variables)

RIASEC Scale	Holland constructs	Method factors				R^2
		Activity	Occupation	Interest	Efficacy	
Realistic OI	.84		−.19	.16		.77
Investigative OI	.86		−.18	.09		.77
Artistic OI	.89		−.20	.00		.84
Social OI	.87		−.24	.13		.84
Enterprising OI	.70		−.29	.48		.81
Conventional OI	.61		−.36	.65		.93
Realistic AI	.83	−.06		.37		.83
Investigative AI	.92	.01		.05		.84
Artistic AI	.93	−.03		−.03		.87
Social AI	.90	−.08		.07		.83
Enterprising AI	.81	−.24		.31		.82
Conventional AI	.74	−.24		.52		.87
Realistic OC	.75		−.21		.53	.89
Investigative OC	.76		−.21		.55	.92
Artistic OC	.74		−.06		.53	.84
Social OC	.77		−.12		.51	.86
Enterprising OC	.65		−.25		.51	.74
Conventional OC	.71		−.29		.54	.88
Realistic AC	.84	.22			.29	.83
Investigative AC	.86	.12			.37	.88
Artistic AC	.81	.21			.39	.86
Social AC	.86	.12			.33	.87
Enterprising AC	.79	.21			.38	.82
Conventional AC	.85	.14			.26	.81

Note. OI = Occupational Interest; AI = Activity Interest; OC = Occupational Confidence; AC = Activity Confidence; RIASEC = Realistic, Investigative, Artistic, Social, Enterprising, and Conventional.

interests and self-efficacy, such as the SII–SCI combination and the CISS. With SEM, both the SCCT and Holland-based interpretations of the relations between interest and self-efficacy were evaluated. In the SCCT model, two sets of latent variables were specified, with one set of six representing interest in each of the six Holland types and the second set of six representing self-efficacy for each of the six Holland types. After including method factors modeling item type (i.e., occupation and activity items), the overall fit of the SCCT model reached the proposed cutoffs for a number of fit indices, producing results consistent with previous research supporting the SCCT model (Lent et al., 1994, 2000). However, unlike previous research on the SCCT model, we also fit an alternative Holland-based model to our data, using one set of six latent variables representing the RIASEC types. After including method factors modeling item type and response format (i.e., either liking or having confidence), the fit of the Holland-based model was equivalent to the SCCT model.

The findings obtained across MDS, clustering, and SEM analyses support Holland's (1959, 1966, 1997) long-standing position that the RIASEC types are a synthesis of a variety of factors related to the career choice process and support our Holland-based hypothesis that this synthesis should include self-efficacy beliefs. The importance of using multiple indicators for interest and self-efficacy for each type in vocational research is also highlighted by these findings. Our results support the use of a Holland-based perspective for interpreting career choice with both interest and self-efficacy measures but without making assumptions about their relative importance in the career choice process. Therefore, the proposed Holland-based model may also represent a challenge to the hypothesized developmental relation between interest and self-efficacy beliefs in the SCCT model. However, the current study is not longitudinal in design and does not include the full range of constructs included in the SCCT model. Therefore, additional research is needed to further examine the interest–efficacy association from a developmental perspective.

Holland as an Integrative Model of Individual Differences

In recent years, there has been a call for greater integration of the various domains of individual differences in personality, ability, interests, and values (Ackerman & Heggestad, 1997; Lubinski, 2000). For example, Armstrong, Day, McVay, and Rounds (2008) have demonstrated that the RIASEC typology can be used to integrate a wide range of individual and environmental characteristics into a two-dimensional interest-based structure referred to as the atlas of individual differences. One issue that can be raised with Armstrong et al.'s (2008) atlas model is the decision to use interests as the organizational framework when there are also well-established models of individual differences in the personality and ability domains, such as the five-factor model of personality (Goldberg, 1993) and hierarchical models of ability (Carroll, 1993). This potential criticism of the atlas model stems primarily from conceptualizing the Holland types narrowly as interest constructs. However, the current results support a return to Holland's (1959, 1997) original theoretical model conceptualizing the types as a broad set of constructs including interest, self-efficacy beliefs, personality, and other characteristics.

The finding that the RIASEC-type structure can encompass both interest and self-efficacy provides a rationale for the continued use of the Holland model as an integrative framework. By tapping into a broad set of career-related components, the RIASEC model may be more inherently integrative than potential alternative models based on personality or ability measures. However, it is also worth noting that issues have been raised with the Holland model's capacity to reflect the full range of career choices in the United States (Rounds, 1995; Armstrong, Smith, Donnay, & Rounds, 2004). If the Holland types are ultimately replaced by an alternative set of constructs that can more effectively represent the full range and complexity of career choices, it will be important to retain Holland's (1997) definition of vocational identity as reflecting a convergence of interest, self-efficacy, personality, ability, and learning experiences.

Implications for Vocational Assessment and Research

The current findings highlight the importance of using both interest and self-efficacy measures in the vocational assessment process. In particular, given the overall strength of interest–efficacy associations within the RIASEC model, it is important to focus on those instances in which there is a discrepancy between interest and efficacy. For example, when results of the SII–SCI are presented in career counseling and other applied settings, one of the options in the assessment report includes some interpretive language highlighting the comparisons between interest and self-efficacy measures (see Betz et al., 2005, pp. 25–40). Betz et al. (2005) labeled Holland types with high scores for both interest and self-efficacy as being *high priority* areas for future career exploration and labeled types with low scores for both as being *low priority.* When there is a discrepancy between interest and self-efficacy, the interpretation of the assessment results focuses on examining the potential to improve the lower of the two areas. The interpretive guidelines for interpreting interest–efficacy discrepancies put forward by Betz et al. (2005) are reaffirmed and independently supported by the present results. Therefore, in career counseling and other applied settings in which issues of academic and vocational choice are examined, it is very important to use measures that are designed for the joint assessment and interpretation of interest and self-efficacy results.

Our findings also highlight the importance of using both interest and efficacy measures in career-related research and demonstrate the usefulness of using more than one structural method of statistical analysis for testing hypotheses regarding individuals' responses to vocational assessment measures. In the present study, we used the AFPD RIASEC marker scales and tested structural hypotheses using a range of statistical techniques with different underlying assumptions. This approach arguably provides stronger evidence in support of our conclusions than would be obtained with only one statistical approach to analyze results from a commercial assessment measure. However, there are a number of questions regarding how interests and self-efficacy are related to other factors involved in the career development process that remain unaddressed. The current finding provides a general understanding of how interest and self-efficacy are interrelated within the context of a Holland-based model, but there is also the possibility of individual differences in the extent to which interest, efficacy beliefs, and other factors influence career choice process. SCCT hypothesizes a linear mediated relation between career-related individual differences, but our results support an alternative Holland-based model in which these variables are joint indicators of the RIASEC types. Although the current results support a RIASEC-based perspective on linking interests and self-efficacy, it remains to be seen whether this approach can be extended to other career-related constructs that are effectively accounted for by the SCCT model, such as learning experiences (Schaub & Tokar, 2005) and outcome expectations (Gore & Leuwerke, 2000).

The results put forward in SCCT-based research, such as Lent et al.'s (2008) longitudinal study, support the SCCT developmental model with an efficacy-antecedent order prediction that self-efficacy is an important predictor of interests. However, the current findings suggest that current SCCT-based research may be limited somewhat by a failure to statistically examine the full range of alternative models available for specifying relations among efficacy, outcome expectations, and interests as predictors of persistence goals. In particular, Lent et al. (2008) did not test an alternative model in which both interest and efficacy are entered simultaneously or a model in which interest is entered before self-efficacy. The current findings would support the fitting of a simultaneous model with interest and self-efficacy measures entered at the same step of the analysis. Additionally, Hogan's socioanalytic theory of identity development (Hogan, 1983; Hogan & Roberts, 2003) could be interpreted as supporting a model with interest as the first construct in the sequence, resulting in an interest-antecedent model: (a) interests, (b) efficacy, (c) outcome expectations, and (d) persistence goals.

To evaluate these potential alternatives, we reanalyzed the data published in Lent et al. (2008). As illustrated in Table 5, when

Table 5
Reanalysis of Models Specifying Longitudinal Interest–Efficacy Relationships

Model	χ^2	*df*	RMSEA	SRMR	NFI	CFI	IFI
Base model[a]	16.36	12	.042	.045	.98	.99	.99
Simultaneous	6.99	7	>.001	.025	.99	1.00	1.00
Efficacy-antecedent[a]	5.69	6	>.001	.021	.99	1.00	1.00
Interest-antecedent	5.29	6	>.001	.018	.99	1.00	1.00
Bidirectional[a]	1.90	3	>.001	.010	1.00	1.00	1.00

Note. RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean residual; NFI = normed fit index; CFI = comparative fit index; IFI = incremental fit index; *df* = degree of freedom. Results obtained from analyzing data presented in Table 1 of Lent et al. (2008) with LISREL 8.80.
[a] Model as specified in Lent et al. (2008).

additional alternative models are fit to the Lent et al. (2008) data, the fit of the interest-antecedent model is very similar to the efficacy-antecedent model originally tested in Lent et al.'s (2008) study. Therefore, the Lent et al. (2008) data cannot effectively differentiate between an SCCT-based efficacy-antecedent model and an alternative interest-antecedent model that directly contradicts the causal order hypothesis of SCCT. These results should be interpreted with caution because the Lent et al. (2008) study focused on engineering students and may not generalize to students in other areas. However, the finding of similar fit indices for both the SCCT-consistent and SCCT-contradicting models can be accounted for by an alternative Holland-based model that does not impose a causal ordering hypothesis on interest and self-efficacy measures. Indeed, when a Holland-based simultaneous model is fit to the Lent et al. (2008) data, it does produce a slightly larger chi-square value than do either of the antecedent models, but by Lent et al. (2008) criteria of parsimony, this model is arguably the best choice because it is a simpler representation of the interrelations among these measures over time. Therefore, future research examining the developmental sequence outlined in the SCCT model should also include alternative models with the measurement approaches outlined in this article.

Limitations and Future Directions

There are a number of limitations to the current research, including the sample of participants and the interest and efficacy measures used in the study, which need to be addressed in future research. One of the key limitations is the cross-sectional design used for data collection, which limits the conclusions that can be drawn concerning the developmental interaction between interest and self-efficacy hypothesized by SCCT. Another potential issue with the current study is its generalizability to populations other than the current sample of college students. Although Holland's (1959, 1997) RIASEC structure is generally supported in research (Armstrong et al., 2003; Rounds & Tracey, 1996), this finding is based primarily on the analysis of interest measures with U.S. samples of students and employed adults and may not generalize to more diverse populations or current RIASEC-based self-efficacy measures. Although we found general support for the RIASEC structure in the current study that is consistent with previous research, this may not generalize to other populations. In fact, Flores, Spanierman, Armstrong, and Velez (2006) found limited support for the RIASEC structure with the SII–SCI interest and self-efficacy measures in a sample of Mexican American high-school students. Therefore, additional research is needed to evaluate the extent to which the RIASEC-consistent correlations between interest and self-efficacy measure observed in the present study can be replicated with diverse samples.

An additional issue with the current study is the use of the experimental RIASEC measures because previous research has generally focused on commercially published measures such as the SII and SCI. This potential limitation is offset somewhat by the fact that the AFPD scales provide multiple indicators of each RIASEC type. It is more important to note that the observed interest–efficacy correlations with the AFPD measures were consistent with the meta-analytic estimates of these constructs reported in Rottinghaus, Larson, and Borgen (2003), falling between the reported values of SII–SCI correlations and interest and efficacy scales from the CISS. Therefore, because the observed correlations suggest that the AFPD scales successfully replicate correlations between commercial interest and self-efficacy measures, the methods used in the current study may serve as an appropriate test of the relations between these constructs. The current findings also provide important validity evidence for the AFPD marker scales by demonstrating the capacity of these measures to represent the RIASEC structure and address research questions that are not always feasible with commercial assessment measures. However, it will be important to evaluate the extent to which our results can be replicated with commercial assessments that are frequently used in career counseling and other applied settings.

Summary and Conclusions

The SCCT perspective on the association between interest and self-efficacy, which defines these two areas as separate sets of constructs with a specified causal ordering, was contrasted with an alternative Holland-based perspective, which defines both areas as indicators of the RIASEC types and recast the interest–efficacy distinction as an issue of method variance. These two competing perspectives were evaluated with hypotheses based on three different statistical models, including MDS, hierarchical clustering, and SEM. Obtained results provide support for the Holland-based model. In the MDS analysis, the dimension separating the interest and efficacy measures was secondary to the RIASEC structure. In the hierarchical clustering analysis, the interest and efficacy measures clustered by RIASEC type instead of forming separate sets of interest and efficacy clusters. The fit of the SCCT and Holland-based models were similar in the SEM analysis, but the Holland model may be preferable because it is more parsimonious than the SCCT model. However, additional research is needed to evaluate the developmental sequence between self-efficacy and interests in the SCCT model. Overall, these results suggest that both interests and self-efficacy beliefs are important components of the RIASEC types, thereby highlighting the importance of using both interest and self-efficacy measures in career counseling research and practice.

References

Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin, 121,* 219–245.

Aldenderfer, M. S., & Blashfield, R. K. (1984). *Cluster analysis.* Newbury Park, CA: Sage.

Armstrong, P. I., Allison, W., & Rounds, J. (2008). Development and initial validation of brief public domain RIASEC marker scales. *Journal of Vocational Behavior, 73,* 287–299.

Armstrong, P. I., Day, S. X., McVay, J. P., & Rounds, J. (2008). Holland's RIASEC model as an integrative framework for individual differences. *Journal of Counseling Psychology, 55,* 1–18.

Armstrong, P. I., Hubert, L., & Rounds, J. (2003). Circular unidimensional scaling: A new look at group differences in interest structure. *Journal of Counseling Psychology, 50,* 297–308.

Armstrong, P. I., Smith, T. J., Donnay, D. A. C., & Rounds, J. (2004). The Strong ring: A basic interests model of occupational structure. *Journal of Counseling Psychology, 51,* 299–313.

Bandura, A. (1982). Self-efficacy mechanisms in human agency. *American Psychologist, 37,* 122–147.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Betz, N. E., & Borgen, F. H. (2000). The future of career assessment: Integrating vocational interests with self-efficacy and personality styles. *Journal of Career Assessment, 8,* 329–338.

Betz, N. E., Borgen, F. H., & Harmon, L. W. (1996). *Skills confidence inventory: Applications and technical guide.* Palo Alto, CA: Consulting Psychologists Press.

Betz, N. E., Borgen, F. H., & Harmon, L. W. (2005). *Skills confidence inventory manual* (rev. ed.). Palo Alto, CA: Consulting Psychologists Press.

Betz, N. E., & Hackett, G. (1981). The relationship of career-related self-efficacy expectations to perceived career options in college women and men. *Journal of Counseling Psychology, 28,* 399–410.

Betz, N. E., & Rottinghaus, P. J. (2006). Current research on parallel measures of interests and confidence for basic dimensions of vocational activity. *Journal of Career Assessment, 14,* 56–76.

Campbell, D. P., & Borgen, F. H. (1999). Holland's theory and the development of interest inventories. *Journal of Vocational Behavior, 55,* 86–101.

Campbell, D. P., Hyne, S. A., & Nilsen, D. L. (1992). *Campbell interest and skill survey.* Minneapolis, MN: National Computer Systems.

Carroll, J. B. (1993). *Human cognitive abilities.* New York: Cambridge University Press.

Day, S. X., Rounds, J., & Swaney, K. (1998). The structure of vocational interests for diverse racial-ethnic groups. *Psychological Science, 9,* 40–44.

Denissen, J. A. P., Zarrett, N. R., & Eccles, J. S. (2007). I like to do it, I'm able, and I know I am: Longitudinal couplings between domain-specific achievement, self-concept, and interests. *Child Development, 78,* 430–447.

Donnay, D. A. C., Morris, M. L., Schaubhut, N. A., & Thompson, R. C. (2005). *Strong interest inventory manual.* Mountain View, CA: CPP.

Dumenci, L. (1995). Construct validity of the Self-Directed Search using hierarchically nested structural models. *Journal of Vocational Behavior, 47,* 21–34.

Flores, L. Y., Spanierman, L. S., Armstrong, P. I., & Velez, A. D. (2006). Validity of the Strong Interest Inventory and Skills Confidence Inventory with Mexican American high school students. *Journal of Career Assessment, 14,* 183–202.

Fouad, N. A., Harmon, L. W., & Borgen, F. H. (1997). Structure of interests in employed male and female members of U.S. racial-ethnic minority and nonminority groups. *Journal of Counseling Psychology, 44,* 339–345.

Gati, I. (1979). A hierarchical model for the structure of interests. *Journal of Vocational Behavior, 15,* 90–106.

Gati, I. (1991). The structure of vocational interests. *Psychological Bulletin, 109,* 309–324.

Goldberg, L. R. (1993). The structure of phenotypic personality traits. *American Psychologist, 48,* 26–34.

Gordon, A. D. (1999). *Classification* (2nd ed.). New York: Chapman & Hall.

Gore, P. A., Jr., & Leuwerke, W. C. (2000). Predicting occupational considerations: A comparison of self-efficacy beliefs, outcome expectations, and person-environment congruence. *Journal of Career Assessment, 8,* 237–250.

Hackett, G., Betz, N. E., O'Halloran, M. S., & Romac, D. S. (1990). Effects of verbal and mathematics task performance on task and career self-efficacy and interest. *Journal of Counseling Psychology, 37,* 169–177.

Harmon, L. W., Hansen, J. C., Borgen, F. H., & Hammer, A. L. (1994). *Strong interest inventory applications and technical guide.* Stanford, CA: Stanford University Press.

Hogan, R. (1983). A socioanalytic theory of personality. In M. M. Page (Ed.), *Nebraska symposium on motivation 1982. Personality: Current theory and research* (pp. 55–89). Lincoln, NE: University of Nebraska Press.

Hogan, R., & Roberts, B. (2004). A socioanalytic model of maturity. *Journal of Career Assessment, 12,* 207–217.

Holland, J. L. (1959). A theory of occupational choice. *Journal of Counseling Psychology, 6,* 35–45.

Holland, J. L. (1966). *The psychology of vocational choice.* Waltham, MA: Blaisdell.

Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Odessa, FL: Psychological Assessment Resources.

Holland, J. L., Fritzsche, B. A., & Powell, A. B. (1997). *The self-directed search technical manual.* Odessa, FL: Psychological Assessment Resources.

Holland, J. L., Whitney, D. R., Cole, N. S., & Richards, J. M., Jr. (1969). *An empirical occupational classification derived from a theory of personality and intended for practice and research* (ACT Research Report No. 29). Iowa City, IA: American College Testing.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1–55.

Kruskal, J. B., & Wish, M. (1978). *Multidimensional scaling.* Newbury Park, CA: Sage.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance [Monograph]. *Journal of Vocational Behavior, 45,* 79–122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology, 47,* 36–49.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31,* 356–362.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology, 33,* 265–269.

Lent, R. W., Sheu, H., Singley, D., Schmidt, J. A., Schmidt, L. C., & Gloster, C. S. (2008). Longitudinal relations of self-efficacy to outcome expectations, interests, and major career goals in engineering students. *Journal of Vocational Behavior, 73,* 328–335.

Lewis, P., & Rivkin, D. (1999). *Development of the O*NET interest profiler.* Raleigh, NC: National Center for O*NET Development.

Lubinski, D. (2000). Scientific and social significance of assessing individual differences: "Sinking shafts at a few critical points." *Annual Review of Psychology, 51,* 405–444.

Martens, M. P. (2005). The use of structural equation modeling in counseling psychology research. *The Counseling Psychologist, 33,* 269–298.

McDaniel, M. A., & Snell, A. F. (1999). Holland's theory and occupational information. *Journal of Vocational Behavior, 55,* 74–85.

Nauta, M. N., Kahn, J. H., Angell, J. W., & Cantareilli, E. A. (2002). Identifying the antecedent in the relation between career interests and self-efficacy: Is it one, the other, or both? *Journal of Counseling Psychology, 49,* 290–301.

Peterson, N. G., Mumbord, M. D., Borman, W. C., Jeanneret, P. R., & Fleishman, E. A. (1999). *An occupational information system for the 21st century: The development of the O*NET.* Washington, DC: American Psychological Association.

Rayman, J., & Atanasoff, L. (1999). Holland's theory and career intervention: The power of the Hexagon. *Journal of Vocational Behavior, 55,* 114–126.

Roe, A. (1956). *The psychology of occupations.* New York: Wiley.

Rottinghaus, P. J., Betz, N. E., & Borgen, F. H. (2003). Validity of parallel

measures of vocational interests and confidence. *Journal of Career Assessment, 11,* 355–378.

Rottinghaus, P. J., Larson, L. M., & Borgen, F. H. (2003). The relation of self-efficacy and interests: A meta-analysis of 60 samples. *Journal of Vocational Behavior, 62,* 221–236.

Rounds, J. (1995). Vocational interests: Evaluating structural hypotheses. In D. J. Lubinski & R. V. Dawis (Eds.), *Assessing individual differences in human behavior: New concepts, methods, and findings* (pp. 177–232). Palo Alto, CA: Davies-Black.

Rounds, J., & Day, S. X. (1999). Describing, evaluating and creating vocational interest structures. In M. L. Savickas & A. R. Spokane (Eds.), *Vocational interests: Meaning, measurement, and counseling use* (pp. 103–133). Palo Alto, CA: Davies- Black.

Rounds, J., & Tracey, T. J. (1993). Prediger's dimensional representation of Holland's RIASEC circumplex. *Journal of Applied Psychology, 78,* 875–890.

Rounds, J., & Tracey, T. J. (1996). Cross-cultural structural equivalence of RIASEC models and measures. *Journal of Counseling Psychology, 43,* 310–329.

Russell, D. W. (1996). The UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment, 66,* 20–40.

Schaub, M., & Tokar, D. M. (2005). The role of personality and learning experiences in social cognitive career theory. *Journal of Vocational Behavior, 66,* 304–325.

Tokar, D. M., Thompson, M. N., Plaufcan, M. R., & Williams, C. M. (2007). Precursors of learning experiences in social cognitive career theory. *Journal of Vocational Behavior, 71,* 319–339.

Tracey, T. J. G. (1997). The structure of interests and self-efficacy expectations: An expanded examination of the spherical model of interests. *Journal of Counseling Psychology, 44,* 32–43.

Tracey, T. J. G. (2002a). Development of interests and competency beliefs: A 1-year longitudinal study of fifth- to eighth-grade students using the ICA-R and structural equation modeling. *Journal of Counseling Psychology, 49,* 148–163.

Tracey, T. J. G. (2002b). Personal Globe Inventory: Measurement of the spherical model of interests and competence beliefs. *Journal of Vocational Behavior, 60,* 113–172.

Tracey, T. J., & Rounds, J. B. (1993). Evaluating Holland's and Gati's vocational-interest models: A structural meta-analysis. *Psychological Bulletin, 113,* 229–246.

Wei, M., Russell, D. R., Mallinckrodt, B., & Vogel, D. L. (2007). The experiences in close relationship scale—Short version: Reliability, validity, and factor structure. *Journal of Personality Assessment, 88,* 187–204.

Williams, C. M., & Subich, L. M. (2006). The gendered nature of career related learning experiences: A social cognitive career theory perspective. *Journal of Vocational Behavior, 69,* 262–275.

Received September 16, 2008
Revision received April 23, 2009
Accepted April 28, 2009 ■