

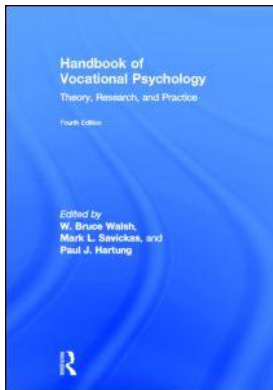
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### **Structure of Interests and Competence Perceptions**

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# Structure of Interests and Competence Perceptions

Terence J. G. Tracey and Sandro M. Sodano

The structure of vocational interests has been and continues to be an important topic in the field of vocational psychology. This topic deals specifically with the theoretical as well as empirical aspects of representing the constructs of vocational interests and more recently competence perceptions as well. In this chapter, we present a summary of the literature on the structure of interests and related competence perceptions. Our review of the literature begins with defining vocational interests within the context of Person–Environment Fit and J. L. Holland’s (1985a, 1997) theory of work personality. We describe the general two-dimensional model of interests and its extension to the three-dimensional sphere model. Our focus is on interests first and then on interests and parallel competencies, with an emphasis on structural validity. Structural validity is a specific yet extremely important aspect of construct validity, particularly for interests and competencies. After summarizing advancements in the research on the structure of interests and competence perceptions, we also provide a summary of the generalization of the structure across groups based on gender, ethnicity, age, and nationality, along with the development of interests. We also briefly include within this chapter two areas where the research we present on the structure of interests and competencies has been applied: the assessment of Person–Environment Fit and the interpretation of assessment results.

Primary assumptions of Holland’s theory (1985a, 1997) are that individuals and environments can be characterized by the same array of interest types. Central to his theory are the relations between the interest types themselves, which are depicted by the shape of a hexagon. Holland’s theory is a mainstay of vocational psychology and the importance of understanding individuals’ interests has been incorporated into the majority of the theories of career development and counseling. When theory proposes constructs that relate in a particular way, the structure of a measure of these constructs (i.e., the interrelations of the items and of the subscales) should behave in a manner that is consistent with the theory upon which the measure is based (Loevinger, 1957).

### GENERAL STRUCTURAL MODEL

Holland's (1985a, 1997) model of interest types is broad and inclusive. He posited the existence of six personality types: Realistic, Investigative, Artistic, Conventional, Enterprising and Conventional (hereafter referred to collectively as RIASEC). These types encompassed not only interests by many personality characteristics. He further proposed that these six types could be represented in a hexagon with the distances between the types indicative of the relative similarity. Finally, he proposed that occupations and social environments could also be classified into the same six RIASEC types enabling a relatively simple person-environment match due to their commensurate representations. Hence, the model is noteworthy in its simplicity, elegance and applicability. It has served as the basis of conceptions of interest research and assessment for over 50 years (Nauta, 2010).

Holland's claim of RIASEC types as being more than simple summaries of vocational interests was first supported by his research examining the overlap of RIASEC scores with the five factors of personality (Holland, 1999). Similar research documenting the overlap of RIASEC types with the big five dimensions has continued as exemplified by Larson, Rottinghaus, and Borgen (2002) as well as the overlap of abilities with interests (Randahl, 1991). Ackerman and Heggestad (1997) examined the overlap among RIASEC interests, intelligence, and personality and they provided several nice graphical representations of how the structures of the many different aspects of each were related. Armstrong, Day, McVay, and Rounds (2008) have taken this a step further and demonstrated how the RIASEC types could be used as a structural model to understand personality dimensions. Armstrong, Smith, Donnay, and Rounds (2004) similarly used the RIASEC types to examine aspects of vocations. All of these studies demonstrate the utility of the RIASEC model in being able to characterize a wide variety of factors just as proposed by Holland in his original conception. The RIASEC structure is elegant and inclusive. It represents a wide variety of personality and vocational characteristics in a very parsimonious and simply understood model. Being able to conceptualize all of these personality, interest, and work characteristics in a simple visual model is one reason for the impact of Holland's model on the field.

### HEXAGONAL REPRESENTATION OF INTEREST TYPES

The structure (or the relations among the interest scales themselves) has proven to be one of the main assets of Holland's model. The hexagonal structure has an intuitive appeal (Rayman, and Atanasoft, 1999). Those types more similar are depicted as residing closer to each other. Thus adjacent types (e.g., R and I) are more similar than types one step away (e.g. R and A) and all these are more similar than types opposite on the hexagon (e.g., R and S). So the hexagon presents a pattern of complex relations among the types in a very simple-to-grasp depiction.

There is a common misunderstanding about Holland's RIASEC types as being six factors. We have had several researchers contact us with "evidence" of the invalidity of Holland's model because their factor or principal components analyses did not yield six factors that resemble the RIASEC types. Generally, there were far fewer scales and the content was not clear. There are several examples of such analyses in the literature also (e.g., Di Scipio, 1974; Lunneborg and Lunneborg, 1975; Rachman, Amernic, and Aranya, 1981). Holland posits that the types are different but not that they form different dimensions of interests. This

is where the researchers are inappropriately looking for different factors where there is no presumption that they should exist. What Holland proposed is that there are six types (i.e., scales) that exist in a hexagonal pattern relative to each other. Hence the hexagonal pattern is a two-dimensional structure, not a six-dimensional structure. The relative placement of the six types in two dimensions is depicted by the hexagon, with closer types more highly related than more distal types. So any factor analysis should yield two factors—not six—if Holland is correct.

Tracey and Rounds (1993) noted that the hexagonal structure is really an example of a circumplex structure with equally spaced points that exists in two dimensions. Guttman (1954) was the first to recognize this alternative structure which he labeled a circumplex. As noted by Hogan (1983), a circumplex is a very different representation of data than is a factor listing. Most structural models are represented using factor analysis, where the minimum number of factors needed to represent the data covariation are selected and then these factors are rotated in such a manner as to best approximate a simple structure (defined as minimal cross-correlation among the items and factors). The result is a list of factors with items and scales loading on only one factor. This is a very parsimonious model in that a great deal of covariation is reduced to just a few factors. Hogan notes that a circumplex exists in two-dimensional space, but that it cannot be reduced to a simple structure. The items and scales are “blendings” of the underlying dimensions and it is the circumplex structure itself that defines the relations among the items and scales more than the underlying dimensions.

Thus the presence of the circumplex structure helps explain the inability of researchers to obtain six factors reflecting RIASEC scales. There should only be two factors or dimensions. Prediger (1982; Prediger and Vansickle, 1992) realized this when he proposed two dimensions that underlie the RIASEC types, which he labeled People versus Things (R vs. S) and Data versus Ideas (E and C vs. I and A). He further advocated that these two dimensions should be the means by which we should portray interest information instead of the RIASEC scores. Both the circumplex arrangement of the six RIASEC types and the underlying two dimensions of People/Things and Data/Ideas equally represent the information but do so in a different manner. One of the characteristics of a circumplex is that the underlying dimensions can have any orientation, but the relation of the points on the circumplex to each other remain unchanged (Rounds and Tracey, 1993). As an example of this, Hogan (1983) proposed two different dimensions underlying the RIASEC circumplex: those of sociability (E and S vs. I and R) and conformity (A vs. C). Both Prediger’s and Hogan’s dimensions equally fit the interest types; there is nothing that makes one empirically superior to the other. The circumplex structure of RIASEC types and the underlying dimensions proposed by Prediger and Hogan are depicted in [Figure 7.1](#). The key defining feature is not the underlying dimensions, but the circumplex structure itself. So the presence of a circumplex structure brought with it many issues to the fore. For example, are the six RIASEC types the best representation of the circumplex (i.e., are the types arbitrary)? And, are the two dimensions underlying the circumplex the complete representation of interest data?

### ARE THE SIX RIASEC TYPES ARBITRARY?

Another key aspect underlying Holland’s structure of interests is the validity of the six types themselves, not just their relation to each other. Tracey and Rounds (1995) examined whether responses to interest items were clustered into six natural groups, which would

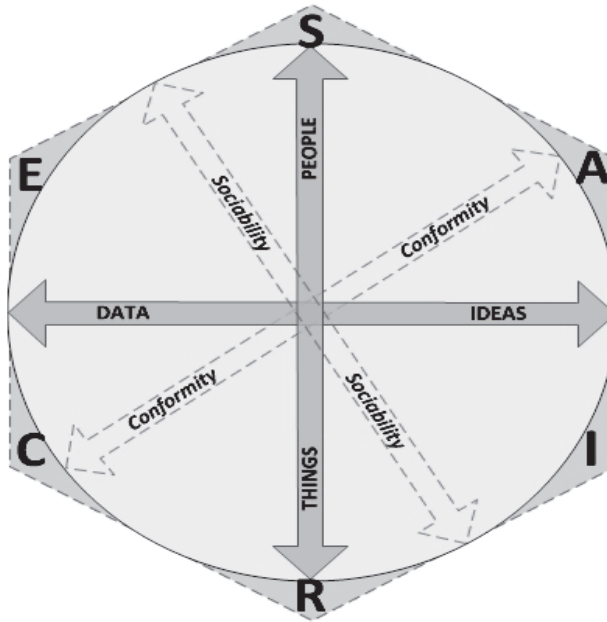


Figure 7.1 Circumplex Structure of RIASEC types shown with hexagon. Both sets of possible underlying dimensions are shown as potential axes of the circumplex. Solid arrows depict Prediger's (1982) People–Things and Data–Ideas and dashed arrows depict Hogan's (1983) Sociability and Conformity. R = Realistic, I = Investigate, A = Artistic, S = Social, E = Enterprising, and C = Conventional

support the presence of the six RIASEC types. They examined whether the six RIASEC types were naturally existing different types or simply convenient and arbitrary representations of the data. They found that responses to interest items were uniformly distributed around the circumplex. There was no empirical basis to the existence of six discrete types. The interest circumplex could be validly carved into any number of types, four or six or eight or 32. Recognizing this, Tracey and Rounds proposed a concentric circles model of interests where inner circles were divided into fewer types (say four, with people, things, data, and ideas as examples), then the six RIASEC types, then eight types, then 12 and then 32. The interest circumplex can be viewed as varying in specificity depending upon how finely the circumplex is divided. This issue of varying specificity in interest assessment has been taken up by several researchers. Borgen and Lindley (2003) noted that even though different occupations may have the same three-letter RIASEC code, they can vary greatly in specific interests manifested. They note the need for more specificity in assessment. Day and Rounds (1997) cataloged these more basic and specific interest groupings. Rottinghaus, Hees, and Conrath, (2009) demonstrated the incremental validity of using more specific basic interests than the more global RIASEC types in predicting job satisfaction. So, more specific basic interests are analogous to facets in personality research. Each global personality scale has several more specific facets underlying it in a hierarchical manner. The only difference in this case of interests is that the facets are arranged in a circumplex manner, emanating from an origin and not in a vertical hierarchical manner as in personality. Liao, Armstrong and Rounds (2008) adopted this facet model in their creation of 31 more specific interest types

underlying the global RIASEC types. Clearly interests can be viewed in a variety of levels of specificity, but the overall structure is the same: that of a circumplex.

Thus far, we have described the structure of interests when assessment is focused at the general and basic interest levels (i.e., the global and facet levels). Interest assessments are most often used to assist individuals in selecting an occupation to enter or to change an occupation, the purposes for which the general and basic interests are most appropriate. However, when assessing within-profession interests, a higher level of specificity is required. Although the within-profession activity interests are analogous to basic interests, the level of distinction is finer because only the domain of one broad profession is being represented and the goal is to identify subdomains (i.e., specialties) within it. For example, the occupation of physician would be expected to contain within it an array of physician-specific activities that are more or less relevant to the various specialties of physicians. Sodano and Richard (2009) showed that the domain of physician-specific activities was characterized by a simple structure instead of a circumplex one. The structure was best characterized by 19 dimensions. The structure of within-profession interests can therefore differ from the structure found at the general and basic interest levels of focus, largely because of the restricted and specialized focus involved. But again, when broader interests are examined, it is the circumplex representation that characterizes the relations and then this can be divided by any number of manners.

### GENERAL FACTOR IN INTEREST DATA

Factor analytic examinations of the relations of interest test have yielded diverse structures and it was not until the work of Prediger (1982) that the reason for the varying results and the “lack of support” of the RIASEC scales was made clear. Prediger found that factor analysis of interest items or scales yields three factors: a general factor and two substantive factors which he labeled People/Things and Data/Ideas. The general factor was characterized by loadings that were high across all items regardless of item content. It indicates a general tendency of people to like or dislike items. Given the lack of differential responding across different content, Prediger viewed this general factor as response bias and that it should be controlled. He recommended that this general factor be removed prior to any factor rotations. Indeed, if it was not removed, a variety of different factors were yielded and these were not reliable. So, understanding the presence of the general factor has helped clarify the structure of RIASEC assessments.

Tay, Su and Rounds (2011) investigated whether indeed Prediger’s two substantive dimensions of People/Things and Data/Ideas were bipolar in the classic sense. After taking account of the general factor (which is necessary to examine if the scales were bipolar), they did not find strong support for the bipolar nature of the dimensions but they did find support for the presence of the two dimensions themselves. So the dimensions may indeed be unipolar with one end representing high values and the other low, such as just People interests or much like the dimensions of Hogan (1983). Tay et al. also note that individuals may not be high on either People or Things, for example, but can be high on both. This concept is very true. While the items from the scales can be at opposite sides of the circumplex structure, this in no way means that individuals have to be at one or the other ends. People can have varying amounts of scores. The structure created by responses to the items is not the same as the plotting of individuals within that space. While it is interesting to ponder the definitional aspect of the dimensions, their presence and usage are still valid aspects of the model.

The general factor also has implications for RIASEC score interpretation. Rounds and Tracey (1993) also supported the presence of the general factor, but they noted that it might not simply be response bias as posited by Prediger (1982). This factor could also just serve as nuisance in that it exists, but is unrelated to any substantive variance, or that it could exist as important individual difference data. Some individuals have high general factor scores, which means they endorse liking most things. Others have low general factor scores, which means they dislike most things. But these two individuals could have identical profile patterns, for example where the three-letter high point code was IRA. However, if the level of scores was taken into account, the first sort of person with the high general factor scores would be viewed as having much higher I, R, and A scores. If this view is right, RIASEC scores should take account of the level of the scores. However, if it is the profile (e.g., the IRA itself) and not the level that matters, then RIASEC scores should only be interpreted in profile or high point code fashion. To help address this issue of the importance of the overall level of the RIASEC scores, Prediger (1998) examined the relation of the level of scores (i.e., the general factor) and its relation to interest-major congruence and found that level did not matter. The match between one's interest scores and one's major was not related to whether they had high overall scores or low overall scores. This appeared to settle the issue of the importance of the general factor: it was a nuisance variable that was unrelated to substantive variables, but needed to be accounted for in factor analysis.

However, Darcy and Tracey (2003) proposed that the general factor should be incorporated into score interpretation and that it did have substantive meaning. Individuals who have low mean scores on interest tests tend to be more moody, cynical, and cautious relative to those who score high who tend to be more cheerful and dominant (Berdie, 1943; Holland, 1997; Stewart, 1960). These characteristics are important and Darcy and Tracey posited that they would be related not to interest-major congruence but that it would moderate the congruence-career outcome (e.g., satisfaction and productivity) relation. They proposed that the general factor was an index of interest flexibility. High general factor scores indicate that the individual liked most things while low scores indicated that the individual was much more critical. For individuals with low general factor scores, the importance of having high interest-occupation fit is crucial to success and they are less interested in different things in general. Individuals with high general factor scores are stating that they like most everything and thus having a job that matches their interests is less crucial for occupational satisfaction and success. Tracey and Robbins (2005; Tracey, Allen, and Robbins, 2012) tested this moderation of the interest-major relation with college outcomes (grades and persistence) on nationally representative samples from over 80 different colleges and found support for the moderating effect of overall score levels. Individuals with low overall score levels needed a better fit between their interests and major to succeed (i.e., obtain high GPAs, persist and graduate) while those with higher overall levels did not. So the general factor has been found to have importance with respect to interest data. It is representative of a different construct called interest flexibility/adaptability and indicates the overall amount liking and endorsing many different activities. It is shown to relate to the importance of interest-environment match with respect to quality of outcomes. Those with lower interest flexibility require a closer match between interests and environment to succeed and be satisfied.

### PRESTIGE AS THE FOURTH FACTOR

Factor analysis has also revealed an important fourth factor that exists in responses to interest items: that of prestige. Tracey and Rounds (1996) factored interest responses to a broad set of occupational titles. They found the same common factors that Prediger (1982) found: that of the general factor and the two substantive factors of People/Things and Data/Ideas. But in addition they found a fourth factor which was prestige. Respondents definitely differentiated their interest in occupations based on prestige. Prediger (1996) commented that this prestige factor was probably more a function of using occupational titles as the items rated for interest in the study rather than activities as the items. To examine if indeed the prestige factor would not be present if activities were used, Tracey (1997a) examined responses to a broad representative set of occupational activities and found support for the same four factors, with prestige as the fourth one. This prestige factor, while present in all interest scales, is often ignored. Others have mentioned related aspects such as occupational level of difficulty and responsibility (Roe, 1956), level of training (Holland, 1985a), and occupational level (Campbell, 1971), but these have not been viewed as part of the interest assessment itself.

The presence of prestige in interest data is somewhat of a surprise as prestige is generally considered to be a value and not an interest (Dawis, 1991). While the definition of interests and values are not always clear (i.e., importance versus liking), the presence of this factor in interest data requires attention. Its meaning is clear in the case of responses to occupational titles where prestige is an essential aspect of all occupations. However, its meaning is less clear when it arises in responses to occupational activities. Sodano and Tracey (2008) proposed that the prestige factor is really an assessment of (a) the ability required to perform the activity or occupation and (b) the amount of effort involved in being successful. They found that ratings of ability and effort were highly related to the prestige factor supporting their contention. Neither ability nor effort alone captured what went into the prestige scores; it was the combination of both. So people do take prestige (composed of ability and effort) into account when they are rating their interest in various occupations as well as activities.

Prestige is thus a key aspect of interest measurement. While there is strong support for the generalizability of prestige rankings (Coxon and Jones, 1978; Crites, 1969; Hodge et al., 1964; Plata, 1975; Reeb, 1974), recent evidence appears to indicate that at least to some extent, prestige is in the eye of the beholder. Walker and Tracey (in press) demonstrated that while there is some agreement in prestige rankings between African Americans and White European Americans, there is also some discrepancy. African Americans evaluate many social occupations higher than do White Americans. Walker and Tracey hypothesize that this result is a function of the importance of social occupations (e.g., teacher and minister) in the African American community. So these results do indicate that while prestige is important, it should be examined in context.

### SPHERICAL STRUCTURE

Factor analyses of a broad set of interest items will demonstrate a four-factor structure with a general factor and three other factors: People/Things, Data/Ideas, and prestige. Tracey and Rounds (1996) found that the three factors when viewed in pairs formed circumplexes. These separate circumplexes when combined formed a spherical structure. These three



substantive factors form a sphere and thus do not have a clear, simple structure. The items are distributed evenly around the sphere and thus there are any number of dimensions that can characterize the sphere. For ease and familiarity, we use People/Things, Data/Ideas and prestige.

This spherical structure forms the basis of the Personal Globe model (Tracey, 2002a) as manifest in the Personal Globe Inventory (PGI), which is a more general representation of Holland's RIASEC structure. It includes the RIASEC types but also uses eight types as an alternative that provides more specific information. The representation of the eight PGI types juxtaposed to Holland's RIASEC types is presented in Figure 7.2. The PGI also incorporates the dimension of prestige and provides more information on interests mapped in the entire three-dimensional space, as represented in Figure 7.3. The PGI is thus a more specific yet general version of Holland's RIASEC types: the six arbitrary RIASEC types have been retained, while more defined scales using octants are also provided as well. The PGI incorporates the prestige inherent in interest data, and it focuses on the circumplex and spherical nature of the data. It has been found to fit the circumplex models as well as if not better than reigning RIASEC interest measures (Tracey, 2002a). The PGI thus provides a more complete representation of the structure of interests.

### SELF-EFFICACY

The incorporation of Bandura's (1986, 1997) concept of self-efficacy into the career literature served as a major boost to career theory and research. Self-efficacy refers not to the motivational factor of interests but to the belief that an individual can actually successfully engage in specific behaviors. It is one's assessment of competence in specific areas, as differentiated

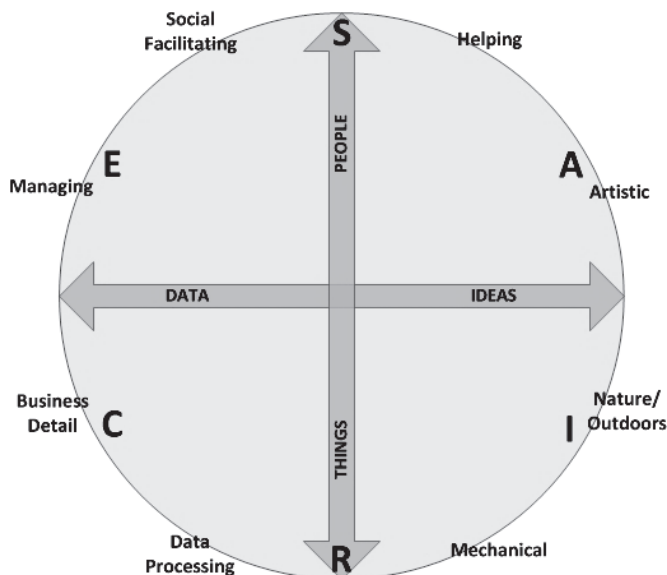


Figure 7.2 Circumplex representation of General Interest Level of the Personal Globe Inventory (PGI; Tracey, 2002a). The eight types are shown with full scale labels along with the six RIASEC types. Prediger's (1982) two underlying dimensions are shown by perpendicular arrows. R = Realistic, I = Investigate, A = Artistic, S = Social, E = Enterprising, and C = Conventional

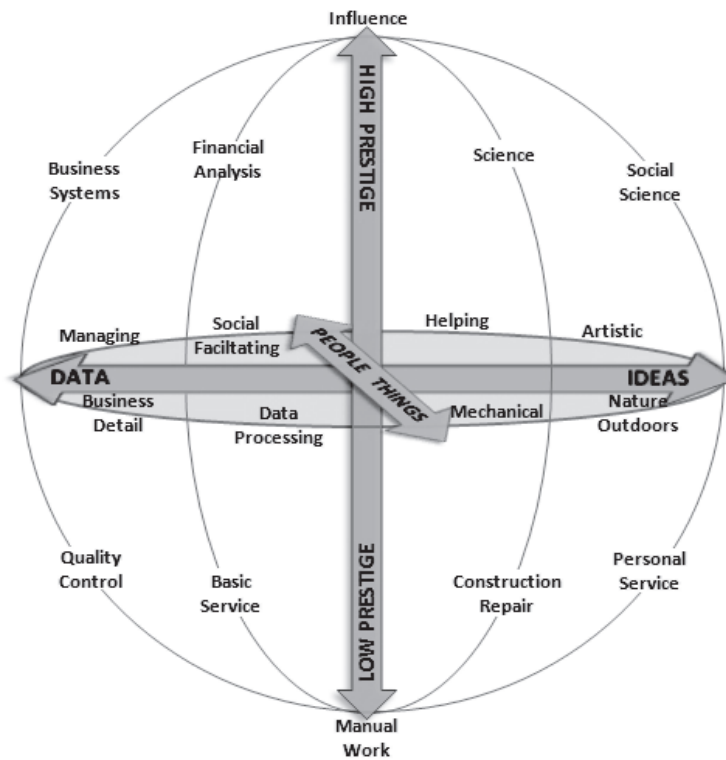


Figure 7.3 Spherical Structure of Interests as modeled by the Personal Globe Inventory (PGI; Tracey, 2002a)

from more global competence assessments such as self-esteem. Given the similarity in the terms self-efficacy and competence, we will use the terms interchangeably, as is done in the literature.

Betz and Hackett (1981) were the first to incorporate these ideas on the importance of an individual's assessment of his or her ability to successfully engage in specific behaviors into the research. Self-efficacy was subsequently incorporated into what is now one of the more prominent models, that of the Social-Cognitive Career Theory (SCCT; Lent, Brown, and Hackett, 1994). However, with the importance of self-efficacy in combination with interests, the need and desire to seek commensurate measures came to the fore. Could RIASEC representations of self-efficacy be developed which would enable easier interface between the two domains? Meta-analytic research has demonstrated that RIASEC interests are related to RIASEC self-efficacy estimates (Rottinghaus, Larson, and Borgen, 2003). Holland (1985b) made it clear that he thought that self-efficacy was vital to interest assessment, but that it was simply a subsection of interests, which he called self-assessment of skills. Boyle and Fabris (1992) found that the structure of the SDS interest items was similar to those of the self-assessment of skill items. Two studies found that when examined together, interest and self-efficacy items conformed to the same structure. Tracey (1997a) demonstrated this in a broad representative sample of activity items where he found support for the four-factors structure noted above (general factor plus the three substantive factors: People/Things, Data/Ideas and prestige) and that the items were distributed in a sphere. Armstrong and Vogel (2009) examined several RIASEC scales, not items, and also found that self-efficacy had a

structure highly similar to that of RIASEC interests. These results indicate that self-efficacy can be represented in a manner identical to that for interests. Having similar structures makes it easier to look at both interests and self-efficacy together. However, these researchers questioned the utility of having separate assessments of self-efficacy at all. The similarity in structure could be viewed as supporting Holland's claim that self-efficacy was simply a part of interests. Interests and self-efficacy was in essence "the same." However, research (e.g., Betz and Rottinghaus, 2006; Donnay and Borgen, 1999; Tracey and Hopkins, 2001) examining the incremental validity of self-efficacy estimates in prediction of career outcomes demonstrates that while both interests and self-efficacy share a good deal of covariation with career outcomes, each had unique predictive variance, thus supporting the distinction between the two. So the similarity in structure between interests and self-efficacy enables easy incorporation of both into research, but each is capturing unique content.

### INTEGRATION OF SELF-EFFICACY INFORMATION WITH INTERESTS

Given the similarity in structure, it is now becoming more common for career assessments to include both interests and self-efficacy scales. For example, the *Strong Interest Inventory* (Harmon, Hansen, Borgen, and Hammer, 1994) is often coupled with the *Skills Confidence Inventory* (Betz, Borgen, and Harmon, 2005), and the *Personal Globe Inventory* (Tracey, 2002a) has both interest and self-efficacy scales. The similarity of interests and self-efficacy makes it relatively easy to put the information together. Betz (1999) suggests that interests and self-efficacy should be split into high and low and then the test taker can see where interests and self-efficacy match and where they do not. Tracey (2002a) proposes that examining both interests and self-efficacy matters only when they are discrepant, i.e., non-redundant. He proposes focusing on both sources of assessment information only when the individual has substantially different levels of interests relative to self-efficacy. As an example, if an individual has high interest in R activities but has low self-efficacy in this area, should self-efficacy be added in the interpretation? If there are no substantial differences in the self-efficacy and interest scores, then self-efficacy adds little other than unneeded complexity to the interpretation.

Generally interests and self-efficacy are used in an additive manner (e.g., Betz, 1999); each one adds to the prediction of the other. However, Tracey (2010) demonstrated that it is more accurate to think of interests and self-efficacy working together in a multiplicative manner, which is similar to the common expectation  $x$  value relation in the developmental literature (Nagengast et al., 2011). The interest and self-efficacy perceptions heighten each other. When both are high, there is a very strong effect on career outcomes. When both are low, there is relatively little relation to career outcomes. So both do need to be attended to in assisting individuals with career decisions.

One issue that arises, while not specifically involving structure, is the sequential importance of interests relative to self-efficacy. Which one leads to the other? Lent et al. (1994) propose in SCCT that self-efficacy leads to the development of interests and they present a meta-analysis of correlations demonstrating a relation between interests and self-efficacy. Tracey (2002b) proposed that the relation is more one of reciprocal causation where one's self-efficacy leads to greater interests, but also that one's interests leads to more time engaged in an activity and this results in greater self-efficacy. This bidirectional relation between interests and self-efficacy has received support in longitudinal research (Lent, Sheu, Gloster,

and Wilkins, 2010; Lent, Tracey, Brown, Soresi, and Nota, 2006; Nauta, Kahn, Angell, and Cantareilli, 2002; Tracey 2002b) as well as experimental research (Bonitz, Larson, and Armstrong, 2010). So it is important to include both interests and self-efficacy estimates into our measure for the mutual and multiplicative impact they have on each other and career outcomes.

### GENERALIZABILITY OF CIRCUMPLEX STRUCTURE

The assessment of the structure of interests and self-efficacy is not done via factor analysis because factor analysis is intended to provide factors and simple structure. Interests and self-efficacy estimates have been shown to be characterized by circumplexes (or spheres) with items uniformly distributed. Hence there is no simple structure achievable through rotation. So evaluations of structure involve examination of the extent to which the circumplex (or sphere) fits the data. Generally there are two aspects to this fit. Does a circumplex fit the data? And, if so, are the data points equally spaced around the circumplex? There have been several methods proposed to examine circumplexes (see Tracey, 2000, for a presentation of most of them). The current common tools for assessing circumplex structure are Browne's (1992) CFA based CIRCUM program (Browne, 1992; Fabrigar, Visser, and Browne, 1997); the randomization test of hypothesized orders (Hubert and Arabie, 1987; Tracey, 1997b); and circumplex unidimensional scaling (Armstrong et al., 2003; Hubert, Arabie, and Meulman, 1997). The relative merits of each approach have been discussed in the literature (Darcy and Tracey, 2007; Gupta, Tracey, and Gore, 2008) and are beyond the scope of this chapter. We will instead summarize the conclusions reached in studies that have examined the circumplex structure over different groups.

#### Gender differences in structure

The literature has demonstrated large differences in mean scores across gender (e.g., Hansen, 1978; Lippa, 1998; Su, Rounds, and Armstrong, 2009; Tracey and Robbins, 2005), with men scoring high on R and women scoring high on S. But to be able to say that these differences are meaningful, it must be demonstrated that the structure of the instrument is equivalent across gender. If the structure is not invariant across gender, then it is impossible to interpret any mean differences in scores between men and women. If the scales have different structures, then the construct being measured in each gender is different. A comparison of means would then be a comparison of different entities (i.e., comparing apples with oranges). Hence to be able to interpret mean differences, the structures must be the same.

There have been several examinations of the structure of interests across gender (e.g., Anderson et al., 1997; Darcy and Tracey, 2007; Day and Rounds, 1998; Day et al., 1998; Fouad et al., 1997; Hansen et al., 1993; Lippa, 1998; Tracey, 1997a, 2002a; Tracey and Robbins, 2005; Tracey and Rounds, 1993). Tracey and Rounds (1993) conducted a structural meta-analysis on over 104 different RIASEC matrices and found that there were no differences in circumplex structural fit across gender. Using national samples, Day and Rounds (1998) and Tracey and Robbins (2005) also found no differences in the circumplex structure of interests across gender. Using a large national sample and comparing all the methods to test circumplex structure, Darcy and Tracey (2007) found differences across methods in terms of overall fit to the circumplex structure, but within each method, the two genders

were equally well fitted by the circumplex structure. Finally, Tracey (2002a) examined the gender invariance in circumplex structure across high school and college groups on the PGI RIASEC and octant scales and found no differences between the genders in any comparison. The results are very supportive of a similar structure in interests across gender. So it is possible to validly compare means on interest scales across men and women.

The literature on the fit of self-efficacy to the circumplex model is less extensive as there are fewer measures, but Tracey (2002a) also found no differences in the fit of self-efficacy estimates to the circumplex (for both RIASEC and octant scales) across gender on the PGI. Before conclusions can be made about the invariance of the circumplex for self-efficacy across gender, more testing is required; however, there is some initial support for the similarity in structure for self-efficacy ratings across gender.

### **Ethnicity differences in structure**

There have also been findings of interest and self-efficacy mean differences across ethnicity (e.g., Harmon et al., 1994; Tracey, Robbins, and Hofsess, 2005), but, again, these differences are meaningless unless there is a common structure underlying them. There have been a number of examinations of the extent to which the data from different ethnic groups are well fitted by the circumplex (e.g., Armstrong, Hubert, and Rounds, 2003; Day and Rounds, 1998; Fouad and Dancer, 1992; Fouad, Harmon, and Borgen, 1997; Fouad and Mohler, 2004; Hansen, Scullard, and Haviland, 2000; Ryan, Tracey, and Rounds, 1996; Swanson, 1992; Tracey, 1997a, 2002a; Tracey and Robbins, 2005; Tracey and Rounds, 1993) and these have yielded somewhat conflicting results. However, these results could be attributable to differing samples and instruments. In their meta-analysis, Tracey and Rounds (1996) found differences between ethnic samples and common U. S. samples in the fit of the circumplex to the data. Ethnic samples were less well fitted by the circumplex structure. However, examining a large national sample, Day and Rounds (1998) found that there were no differences in fit to the circumplex across the major U.S. ethnic groups. Tracey and Robbins (2005) also demonstrated this lack of differences across the major U.S. ethnic groups in another large representative sample. Gupta, Tracey, and Gore (2008) examined the fit of the circumplex to the major ethnic groups in the population of high school students from several states. The sample was thus noteworthy in that it included all high school students in several states, not just a more common, selected sampling of individuals who plan on attending college. Gupta et al. used all of the primary analytic tools to assess circumplex structure and, like Darcy and Tracey (2007) in their examination of gender differences, they found that the results varied across analytic technique, but within technique there were no substantial differences across the different ethnic groups in the fit to the circumplex structure. Tracey (2002a) examined the invariance across ethnic groups for the PGI RIASEC scales as well as the octant scales in both high school and college students and found that there were no differences in fit of the circumplex across major ethnic groups. So, with adequate sampling, there does not appear to be any differences in fit of the circumplex structure to the different U.S. ethnic groups.

All of the above results pertain to interests. Again there are fewer examinations of structural invariance across ethnicity for self-efficacy, but Tracey (2002a) demonstrated no difference in fit of the circumplex model across the major ethnic groups in samples of both high school and college students using the PGI. So there is some support for the ethnic invariance of self-efficacy estimates across ethnic groups, at least for the PGI.

### **Age differences in structure**

The generalizability of the structure of interests and self-efficacy across age is also crucial given the application of associated assessments to individuals of varying ages. In their meta-analysis, Tracey and Rounds (1993) found no difference in the fit of RIASEC interest data to the circumplex using samples aged 14 years old and above. A similar result has been found by Tracey and Robbins (2005) using a large representative sample and examining difference in fit to the circumplex longitudinally from grades 8 through 12. So it appears safe to conclude that by eighth grade (14 years old) the circumplex structure of interests is present. Low et al. (2005) also demonstrated that the RIASEC interest scales themselves become relatively stable with respect to test-retest reliability at about the same time, 14 years old. Given this stability of structure and scores, it is valid to compare scores of individuals at different ages, at least above 14 years old, and have a meaningful result.

There are few examinations of self-efficacy structure over different age groups, but Tracey (2002a) has demonstrated that the circumplex model fits high school student self-efficacy data as well as it does college student self-efficacy data using the PGI, partially supporting the results yielded with interest data.

However, much less is known about the structure at ages below eighth grade. Tracey and Ward (1998) examined the structure of interest and self-efficacy estimates in samples of children (grades 4 and 5), middle school students (grades 6 and 7) and college students. The pattern of fit for both RIASEC interests and self-efficacy assessments to the circumplex was a positive one with age; the older samples' data fitted the circumplex better. The college sample had a good fit to the circumplex, the middle school sample had a fair fit, and the younger sample had a poor fit. This pattern was similar for both interests and self-efficacy estimates. An examination of Italian children demonstrated a similar pattern of increasing fit of RIASEC interest and self-efficacy data to the circumplex with increasing age (Lent, et al, 2006). So for both interests and self-efficacy estimates, the structure is substantially different in children younger than 14 years old and caution should be used in assessing children at these younger ages because different constructs are being assessed.

### **International differences in structure**

RIASEC interest measures have been used all over the world. This usage is a testament to the appeal of the scales and the need for interest assessments. However, it is not common for there to be accompanying assessments of the validity of these applications. Structural examinations of interest and self-efficacy measures are rare (Tracey and Gupta, 2008). In some cases, RIASEC instruments are just given out in other countries unchanged. Sometimes, if needed, they are translated into another language and then used. In each case, it is assumed that the structure is the same as it is in the U.S. However, applying U.S. measures to other countries is not so simple or straightforward. Even if the country uses English as its language, it cannot be assumed that the items work similarly. If the scale has occupational titles, many of these are not present in all countries. As examples, we will use our experience in adapting the PGI to other cultures. Attempts to translate the occupational scales into Farsi for Iranian use was difficult because there are no occupations that resemble a bartender or an aerobics instructor. It is usually easier to employ activity items in different cultures for this reason, but even here there are differences which need adjusting. For example, one PGI activity item is

about inspecting landfills, but this item made no sense in Singapore—even though English is the official language—because they have no landfills: garbage is exported. In addition, what appear to be common terms in one country have no meaning in another. In adapting the PGI to Ireland, the item “vacuuming” was not understood. Changing the item to “hooverizing” yielded the desired response pattern. The best practice in applying any test to another country or culture is to carefully translate each item into that culture and then have it back translated to see if it is accurate. Problematic items are often revealed through this process. However, this translation–back translation practice does not provide evidence of structural equivalency, which must be substantiated empirically.

The structural equivalency of RIASEC interest measures across country was examined in a meta-analysis of 76 data sets from 18 countries by Rounds and Tracey (1996). They found that the circumplex structure of RIASEC interests did not generalize across countries. Almost all countries (with the exception of Iceland) had fits to the circumplex structure worse than the U.S. Furthermore, there did not appear to be any particular pattern for the lack of fit observed. Although they hypothesized that more developed countries would have a better fit to the circumplex structure, this was not supported. Even countries more similar to the U.S. (e.g., Australia and Canada) had a substantially lower fit to the circumplex structure. Rounds and Tracey found that foreign samples were best fitted by Gati’s (1991) simpler three-group partition structure where R and I are combined, A and S are combined, and E and C are combined. So there was little support for the validity of the circumplex RIASEC structure for interests in countries other than the U.S. There have been subsequent examinations of specific countries, but these have yielded generally similar results (e.g., du Toit and de Bruin, 2002; Farh, Leong, and Law, 1998; Glidden-Tracey and Parraga, 1996; Leong, Austin, Sekaran, and Komarraju, 1998; Long and Tracey, 2006; Tak, 2004; Tang, 2001), calling into question the application of RIASEC interest measures in other countries. There have yet to be any examinations of the generalization of RIASEC self-efficacy scales to other countries. There have been fewer factor analytic examinations of interest structure across country, but two recent examinations of interest responses to occupational titles have demonstrated that the structure is similar to the three-factor structure noted above with People/Things, Data/Ideas, and Prestige being supported in Japanese (Tracey, Watanabe, and Schneider, 1997) and Spanish (Sastre, Mullet, and Semin, 1999) samples. So there is some support for similar underlying dimensions in non-U.S. interest assessments, but not for the RIASEC interest scales themselves.

While the structural support for the RIASEC interests in non-U.S. countries is not strong, examinations of the generalizability of the interest and self-efficacy scales from the Personal Globe Inventory (PGI; Tracey, 2002a) have shown some initial promise. The PGI yields both RIASEC scales as well as the eight-type scales presented in [Figure 7.1](#). These two are alternative methods of depicting the circumplex structure. The eight-type is more specified than the six type but they still account for the same circumplex. Applications of the PGI in Serbia (Hedrih, 2008), Croatia (Sverko, 2008; Sverko, and Babarovic, 2006), Ireland (Darcy, 2005), Japan (Long, Watanabe, and Tracey, 2006), and China (Long, Adams, and Tracey, 2005) have all demonstrated similar or better fit to the circumplex for RIASEC interest scales as obtained for U.S. samples (Tracey, 2002a) and comparable to those of other RIASEC scales (Tracey and Rounds, 1993). Similar high fit-values were obtained for the RIASEC self-efficacy scales in these countries. However, the eight-type model appeared to fit better than the six-type RIASEC model for both interests and self-efficacy in most of the countries (i.e., Ireland,

Japan, and Croatia), while it was comparable in Serbia and China. Each of the above studies has found good support for the generalizability of the spherical structure (i.e., the combination of the interest and self-efficacy circumplex with prestige) across each of the countries. So the support for the generalizability of both interests and self-efficacy estimates across nationality appears promising for applications of the PGI, but not so for other measures.

### **Structure as an individual construct**

The examination of structure has always been an aspect of group data, where the correlations among the items are under study. As such, the structure is an examination of how groups of people perceive the similarity or difference among the items. Application of this group structure to any specific individual will thus be questionable. Does this individual think about interests in a manner similar to that used by most people? To examine this individual variation in how people conceive interests, Tracey and Darcy (2002) adopted an ideothetic approach (Darcy, Lee, and Tracey, 2004) in evaluating how well the circumplex structure fitted each individual. On average, over a sample of college students, most people use the circumplex structure in evaluating the similarity of the different interests, but there is still a great deal of variation in this fit across individuals, with some having completely different ways of thinking about interests. Unlike the nomothetic approach, this variation cannot be attributed to error. Tracey and Darcy found that the less the circumplex structure of interests was endorsed by an individual, the greater career undecidedness was evidenced. Their hypothesis was that individuals who think about interests differently from the norm would have more difficulty understanding, organizing, and using career information in their decision making and that this would result in greater indecision. However, the intervention implication of this result was not clear. Should we provide information to individuals in a manner that matches how they think about it so they can understand and use it better? Or, should we educate them in the normative structure so they can more readily understand and use existing information? To address these questions, Tracey (2008) examined the effect of direct RIASEC instruction on individual structures and subsequent career decision making. He found that instruction increased mean levels of individual circumplex structure adherence only for those who did not use the circumplex structure originally. Also, the instruction helped these same individuals more with respect to career decision making. So Holland's claim (1997) that teaching the RIASEC structure is helpful in itself was supported for those who did not use it or understand it well. The structure is thus important at an individual level also in that the more we can help individuals use the normative circumplex structure, the better their use of career information and better their career decision making.

## **DEVELOPMENT OF INTERESTS**

In this section, we present a summary of the research on interest development as it relates to the structure of interests from childhood through adolescence, spanning the primary, middle, and high school periods in the United States. Our focus here is on describing the substantive differences in interest and competency perceptions that are occurring along with the changes in structure observed as children age (as was described within the previous section). We will also review how structural stability (or lack thereof) relates to the commonly used methods of profile assessment.



Assessing interests or self-efficacy in children is a different process from that with adults. It is not desirable to use occupational titles as items because children have limited knowledge of different occupations and thus little basis on which to make judgments. Although activity items are more appropriate for children relative to occupational titles, it is essential that developmentally appropriate items be utilized. Only activity items whose content are commensurate with children's experiences and their grade reading level—either being at or below it—are appropriate for assessing interests and competencies and are therefore also appropriate for the subsequent examination of structure in children. Early attempts to assess the interests of children were focused to some degree on activities that were relevant to children, with research revealing a unique structure of interests for children (Tyler, 1955; Zbaracki, Clark, and Wolins, 1985). However, establishing the general circumplex model of interests as a representation of Holland's interest model (Rounds and Tracey, 1993; Tracey and Rounds, 1993) highlighted the differences in structures between adults and children. Furthermore, it was not clear at what age the structure commonly utilized by adults would cease to be valid for children and vice versa.

Tracey and Ward (1998) assessed both interests and related competency perceptions using developmentally appropriate language to describe activities common to children's everyday experiences. When the children's activity interest or competency items were logically grouped into the RIASEC types, the fit to the circular RIASEC structure was shown to be valid with college students but not with children. The RIASEC types were not valid for children presumably because the types are more abstract than the concrete thinking of children allows. However, when examining the covariation at the item level across grades, the different underlying dimensions utilized by children relative to adults were shown. The children's responses to items could not be characterized by the Things/People and Data/Ideas dimensions, which were clearly evident in the college students. Children's responses could instead be characterized by Sex Typing (i.e., whether the activities were associated with boys or girls) rather than Things/People and Locus of the Activity (i.e., whether the activity occurred in or out of school) rather than Data/Ideas. The dimensions utilized by the children were salient to their world and more concrete relative to the dimensions commonly utilized by adults. This research resulted in the Inventory of Children's Activities-Revised (ICA-R; Tracey and Ward, 1998; Tracey, 2002b), which allowed the developmental shift in the meaning of interests and competencies to be observed, in addition to the relative differences in fit to the RIASEC structure between grade levels. In addition, the overall responding by children to interest items was shown to be relatively undifferentiated, with fairly equal liking and disliking, while the overall competency responding was generally high, suggesting an overestimation by children of their competencies, as would be expected based on the developmental literature.

Support was found for structural stability during the transition from elementary to middle school (Tracey, 2002b). Possible explanations for the structural differences in the developing children (Butler, 2005) are cognitive maturation, which accounts for increased ability for abstraction (Nichols, 1990; Phillips and Zimmerman, 1990; Piaget, 1972; Ruble and Seidman, 1996) and social changes (e.g., social status) occurring with the shift into middle school. Regardless of the reasons for the observed changes, as children age, their interests and competency perceptions become more differentiated and this coincides with better fit to the normative RIASEC structure. Therefore, there is an increase in approximating the normative RIASEC structure as most children and adolescents age and this is accompanied

by an increase in stability of the structure that becomes invariant by the eighth grade. In fact, the RIASEC structure did not vary as students aged from grades 8 to 12 (Tracey, 2002b; Tracey and Robbins, 2005; Tracey et al., 2005) and this structural invariance was across gender and ethnicity. A major implication of the research described is that RIASEC scale scores can be considered valid from the eighth grade on with most groups in the U.S. It is during this time that interpretations based on RIASEC scale scores along with mean-level and other profile comparisons become valid. However, caution is still warranted with respect to the validity of RIASEC scale scores in international groups (Rounds and Tracey, 1996).

The presence of structural similarity across age groups is perhaps the most important type of stability because structural stability is implicitly assumed in other stability examinations. In particular, assessments of relative stability, or the test-retest correlation of scales over time, and absolute stability, or the changes in score levels over time, assume scales have the same meaning at time one and time two. Children in elementary school (grades 4–6) have shown moderate levels of relative stability, which increases as children age (Tracey and Ward, 1998; Tracey, 2002b). Although the observed stability is less for children relative to adults, the levels that are attained are greater than previously thought possible with this age group. With respect to absolute stability, the overall pattern of interest levels has been described as one where score levels are high in elementary school, but then drop dramatically with the transition to middle school where they continue to decline until high school when they begin to increase again (Tracey and Sodano, 2008). However, the meaning of the scales is different for children compared to older adolescents and adults because of the differences in structure.

Moreover, despite the presence of the normative RIASEC structure at the group level beginning in the eighth grade, the individual adherence to this structure can still vary. Using a blend of idiographic and nomothetic approaches with Italian adolescents, Tracey et al. (2006) showed that early adolescents increased in adherence to the RIASEC structural model over time. However, taking a similar approach with Italian middle school children showed that those with lower adherence to the RIASEC model engaged in less career exploration over time (Lent, Tracey, Brown, Soresi, and Nota, 2006). These studies further indicate that students in lower middle school grades, and below, present unique challenges to the field in terms of how to best approach career development interventions with children.

Overall, the support found for the benefits in teaching Holland's model in adults suggests that this should also be done with children as well. However, it is not clear how the differences in activity perceptions of children relative to adults should best be approached. Sodano (2011) examined the interpersonal aspects of the developing RIASEC-based activity interests and competencies in a sample of seventh grade American children. The enterprising interest and competency was associated with a cold and somewhat dominant interpersonal style instead of a warm and dominant style (i.e., extraversion), which is expected in adults. More work is needed to better understand interest and related competency development in order to inform career development interventions with children. However, teaching the model or even the main dimensions of it using developmentally appropriate language appears to be a viable approach with children.

### PERSON-ENVIRONMENT (PE) FIT

The basic assumption in vocational psychology in Parsons' (1909) work is that the more a person fits or matches an environment (i.e., work or academic major), the better the outcomes

(i.e., satisfaction and productivity). This matching view is a cornerstone of the Theory of Work Adjustment (Dawis and Lofquist, 1984) as well as Holland's person environment fit model (Holland, 1997; Rounds and Tracey, 1990). However, assessing the fit between the person and the environment is not simple or straightforward (cf. Edwards, 1991, Kristof, 1996; Kristof-Brown, Zimmerman, and Johnson, 2005). One of the extremely appealing aspects of the structure of interests and self-efficacy is that their structures mirror each other as well as the structures of occupations and academic majors (e.g. Deng, Armstrong, and Rounds, 2007; Tracey and Rounds, 1993). The availability of commensurate models enables relatively easy determination of person–environment fit. The research examining interest–environment fit (also called congruence) with occupational and academic outcomes has yielded results that are modest, with small to moderate effect sizes (Asouline and Meir, 1987; Tranberg, Slane, and Ekeberg, 1993; Spokane, 1985; Spokane, Meir, and Catalano, 2000; Tsabari, Tziner, and Meir, 2005). Results such as these have resulted in several individuals calling for the removal of person–environment fit as a central concept in the field (e.g., Arnold, 2004; Tinsley, 2000). One reason for the modest PE fit–outcome covariation is that there are a great number of fit indices used and there are problems with many if not all (e.g., De Fruyt, 2002). Many of these indices agree to a moderate level (Camp and Chartrand, 1992), but the research has demonstrated that the support for the congruence–outcome relation varies as a function of the congruence measure used (Asouline and Meir, 1987; Tinsley, 2000; Tsabari et al., 2005; Young, Tokar, and Subich, 1998).

Most of the indices of P-E fit examine the similarity of the structure of interests with that of the occupation or major using high point codes which are the highest one, two, or three codes for the person or the environment. The indices vary with respect to whether they use only the first letter, only the first two letters, or only the first three letter codes. Also, the indices vary with respect to whether or not they take account of the circumplex structure. Some indices only look at exact match or not, while others give partial credit to mismatches that are closer on the RIASEC circumplex. Finally, the indices vary with respect to the underlying statistical and distributional properties. An example of one of the more sophisticated indices is the C index (Brown and Gore, 1994) which uses all three high point codes, with credit given to the circumplex structure. However, Tinsley (2000) noted that the better the fit index, the worse the results with respect to being related to career outcomes. A potential reason is that all the current measures of P-E fit use high point codes. There are many problems with high point codes (cf. Arnold, 2004). First, they present only a limited amount of information from the interest profile. At minimum (if the three high point codes are used), half of the profile of interests is ignored. Dik, Strife, and Hansen (2010) recently demonstrated that the three lowest interest codes were also predictive of career outcomes. So it is important to include the full profile of scores—yet none of the current measures do this. Second, all indices rely on a rank ordering of the interest scores and this is especially problematic in the case of ties. Differences in levels across profiles are also ignored. For example, an individual with a profile of R = 70, I = 30, and A = 29 would have the same three-letter high point code as someone who scored R = 70, I = 69, and A = 68, but these two profiles are very different. Because there is now complete profile information available for each of the RIASEC scales on all occupations (e.g., O\*NET) and majors (National Center for Educational Statistics Classification of Instructional Program, CIP) there is no reason why methods using partial profile information should continue to be used.

There have been three alternative P-E fit indices proposed and examined in the literature that avoid the above problems associated with high point codes. The first two indices—angular

displacement and Euclidean distance—rely upon the validity of the circumplex structure of interests. Since interests can be validly represented using a circumplex, then the six RIASEC scores (or eight octant scores in the PGI) can be validly summarized as a point in two-dimensional space (Mardia, 1972; Prediger, 1982). So each person's RIASEC interest profile can be reduced to a point along the Things/People and the Data/Ideas dimensions, which also allows the entire profile to be represented. The RIASEC profile of occupations and majors can also be represented as a point in two-dimensional space. Then it becomes a simple matter of representing the difference between these two points, one for the person and one for the environment. The first means of representing the similarity between these two points is angular displacement (Fisher, Heise, Bohrnstedt, and Lucke, 1985), which assesses how great the angle is between the two points. This index focuses on the overall similarity of the person with the environment across the slices of the circumplex. Thus, it asks the question, "Are the two in similar sections or very different sections of the circumplex?" The other index, Euclidean distance, focuses on the absolute distance between the two points. A third index that has also been proposed is a simple profile correlation between the interest RIASEC scores and the environment occupation scores. It does not use the circumplex information in its calculation; indeed, it assumes that the RIASEC scores are independent (which is not true). However, at a minimum, it does take account of the entire profile.

Both the angular displacement and Euclidean distance measures were used in a study by Tracey and Robbins (2005; Tracey, Robbins, and Hofsess, 2005) who examined interest–major match and its relation to academic outcomes. They found equal support for both measures of P-E fit. Neumann, Olitsky, and Robbins (2009) used Euclidean distance in their study of interest–major congruence and occupational earnings and found support for this means of determining P-E fit. Durr and Tracey (2009) found support for the Euclidean distance index of interest–major congruence and career decidedness. Allen and Robbins (2010) used the profile correlation index of congruence and found that it related to persistence within one's major and timely degree attainment. Finally, Tracey, Allen, and Robbins (2012) examined both Euclidean distance and profile correlation in the relation of interest–major match and academic outcomes and found that although the two only minimally related to each other, both indices performed equally well, and both predicted GPA, persistence, and graduation well.

So these three indices each take account of the entire profile and have been shown to relate well and similarly to important outcomes. Given ease of calculation, the unneeded assumption of independence of scales, and the easy extrapolation to more than two dimensions (e.g., in the case of the PGI), it appears that the Euclidean distance index is superior.

## SUMMARY

In this chapter, we have reviewed the major findings on the structure of vocational interests and competence perceptions. We began our review with a description of Holland's (1985a; 1997) model of interests. This broad and inclusive model offers an elegant and parsimonious representation of interests and corresponding environments. Holland articulated relations between his six interest types that were located around the perimeter of a hexagon using the RIASEC acronym. The hexagon itself has had a tremendous influence on how interests are understood, particularly in terms of their interrelations. Its heuristic value to researchers, practitioners, and clients cannot be overstated. As a model, the hexagonal figure is arguably

one of the most recognizable figures in the psychology and counseling fields, attesting to the magnitude of Holland's overall contribution beyond vocational psychology.

Our review is essentially a summary of the advancements in research that have supported, clarified, and extended the main points of Holland's (1985a, 1997) model of interests. Earlier factor analytic approaches to summarizing interest data led to the separation of the general factor from the two substantive dimensions underlying the hexagon. The introduction of the circumplex (Guttman, 1956) brought a mathematical model that empirically accounted for the theoretical relations between the interest types being assessed (Hogan, 1983; Prediger, 1982; Tracey and Rounds, 1993). The recognition of the hexagon as a circumplex enabled specific empirical tests of hypotheses about the structure of interests that are explicit as well as implicit in Holland's (1985a, 1997) theoretical model. The application of the circumplex to the structure of interests represents a key advancement in the study of interests because it enabled a closer alignment between Holland's theory and measures of interests. When the arbitrariness of the interest types within the model and the different orientations of the two underlying dimensions became apparent, the emphasis shifted to the relative ordering of interest types that could have a broader or more specific level of focus than the six types initially proposed by Holland. With few exceptions, the circumplex approach to studying interest structure has well supported the key features of Holland's (1985a, 1997) model. However, as proposed by others (e.g., Hogan, 1983; Tracey and Rounds, 1993), Holland's six RIASEC interest types and the accompanying hexagonal depiction of interests is more appropriately subsumed under the general circumplex model of interest structure.

Support found for the additional dimension of Prestige being inherent in the data of responses to a broader domain of interest items led to a significant extension of Holland's model. The dimension of prestige adds a third substantive dimension that is orthogonal to the two-dimensional plane where the general circumplex structure of interests resides (Tracey and Rounds, 1996). The spherical interest model accounts for the differential reliance on the prestige dimension in interest and competency ratings. The stronger the preference for higher or lower levels of prestige, the further the distance one moves from the equator of the sphere in either direction. A key advantage of using a spherical model is that it shows how preferences become truncated the more prestige is being relied on in making interest ratings. The incorporation of prestige can yield different profiles that can then be associated with different occupations than when only the mid-range level of prestige is represented, as is the case with all assessments that utilize only two dimensions (e.g., people/things and data/ideas). Another advancement in research on the structure of interests came with findings that the structure of self-efficacy mirrored that of interests (Armstrong and Vogel, 2009; Boyle and Fabris, 1992; Tracey, 1997a, 2002a). The benefits of using parallel interest and self-efficacy assessments appears to occur when using the two- and three-dimensional models when interest and self-efficacy profiles are either high and consistent or discrepant (Tracey, 2010).

Currently, the PGI (Tracey, 2002a) is the only interest inventory that takes advantage of the above advancements in research on the structure of interests and competency perceptions in terms of assessment and interpretation of results. Use of the PGI offers researchers and practitioners the ability to assess interests and parallel competencies using the two-dimensional general circumplex and three-dimensional spherical models of interests and competencies. Consistent with the concentric circles proposed by Tracey and Rounds (1995), varying levels of specificity can not only be assessed by the PGI (i.e., four, six, eight,

12, 24, 32 interest and competency types), but it is also possible to tailor the presentation of the assessment results to the level of specificity that is unique to the respondent and whether or not the interest and competency estimates are consistent or discrepant (Tracey, 2002a). Thus the PGI makes it possible to tailor feedback that is specific to each individual. For example, those individuals who utilize prestige can receive a three-dimensional presentation of their results, while those that do not utilize prestige can receive their results presented in two dimensions. The number of interest types (i.e., the profile of scores) presented to the individual would correspond to the level of specificity that is most salient to him or her. In addition, the self-efficacy results need only be included in the presentation when they are discrepant from the interests or when both are at high levels and consistent.

A variety of analytical methods for specifically testing the circumplex structure have been utilized (e.g., Tracey, 2000) to assess model-data fit using data generated by various interest inventories across different groups of respondents. The findings with respect to the generalizability of the circumplex and spherical structures based on gender, ethnicity, age, and country were summarized. Although mean score differences between males and females will still exist, the gender invariance of the circumplex structure of interests has been supported (Tracey and Rounds, 1993) and research thus far has suggested gender invariance in the circumplex structure of self-efficacy too (Tracey, 2002a). The research reviewed on ethnicity differences in fit to the circumplex model suggests that the cross-ethnic differences in model fit are largely attributable to different analytic methods employed across studies and sampling adequacy. Thus the major ethnic groups in the U.S. apparently fit the circumplex model equally well with respect to interests, with initial findings again suggesting a similar conclusion can be made for self-efficacy as well (Tracey, 2002a). With respect to structural equivalency across international groups, the circumplex structure of RIASEC was not supported across examinations (e.g., Rounds and Tracey, 1996). However, the available research on the PGI has supported the fit of the spherical structure of interests and self-efficacy across several countries, along with good fits of the eight-type, two-dimensional model as well.

With respect to age differences, the fit to the RIASEC circumplex model was equivalent down to age 14 in the U.S. in either cross-sectional (Tracey and Rounds, 1993) or longitudinal (Tracey and Robins, 2005) examinations. However, the fit of interests and competence estimates decreased dramatically from the eighth to fourth grades (Tracey and Ward, 1998). A very different structure is therefore utilized by children and this signals a difference in meaning of the content of activities to children relative to adults. In addition, individual differences in adherence to the interest circumplex structure (Lent et al., 2006; Tracey, 2008; Tracey and Darcy, 2002; Tracey et al., 2006) was found to be predictive of the level of career decidedness and exploration, thus supporting Holland's (1997) notion that understanding the interest model (i.e., the structural model) has greater benefits to individuals than simply viewing it as a summary of interests.

Several issues and key findings regarding the development of interests were presented. The drop in fit to the circumplex model from the eighth to fourth grades was associated with a qualitative shift in the meaning of interests and competence perceptions. The unique structure of children's interests and competence perceptions continues to present challenges to researchers and practitioners when it comes to career development interventions involving the assessment of interests. Moreover, research on interest development is also complicated since structural stability is required in assessments of scale levels over time.

And, although certain types of stability have been shown to be greater for children than was previously believed possible (e.g., relative stability), it is important to point out that the scales used to assess this stability will still have a different meaning for children relative to adults. In the final section of the chapter, we provided a brief review of the merits and limitations of the common indices that are currently available for assessing P-E fit. Research has suggested that Euclidean distance (e.g., Tracey, Allen, and Robbins, 2012), which utilizes all of the information in a circumplex-based profile, continues to show promise for being a superior index of congruence, relative to existing indices.

## REFERENCES

- Ackerman, P. L. and Heggestad, E. D. (1997). Intelligence, personality and interests: Evidence for overlapping traits. *Psychological Bulletin*, 121, 219–45.
- Allen, J. and Robbins, S. B. (2010). Effects of interest–major congruence, motivation, and academic performance on timely degree attainment. *Journal of Counseling Psychology*, 57, 23–35.
- Anderson, M. Z., Tracey, T. J. G., and Rounds, J. B. (1997). Examining the invariance of Holland’s vocational interest model across sex. *Journal of Vocational Behavior*, 50, 349–64.
- Armstrong, P. I., Day, S. X., McVay, J. P., and Rounds, J. B. (2008). Holland’s RIASEC model as an integrative framework for individual differences. *Journal of Counseling Psychology*, 55, 1–18.
- Armstrong, P. I., Hubert, L., and Rounds, J. B. (2003). Circumplex 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., and Rounds, J. B. (2004). The Strong Ring: A basic interest mode of occupational structure. *Journal of Counseling Psychology*, 51, 299–313.
- Armstrong, P. I. and Vogel, D. L. (2009). Interpreting the Interest–Efficacy Association from a RIASEC Perspective. *Journal of Counseling Psychology*, 56, 392–407.
- Arnold, J. (2004). The congruence problem in John Holland’s theory of vocational decisions. *Journal of Occupational and Organizational Psychology*, 77, 95–113.
- Asouline, M. and Meir, E. I. (1987). Meta-analysis of the relationship between congruence and well-being measures. *Journal of Vocational Behavior*, 31, 319–23.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Berdie, R. F. (1943). Likes, dislikes, and vocational interests. *Journal of Applied Psychology*, 27, 180–9.
- Betz, N. E. (1999). Getting clients to act on their interests: Self-efficacy as a mediator of the implementation of vocational interests. In M. L. Savickas and A. R. Spokane (eds.), *Vocational interests: Meaning, measurement, and counseling use* (pp. 327–44). Palo Alto, CA: Davies Black.
- Betz, N. E., Borgen, F. H., and Harmon, L. W. (2005). *Skills confidence inventory manual* (rev. ed.). Palo Alto, CA: Consulting Psychologists Press.
- Betz, N. E. and 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. and 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.
- Bonitz, V. S., Larson, L. M., and Armstrong, P. I. (2010). Interests, self-efficacy, and choice goals: An experimental manipulation. *Journal of Vocational Behavior*, 76, 223–33.
- Borgen, F. H. and Lindley, L. D. (2003). Individuality and optimal human functioning: Interests, self-efficacy, and personality. In W. B. Walsh (Ed.), *Counseling psychology and optimal human functioning* (pp. 55–91). Hillsdale, NJ: Lawrence Erlbaum.
- Boyle, G. J. and Fabris, S. (1992). LISREL analysis of the RIASEC model: Confirmatory and congeneric factor analysis of Holland’s Self-Directed Search. *Personality and Individual Differences*, 13, 1077–84.
- Brown, S. D. and Gore, P. A. (1994). An evaluation of interest congruence indices: Distribution characteristics and measurement properties. *Journal of Vocational Behavior*, 45, 310–27.
- Browne, M. W. (1992). Circumplex models for correlation matrices. *Psychometrika*, 57, 469–97.
- Butler, R. (2005). Competence assessment, competence, and motivation between early and middle childhood. In A. J. Elliot and C. S. Dweck (eds.), *Handbook of competence and motivation* (pp. 202–221). New York: Guilford.
- Camp, C. C. and Chartrand, J. M. (1992). A comparison and evaluation of interest congruence indices. *Journal of Vocational Behavior*, 41, 162–82.

- Campbell, (1971). *Handbook for the Strong Vocational Interest Blank*. Stanford, CA: Stanford University Press.
- Coxon, A. P. M. and Jones, C. L. (1978). *The images of occupational prestige*. New York: St. Martin.
- Crites, J. O. (1969). *Vocational psychology: The study of vocational behavior and development*. New York: McGraw-Hill.
- Darcy, M. U. A. (2005). Examination of the structure of Irish students' vocational interests and competence perceptions. *Journal of Vocational Behavior*, 67, 321–33. doi: 10.1016/j.jvb.2004.08.007.
- Darcy, M. A. U., Lee, D., and Tracey, T. J. G. (2004). Complementary approaches to individual differences using paired comparisons and multidimensional scaling: Applications to multicultural counseling competence. *Journal of Counseling Psychology*, 51, 139–50. doi: 10.1037/0022-0167.51.2.139.
- Darcy, M. A. U. and Tracey, T. J. G. (2003). Integrating abilities and interests into career choice: Maximal versus typical assessment. *Journal of Career Assessment*, 11, 219–37. doi:10.1177/1069072703011002007.
- (2007). Circumplex structure of Holland's RIASEC Interests across gender and time. *Journal of Counseling Psychology*, 54, 17–31. doi: 10.1037/0022-0167.54.1.17.
- Dawis, R. V. (1991). Vocational interests, values, and preferences. In M. D. Dunnette and L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (2nd edn, Vol. 2; pp. 833–872). Palo Alto, CA: Consulting Psychologists Press.
- Dawis, R. L. and Lofquist, L. H. (1984). *A psychological theory of work adjustment*. Minneapolis, MN: University of Minnesota Press.
- Day, S. X. and Rounds, J. B. (1997). "A little more than kin, and less than kind": Basic interests in vocational research and career counseling. *Career Guidance Quarterly*, 45, 207–20.
- (1998). Universality of vocational interest structure among racial and ethnic minorities. *American Psychologist*, 53, 728–36.
- Day, S. X., Rounds, J. B., and Swaney, K. B. (1998). The structure of vocational interests for diverse racial-ethnic groups. *Psychological Science*, 9, 40–4.
- De Fruyt, F. (2002). A person-centered approach to P-E fit questions using a multiple trait model. *Journal of Vocational Behavior*, 60, 73–90.
- Deng, C. P., Armstrong, P. I., and Rounds, J. B. (2007). The fit of Holland's RIASEC model to U.S. occupations. *Journal of Vocational Behavior*, 71, 1–22.
- Dik, B. J., Strife, S. R., and Hansen, J. C. (2010). The flip side of Holland type congruence: Incongruence and job satisfaction. *Career Development Quarterly*, 58, 352–8.
- Di Scipio, W. J. (1974). A factor analytic validation of Holland's Vocational Preference Inventory. *Journal of Vocational Behavior*, 4, 389–402.
- Donnay, D. A. C. and Borgen, F. H. (1999). The incremental validity of vocational self efficacy: An examination of interest, self-efficacy, and occupation. *Journal of Counseling Psychology*, 46, 432–47.
- Durr, II, M. R. and Tracey, T. J. G. (2009). Relation of person–environment fit to career certainty. *Journal of Vocational Psychology*, 75, 129–38.
- Edwards J. R. (1991). Person–job fit: A conceptual integration, literature review, and methodological critique. In Cooper CL/IT (Ed.), *International review of industrial and organizational psychology* (Vol. 6, pp. 283–357). Chichester: John Wiley & Sons.
- Fabrigar, L. R., Visser, P. S., and Browne, M. B. (1997). Conceptual and methodological issues in testing the circumplex structure of data in personality and social psychology. *Personality and Social Psychology Review*, 1, 184–203.
- Farh, J., Leong, F. T. L., and Law, K. S. (1998). Cross-cultural validity of Holland's model in Hong Kong. *Journal of Vocational Behavior*, 52, 425–440.
- Fisher, G. A., Heise, D. R., Bohrnstedt, G. W., and Lucke, J. F. (1985). Evidence for extending the circumplex model of personality trait language to self-reported moods. *Journal of Personality and Social Psychology*, 49, 233–42.
- Fouad, N. A. and Dancer, L. S. (1992). Cross-cultural structure of interests: Mexico and the United States [Special issue]. *Journal of Vocational Behavior*, 40, 129–43.
- Fouad, N. A., Harmon, L. W., and 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, 339–45.
- Fouad, N. A. and Mohler, C. J. (2004). Cultural validity of Holland's theory and the Strong Interest Inventory for five racial/ethnic groups. *Journal of Career Assessment*, 12, 423–39.
- Gati, I. (1991). The structure of vocational interests. *Psychological Bulletin*, 109, 309–24.
- Glidden-Tracey, C. and Parraga, M. (1996). Assessing the structure of vocational interests among Bolivian university students. *Journal of Vocational Behavior*, 48, 96–106.
- Gupta, S., Tracey, T. J. G., and Gore, P. A., Jr. (2008). Structural examination of RIASEC scales in high school students: Variation across ethnicity and method. *Journal of Vocational Behavior*, 72, 1–13. doi: 10.1016/j.jvb.2007.10.013.
- Guttman, L. R. (1954). A new approach to factor analysis: The radex. In P. F. Lazarsfeld (ed.), *Mathematical thinking in the social sciences* (pp. 258–348). New York: Columbia University Press.
- Hansen, J. C. (1978). Sex differences in vocational interests: Three levels of exploration. In C. K. Tittle and D. G. Zytowski (eds.), *Sex-fair interest measurement: Research and implications* (pp. 69–76). Washington, DC: National Institute of Education.



- Hansen, J. C., Collins, R. C., Swanson, J. L., and Fouad, N. A. (1993). Gender differences in the structure of interests. *Journal of Vocational Behavior*, 40, 188–93.
- Hansen, J. C., Scullard, M. G., and Haviland, M. G. (2000). The interest structures of Native American college students. *Journal of Career Assessment*, 8, 159–72.
- Harmon, L. W., Hansen, J. C., Borgen, F. H., and Hammer, A. L. (1994). *Strong Interest Inventory*. Stanford, CA: Stanford University Press.
- Hedrih, V. (2008). Evaluation of the spherical model: Structure of vocational interests in Serbia. *Journal of Vocational Behavior*, 73, 13–23.
- Hodge, R. W., Siegel, P. M., and Rossi, P. H. (1964). Occupational prestige in the United States, 1925–1963. *American Journal of Sociology*, 70, 286–302.
- Hogan, R. T. (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.
- Holland, J. L. (1985a). *Making vocational choices: A theory of vocational personalities and work environments* (2nd edn). Englewood Cliffs, NJ: Prentice Hall.
- (1985b). *Professional manual for the Self-Directed Search*. Odessa, FL: Psychological Assessment Resources.
- (1997). *Making vocational choices: A theory of vocational personalities and work environments*. (3rd edn). Odessa, FL: Psychological Assessment Resources.
- (1999). Why interest inventories are also personality inventories. In M. L. Savickas and A. R. Spokane (eds.), *Vocational interests: Their meaning, measurement, and use in counseling* (pp. 87–101). Palo Alto, CA: Davies-Black.
- Hubert, L. and Arabie, P. (1987). Evaluating order hypotheses within proximity matrices. *Psychological Bulletin*, 102, 172–8.
- Hubert, L., Arabie, P., and Meulman, J. (1997). The representation of symmetric proximity data: Dimensions and classifications. *British Journal of Mathematical and Statistical Psychology*, 50, 253–84.
- Kristof, A. L. (1996). Person–organization fit: An integrative review of its conceptualizations, measurement, and implications. *Personnel Psychology*, 49, 1–49.
- Kristof-Brown, A. L., Zimmerman, R. D., and Johnson, E. C. (2005). Consequences of individuals' fit at work: A meta-analysis of person–job, person–organization, person–group, and person–supervisor fit. *Personnel Psychology*, 58, 281–342.
- Larson, L. M., Rottinghaus, P. J., and Borgen, F. H. (2002). Meta-analyses of big six interests and big five personality factors. *Journal of Vocational Behavior*, 61, 217–39.
- Lent, R. W., Brown, S. D., and Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45, 79–122.
- Lent, R. W., Sheu, H., Gloster, C. S., and Wilkins, G. (2010). Longitudinal test of the social cognitive model of choice in engineering students at historically Black universities. *Journal of Vocational Behavior* 76, 387–94.
- Lent, R. W., Tracey, T. J. G., Brown, S. D., Soresi, D., and Nota, L. (2006). Development of interests and competency beliefs in Italian adolescents: An exploration of circumplex structure and bidirectional relationships. *Journal of Counseling Psychology*, 53, 181–91. doi: 10.1037/0022-0167.53.2.181.
- Leong, F. T. L., Austin, J. T., Sekaran, U., and Komarraju, M. (1998). An evaluation of the cross-cultural validity of Holland's theory: Career choices by workers in India. *Journal of Vocational Behavior*, 52, 441–55.
- Liao, H., Armstrong, P. I., and Rounds, J. B. (2008). Development and initial validation of public domain basic interest markers. *Journal of Vocational Behavior*, 73, 159–183. doi:10.1016/j.jvb.2007.12.002.
- Lippa, R. (1998). Gender-related individual differences and the structure of vocational interests: The importance of the people-things dimension. *Journal of Personality and Social Psychology*, 74, 996–1009.
- Loevinger, J. (1957). Objective tests as instruments of psychological theory. *Psychological Reports*, 3, 635–94.
- Long, L., Adams, R. S., and Tracey, T. J. G. (2005). Generalizability of interest structure to China: Application of the Personal Globe Inventory. *Journal of Vocational Behavior*, 66, 66–80. doi: 10.1016/j.jvb.2003.12.004.
- Long, L. and Tracey, T. J. G. (2006). Structure of RIASEC scores in China: A structural meta-analysis. *Journal of Vocational Behavior*, 68, 39–51. doi: 10.1016/j.jvb.2005.01.002.
- Long, L., Watanabe, N., and Tracey, T. J. G. (2006). Structure of interests in Japan: Application to the Personal Globe Inventory occupational scales. *Measurement and Evaluation in Counseling and Development*, 38, 222–35.
- Low, K. S. D., Yoon, M., Roberts, B. W., and Rounds, J. B. (2005). The stability of vocational interests from early adolescence to middle adulthood: A quantitative review of longitudinal studies. *Psychological Bulletin*, 131, 713–37.
- Lunneborg, C. E. and Lunneborg, P. W. (1975). Factor structure of the vocational interest models of Roe and Holland. *Journal of Vocational Behavior*, 7, 313–26.
- Mardia, K. V. (1972). *Statistics of directional data*. London: Academic Press.
- Nagengast, B., Marsh, H. W., Scalas, L. F., Xu, M. K., Hau, K., and Trautwein, U. (2011). Who took the “x” out of expectancy-value theory?: A psychological mystery, a substantive-methodological synergy, and a cross-national generalization. *Psychological Science*, 22, 1058–68. doi: 10.1177/0956797611415540.
- Nauta, M. M. (2010). The development, evolution, and status of Holland's theory of vocational personalities: Reflections and future directions for counseling psychology. *Journal of Counseling Psychology*, 57, 11–22. doi: 10.1037/a0018213.

- Nauta, M. M., Kahn, J. H., Angell, J. W., and 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.
- Neumann, G., Olitsky, N., and Robbins, S. B. (2009). Job congruence, academic achievement, and earnings. *Labour Economics*, 16, 503–9.
- Nichols, J. G. (1990). What is ability and why are we mindful of it? A developmental perspective. In R. J. Sternberg and J. Killigian, Jr. (eds.), *Competence considered* (pp. 11–40). New Haven, CT: Yale University Press.
- Parsons, F. (1909). *Choosing a vocation*. Boston, MA: Houghton Mifflin.
- Phillips, D. A. and Zimmerman, M. (1990). The developmental course of perceived competence and incompetence among competent children. In R. J. Sternberg and J. Killigian, Jr. (eds.), *Competence considered* (pp. 41–66). New Haven, CT: Yale University Press.
- Piaget, J. (1972). Intellectual evolution from adolescence to adulthood. *Human Development*, 15, 1–12.
- Plata, M. (1975). Stability and change in prestige rankings of occupations over 49 years. *Journal of Vocational Behavior*, 6, 95–9.
- Prediger, D. J. (1982). Dimensions underlying Holland's hexagon: Missing link between interests and occupations? *Journal of Vocational Behavior*, 21, 259–87.
- (1996). Alternative dimensions for the Tracey-Rounds interest sphere. *Journal of Vocational Behavior*, 48, 51–8.
- (1998). Is interest profile level relevant to career counseling? *Journal of Counseling Psychology*, 45, 204–11.
- Prediger, D. J. and Vansickle, T. R. (1992). Locating occupations on Holland's hexagon: Beyond RIASEC. *Journal of Vocational Behavior*, 40, 111–28.
- Rachman, D., Amernic, J., and Aranya, N. (1981). A factor-analytic study of the construct validity of Holland's Self-Directed Search test. *Educational and Psychological Measurement*, 41, 425–37.
- Randahl, G. J. (1991). A typological analysis of the relations between measured vocational interests and abilities. *Journal of Vocational Behavior*, 38, 333–50.
- Rayman, J. and Atanasoft, L. (1999). Holland's theory and career intervention: The power of the hexagon. *Journal of Vocational Behavior*, 55, 114–26.
- Reeb, M. (1974). The perceptions of occupational structure: An intervening variable in vocational behavior. *Journal of Vocational Behavior*, 4, 125–37.
- Roe, A. (1956). *The psychology of occupations*. New York: John Wiley & Sons.
- Rottinghaus, P. J., Hees, C. K., and Conrath, J. A. (2009). Enhancing job satisfaction perspectives: Combining Holland themes and basic interests. *Journal of Vocational Behavior*, 75, 139–51. doi:10.1016/j.jvb.2009.05.010.
- Rottinghaus, P. J., Larson, L. M., and Borgen, F. H. (2003). The relation of self-efficacy and interests: A meta-analysis of 60 samples. *Journal of Vocational Behavior*, 62, 221–36.
- Rounds, J. B. and Tracey, T. J. (1990). From trait-and-factor to person–environment fit counseling: Theory and process. In W. B. Walsh and S. H. Osipow (eds.), *Career Counseling: Contemporary topics in vocational psychology* (pp. 1–44). Hillsdale, NJ: Lawrence Erlbaum.
- (1993). Prediger's dimensional representation of Holland's RIASEC circumplex. *Journal of Applied Psychology*, 78, 875–90. doi:10.1037//0021-9010.78.6.875.
- (1996). Cross-cultural structural equivalence of RIASEC models and measures. *Journal of Counseling Psychology*, 43, 310–29. doi: 10.1037//0022-0167.43.3.310.
- Rounds, J. B., Tracey, T. J., and Hubert, L. (1992). Methods for evaluating vocational interest structural hypotheses. *Journal of Vocational Behavior*, 40, 239–259.
- Ruble, D. N. and Seidman, E. (1996). Social transitions: Windows into social psychological processes. In E. T. Higgins and A. W. Kruglanski (eds.), *Social psychology: Handbook of basic principles* (pp. 830–856). New York: Guilford.
- Ryan, J. M., Tracey, T. J. G., and Rounds, J. B. (1996). The generalizability of Holland's structure of vocational interests across ethnicity, gender, and socioeconomic status. *Journal of Counseling Psychology*, 43, 330–37. doi: 10.1037//0022-0167.43.3.330.
- Sastre, M. T. M., Mullet, E., and Semin, C. (1999). The cognitive map of occupations: Factor structure in a Spanish sample. *European Journal of Psychological Assessment*, 15, 57–61.
- Sodano, S. M. (2011). Integrating vocational interests, competencies, and interpersonal dispositions in middle school children. *Journal of Vocational Behavior*, 79, 110–120.
- Sodano, S. M. and Richard, G. V. (2009). Construct validity of the Medical Specialty Preference Inventory: A critical analysis. *Journal of Vocational Behavior*, 74, 30–37.
- Sodano, S. M. and Tracey, T. J. G. (2007). Development of career interests and perceived competence. In W. Patton and V. B. Skorikov (eds.), *Career development in childhood and adolescence* (pp. 71–86). Rotterdam, Netherlands: Sense Publishers.
- (2008). Prestige in interest activity assessment. *Journal of Vocational Behavior*, 73, 310–17. doi:10.1016/j.jvb.2008.07.002.
- Spokane, A. R. (1985). A review of research on person–environment congruence in Holland's theory of careers. *Journal of Vocational Behavior*, 26, 306–43.
- Spokane, A. R., Meir, E. I., and Catalano, M. (2000). Person–environment congruence and Holland's theory: A review and reconsideration. *Journal of Vocational Behavior*, 57, 137–87.

- Stewart, L. H. (1960). Modes of response on the Strong Blank and selected personality variables. *Journal of Counseling Psychology*, 7, 127–31.
- Su, R., Rounds, J. B., and Armstrong, P. I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, 135, 859–84. doi: 0033-2909/09/\$12.00 doi: 10.1037/a0017364.
- Sverko, I. (2008). Spherical model of interests in Croatia. *Journal of Vocational Behavior*, 72, 14–24.
- Sverko, I. and Babarovic, T. (2006). The validity of Holland's theory in Croatia. *Journal of Career Assessment*, 14, 490–507.
- Swanson, J. L. (1992). The structure of vocational interests for African American college students. *Journal of Vocational Behavior*, 40, 129–43.
- Tak, J. (2004). Structure of vocational interests for Korean college students. *Journal of Career Assessment*, 12, 298–311.
- Tang, M. (2001). Investigation of the structure of vocational interests of Chinese college students. *Journal of Career Assessment*, 9, 365–79.
- Tay, L., Su, R., and Rounds, J. B. (2011). People–Things and Data–Ideas: Bipolar dimensions? *Journal of Counseling Psychology*, 58, 424–440.
- Tinsley, H. E. A. (2000). The congruence myth: An analysis of the efficacy of the person–environment fit model. *Journal of Vocational Behavior*, 56, 405–423.
- du Toit, R. and de Bruin, G. P. (2002). The structural validity of Holland's RIASEC model of vocational personality types for young Black South African men and women. *Journal of Career Assessment*, 10, 62–77.
- Tracey, T. J. G. (1997a). The structure of interests and self-efficacy expectations: An expanded examination of the spherical model of interests. *Journal of Counseling Psychology*, 44, 32–43. doi: 10.1037/0022-0167.44.1.32.
- (1997b). RANDALL: A Microsoft FORTRAN program for the randomization test of hypothesized order relations. *Educational and Psychological Measurement*, 57, 164–8.
- (2000). Analysis of circumplex models. In H. E. A. Tinsley and S. D. Brown (eds.), *Handbook of applied multivariate statistics and mathematical modeling* (pp. 641–664). San Diego, CA: Academic Press.
- (2002a). Personal Globe Inventory: Measurement of the spherical model of interests and competence beliefs. [Monograph] *Journal of Vocational Behavior*, 60, 113–72. doi: 10.1006/jvbe.2001.1817.
- (2002b). Development of interests and competency beliefs: A one-year longitudinal study of fifth to eighth grade students using the ICA-Rand structural equation modeling. *Journal of Counseling Psychology*, 49, 148–63. doi: 10.1037//0022-0167.49.2.148.
- (2008). Adherence to RIASEC structure as a key career decision construct. *Journal of Counseling Psychology*, 55, 146–57. doi: 10.1037/0022-0167.55.2.146.
- (2010). Relation of interest and self-efficacy occupational congruence and career choice certainty. *Journal of Vocational Behavior*, 76, 441–7. doi: 10.1016/j.jvb.2009.10.013.
- Tracey, T. J. G., Allen, J., and Robbins, S. B. (2012). Moderation of the relation between person–environment congruence and academic success: Environmental constraint, personal flexibility and method. *Journal of Vocational Behavior*, 80, 38–49. doi: 10.1016/j.jvb.2011.03.005.
- Tracey, T. J. G. and Darcy, M. A. U. (2002). An idiographic examination of vocational interests and their relation to career decidedness. *Journal of Counseling Psychology*, 49, 420–7. doi: 10.1037//0022-0167.49.4.420.
- Tracey, T. J. G. and Gupta, S. (2008). Interest assessment in an international context. In J. Athanassou and R. van Esbroeck (Eds.), *International Handbook of Career Guidance* (pp. 525–38). London: Springer.
- Tracey, T. J. G. and Hopkins, N. (2001). Correspondence of interests and abilities with occupational choice. *Journal of Counseling Psychology*, 48, 178–89. doi:10.1037/0022-0167.48.2.178.
- Tracey, T. J. G., Lent, R. W., Brown, S. D., Soresi, S., and Nota, L. (2006). Adherence to RIASEC structure in relation to career exploration and parenting style: Longitudinal and ideographic considerations. *Journal of Vocational Behavior*, 69, 248–61. doi: 10.1016/j.jvb.2006.02.001.
- Tracey, T. J. G. and Robbins, S. B. (2005). Stability of interests across ethnicity and gender: A longitudinal examination of grades 8 through 12. *Journal of Vocational Behavior*, 63, 335–64.
- Tracey, T. J. G., Robbins, S. B., and Hofstess, C. D. (2005). Stability and change in interests: A longitudinal study of adolescents from grades 8 through 12. *Journal of Vocational Behavior*, 66, 1–25.
- Tracey, T. J. and Rounds, J. B. (1993). Evaluating Holland's and Gati's vocational-interest models: A structural meta-analysis. *Psychological Bulletin*, 113, 229–46.
- (1995). The arbitrary nature of Holland's RIASEC types: Concentric circumplexes as a structure. *Journal of Counseling Psychology*, 42, 431–439. doi:10.1037//0022-0167.42.4.431.
- (1996). Spherical representation of vocational interests. [Monograph] *Journal of Vocational Behavior*, 48, 3–41. doi:10.1006/jvbe.1996.0002.
- Tracey, T. J. G. and Sodano, S. M. (2008). Issues of stability and change in interest development. *Career Development Quarterly*, 57, 51–62.
- Tracey, T. J. G. and Ward, C. C. (1998). The structure of children's interests and competence perceptions. *Journal of Counseling Psychology*, 45, 290–303. doi: 10.1037//0022-0167.45.3.290.
- Tracey, T. J. G., Watanabe, N., and Schneider, P. L. (1997). Structural invariance of vocational interests across Japanese and American culture. *Journal of Counseling Psychology*, 44, 346–54. doi: 10.1037//0022-0167.44.4.346.

- Tranberg, M., Slane, S., and Ekeberg, S. E. (1993). The relation between interest congruence and satisfaction: A meta-analysis. *Journal of Vocational Behavior*, 42, 253–64.
- Tsabari, O., Tziner, A., and Meir, E. I. (2005). Updated meta-analysis on the relationship between congruence and satisfaction. *Journal of Career Assessment*, 13, 216–32.
- Tyler, L. E. (1955). The development of vocational interests: 1. The organization of likes and dislikes in ten-year-old children. *Journal of Genetic Psychology*, 86, 37–44.
- Walker, T. L. and Tracey, T. J. G. (in press). Perceptions of occupational prestige: Differences between African American and White college students. *Journal of Vocational Behavior*.
- Young, G., Tokar, D. M., and Subich, L. M. (1998). Congruence revisited: Do 11 indices differentially predict job satisfaction and is the relation moderated by person and situation variables? *Journal of Vocational Behavior*, 52, 208–23.
- Zbaracki, J. U., Clark, S. G., and Wolins, L. (1985). Children's interests inventory, grades 4–6. *Educational and Psychological Measurement*, 45, 517–521.

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