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Chapter 23

Vocational Psychology and Individual Differences

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## Vocational Psychology and Individual Differences

According to estimates from the U.S. Department of Labor's Bureau of Labor Statistics, there are currently more than 140 million employed adults in the United States, and this number is projected to increase to more than 160 million by 2014 (Hecker, 2005). Given the wide range of options available to individuals entering the labor market, the process of making educational and career choices can be very difficult and stressful. A critical role for vocational psychology is to facilitate the process of linking individuals to educational and career opportunities in which they can become successful and satisfied. This chapter focuses on how measures of individual differences contribute to the work counseling psychologists do with clients struggling with issues related to career decision making and work adjustment, and also examines how individual differences measures are used in the field of vocational psychology to predict work performance and satisfaction.

This chapter begins with a brief overview of applications of individual differences in vocational psychology and conceptualizations of career success. The discussion of individual differences measures is divided into sections on the validity evidence for cognitive and noncognitive predictors of career-related outcomes such as job performance and career choices. Traditionally, cognitive and noncognitive measures have been viewed as distinct, separate areas of study. However, recent attempts have been made to combine information obtained using both types of measures to predict career-related outcomes. We review issues related to the development of integrated models of individual differences, including an examination of methodological issues related to using multiple indicators in predicting career-related outcomes. We also examine models put forward to integrate cognitive and noncognitive individual differences measures, and provide a critical look at how sex differences in these measures may

play an important role in the ongoing debate over the poor representation of women in the fields of the 'hard' sciences, mathematics, and engineering.

## APPLICATIONS OF INDIVIDUAL DIFFERENCES

### Individual Differences and Counseling Psychology

Working with individuals to promote successful career development using individual differences measures is not a new role for counseling psychologists (Dawis, 1992). Although the mandate of counseling psychology has expanded beyond its vocational roots, as evidenced by the wide range of issues and research findings presented in this current volume, issues related to career development remain a cornerstone of our profession. Individual difference measures used in vocational psychology can be used to predict what Ozer and Benet-Martinez (2006) refer to as consequential outcomes: "Certain life outcomes and events are widely recognized as important – important for individuals and important for the society in which they live" (p. 402). Therefore, measures of individual differences are important to the extent that they can be used to predict meaningful, or consequential, career-related outcomes.

In counseling psychology, however, we are often interested in more than simply predicting outcomes, no matter how consequential they may be. Predicting career choices and job performance are important, and provide validity evidence for individual differences measures. However, as noted by Prediger and Johnson (1979), counseling often involves expanding the range of options being considered by clients. Therefore, the notion of consequential outcomes in the field of counseling psychology can be viewed more broadly to include goals such as expanding the range of options considered by career counseling clients. The ultimate goal of this expanded view of consequential outcomes is to help clients increase the

range of occupational options they consider, so that the choices that they ultimately make are those that have the best chance of maximizing their occupational success and satisfaction.

### Defining Career Success

Career success can be viewed as arising primarily from two sources: Intrinsic and extrinsic rewards (Ozer & Benet-Martinez, 2006; Judge, Higgins, Thoresen, and Barrick, 1999).

*Intrinsic* career success reflects the level of job satisfaction obtained by an individual. In comparison, *extrinsic* career success reflects concepts such as work performance, income level and occupational status. There may be some overlap between these conceptualizations because an individual may be satisfied with a career choice because of its financial rewards. However, the key distinction between intrinsic and extrinsic career success lies in the difference between an internalized, subjective sense of success that is experienced by the individual versus an externalized measure of the rewards associated with an occupation.

In addition to satisfaction produced by intrinsic and extrinsic rewards, the fit between individuals and career choices can be measured by comparing abilities with job performance requirements, and needs with job reinforcers. *Satisfactoriness* is the term often used to describe the extent to which cognitive abilities possessed by individuals are compatible with the cognitive demands of occupations (Dawis & Lofquist, 1984). From an employer's perspective, workers are sought who possess the abilities, skills, and training (or the capacity to become trained) to fulfill job requirements. From the individual's perspective, however, potential employment opportunities are evaluated based primarily on the presence of intrinsic and extrinsic rewards. Individuals are satisfied for a job to the extent that they have the intellectual capacities and associated skills and training to perform job tasks, but individuals will be satisfied with a job to the extent that their needs are met by the job, and the job is perceived as being consistent with

their interests, personality traits and abilities. The challenge when studying career decisions, therefore, is to develop methods to balance both cognitive abilities with cognitive demands, and noncognitive traits with intrinsic and extrinsic rewards.

The gravitational hypothesis, first proposed by McCormick, Jeanneret, and Mecham (1972), has been put forward as model of how cognitive and noncognitive individual differences impact career development over time. McCormick, DeNisi, and Shaw (1979) proposed that: “people tend to gravitate toward and remain in jobs that they are able to perform and that are reasonably compatible with their personal characteristics” (p. 52). Individual differences in the capacity to perform job requirements will lead to gravitation towards occupations with higher or lower levels of cognitive demands in accordance with the individual’s intellectual capacities. Simultaneously, individual differences in noncognitive traits, combined with variability in the rewards offered by occupations, will lead to gravitation towards those occupations that provide the most desirable intrinsic and extrinsic rewards (Reeve & Heggestad, 2004; Wilk, Desmarais, & Sackett, 1995). Career adjustment is impacted by experiences in the environment, as individuals strive to match both cognitive and noncognitive characteristics to the demands and rewards of the workplace (Hogan & Roberts, 2004; Roberts, Caspi, & Moffitt, 2004).

#### COGNITIVE AND NONCOGNITIVE MEASURES

Our review of individual differences measures in vocational psychology is divided into two areas: Cognitive and noncognitive measures. Measures of cognitive abilities, especially General Mental Ability (GMA), are frequently used to predict job performance, and noncognitive measures of interests and personality are frequently used to predict job satisfaction and career choices, as well as job performance. Research on job performance criteria can be used to develop selection criteria for employment decisions, and selection criteria are most

effective when the number of applicants is large relative to the number of positions (Taylor & Russell, 1939). Counseling psychologists, however, do not have the luxury of choosing the 'best' clients from a large pool of applicants, and are ethically bound to provide services to individuals from diverse backgrounds, and will often focus on non-cognitive measures such as interests, personality, and self-efficacy beliefs. However, both types of individual differences measures provide useful information for linking people to career options (Dawis, 1996).

### Cognitive Predictors of Career-Related Outcomes

Cognitive measures of General Mental Ability (GMA) are very effective predictors of job performance and level of occupational attainment (Schmidt & Hunter, 1998, 2004). In a review of 85 years of research on selection criteria that are used in personnel decision making, Schmidt and Hunter (1998) found that GMA measures had a mean validity coefficient ( $r$ ) of .51 for overall job performance. A recent meta-analysis performed in the U.K. found similar results (Bertua, Anderson, & Salgado, 2005). GMA is also an important predictor of performance in academic settings (Kuncel, Hezlett, & Ones, 2001, 2004). Kuncel and Hezlett (2007) have subsequently synthesized nine meta-analyses and demonstrated that standardized admission tests (e.g., Graduate Record Examination, Law School Admissions Test, Medical College Admissions Test) predict many measures of student success better than academic grades. Nevertheless, a combination of standardized test scores and grades are the best predictors of success.

Schmidt and Hunter (2004) reported that the effects of GMA on job performance and training success are contingent upon the level of cognitive complexity for an occupation, with the highest validity coefficients observed in occupations at the highest levels of cognitive complexity. They also cited the findings of Judge et al. (1999), who reported that general mental ability level measured in early adolescence can predict adult levels of occupational attainment ( $r$

= .51) and income ( $r = .53$ ). There is, however, an important caveat to the conclusions drawn by Schmidt and Hunter: “GMA predicts one’s ultimate attained job level, but it does not predict which occupation at that level one will enter. That role falls to interests.” (Schmidt & Hunter, 2004, p. 163).

The meta-analytic work by Schmidt and Hunter (1998, 2005) clearly demonstrates the importance of GMA in predicting job performance, training success, and level of occupational attainment. Longitudinal research by Austin and Hanisch (1990) also supports the central role of GMA in job performance in an analysis of the predictors of occupational attainment from the Project Talent dataset (more than 13,000 high school students with an 11-year follow-up after graduation). The discriminant function analyses they conducted included variables measuring abilities, interest, gender and socioeconomic status. Overall, Austin and Hanish found that the best predictor of attainment was a composite score interpreted as representing general mental ability, with the second best predictor being a composite score of gender and mathematics. These first two factors primarily representing cognitive abilities and gender accounted for 81.9% of the variance in occupational attainment. Three additional composite scores that included interest variables increased the variance accounted for to 96.8%, which does support the incremental validity of noncognitive predictors of occupational attainment.

Austin and Hansich (1990) showed that individual differences measures are very effective predictors of career-related outcomes over an extended 13 year period, despite being measured at a young age. These results highlight the central importance of cognitive ability in the career development process. However, Austin and Hanish questioned the relative utility of interests in the counseling process: “Given the proportions of between-groups variance accounted for by the first two functions, counseling psychologists may have been using interest

to a greater extent than warranted by their influence on occupational attainment” (pp. 84-85). If the goal of career counseling is to predict occupational attainment, then Austin and Hanisch are right to suggest a move towards an increased emphasis on cognitive measures. The field of counseling psychology, however, does not have a narrow focus on using measures of individual differences to predict levels of occupational attainment (see Dawis, 1992, Prediger & Johnston, 1979). Issues related to predicting occupational attainment are clearly important to career-related outcomes, but career practitioners are also interested in predicting occupational satisfaction as well as attainment. Furthermore, as discussed below, personality and interest measures add incremental validity to measures of GMA when predicting occupational attainment and do a better job than GMA in predicting occupational satisfaction. Thus, the use of both cognitive and noncognitive variables is supported in vocational research.

Longitudinal analyses on the relationships among personality, GMA, and career success were also conducted by Judge et al. (1999). This research is notable due to the inclusion of separate analyses of intrinsic and extrinsic concepts of career success. Data were obtained from three longitudinal studies obtained from the intergenerational studies program at the University of California at Berkeley; participants were recruited from 1928 to 1931 and followed through retirement. For measures of intrinsic career success the key predictors were personality, with a multivariate  $R$  of .42, in comparison the  $R$  value for GMA was .09 which showed no incremental validity over personality in predicting intrinsic career success. However, for extrinsic success the  $R$ s for personality traits and GMA were .54 and was .53, respectively, with a combined  $R$  for the two sets of constructs of .64. From a usefulness standpoint, these results suggest that personality traits play a role in determining both intrinsic and extrinsic career success, whereas GMA is primarily involved in extrinsic success.

Gottfredson (2003) has claimed that the use of cognitive assessments in career counseling has been limited because of potential difficulties in presenting results to clients. With an interest measure, the finding that one person prefers working with things and another person prefers working with ideas does not necessarily imply the superiority of one person over the other. Although some individuals may attach greater prestige, status, and desirability to some types of occupations than others, a career counselor can explore the notion of interests without implying that some choices are inherently superior to others. The challenge with using cognitive measures in counseling, therefore, is to find ways to include this information in the career counseling process to constructively expand the range of options considered by individuals, and not simply to predict their level of success. For example, measures of specific abilities may help clients fine-tune their occupational choices by identifying occupations that make the most effective use of their particular constellations of abilities (see Dawis, 2005; Humphreys, Lubinski, & Yao, 1993; Lofquist & Dawis, 1984; Lubinski & Benbow, 2006).

#### Noncognitive Predictors of Career Related Outcomes

In comparison to the cognitive predictor literature, where debate focuses primarily on interpretations of GMA, a wider range of noncognitive constructs have been explored by vocational psychologists. Research on the utility of noncognitive measures such as interests and personality will typically focus on two issues: (a) the incremental validity of noncognitive measures in predicting job performance over and above GMA, and (b) the use of interests, personality, and self-efficacy beliefs to predict work satisfaction and career choices. There is a long tradition in vocational psychology of using interest measures to predict career choices (see, for example, Fryer, 1931). Interests reflect preferences for activities and work environments, and as such can be very effective for predicting future aspirations of students and the occupations

they choose up to 23 years later (Campbell, 1971; Hansen & Campbell, 1985; Hansen & Dik, 2006). Additional validity evidence is found in research examining the extent to which interest measures can predict the current occupations of employed individuals (Dik & Hansen, 2004; Donnay & Borgen, 1996).

Interests are very stable over time (Low, Yoon, Roberts, & Rounds, 2005), which may contribute to their strong predictive validity. Low et al. (2005) estimated the stability of vocational interests at different life stages in a meta-analytic review of 66 longitudinal studies. Interests were observed to be relatively stable, even in early adolescence. Stability estimates for different age periods from adolescence to middle adulthood suggest that, contrary to popular notions about interest development, rank-order and profile stabilities of vocational interests changed very little during the greater part of adolescence (Low & Rounds, in press). Also, contrary to common wisdom (e.g., Campbell, 1971), stability rose markedly only during the beginning of emerging adulthood (i.e., ages 18-22), and subsequently plateaued for the remainder of the next two decades.

There are several explanations for this observed developmental trend. For example, the marked increase in stability during the age period of 18 to 22 years coincides with emerging adulthood in which adolescents leave their families and high schools for novel settings like college or the workforce. With fewer environmental constraints, individuals are more able to choose the contexts (e.g., educational courses, work, leisure activities, and social relationships) that best fit their interests. These experiences can serve to reinforce the characteristics that led people to those experiences in the first place, resulting in an elaboration, refinement, and stability of interests during this period. After the age 18-22 period when interests plateau, the individual begins his or her entry to adulthood. Adulthood involves increased commitment to other life

roles, such as being a worker, spouse, and/or parent (Levinson 1986). These commitments serve to restrict the latitude an individual has in changing environments. A person's talents, expectations, irreversible choices, and credentials further diminish the range of movement he or she has after entry into the workforce. Interests, therefore, increase in stability within a small window of time (18-22 years), after which the constancy of workplace environments limits the frequency of new experiences, as well as curtails further elaboration of fit between the individual and new environments.

Interest-based research typically focuses on Holland's (1957, 1997) RIASEC model of vocational personality types and work environments. Holland's model includes six categories of interests and types of work environments: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising, and Conventional (C). This model has been used to classify individuals' interests and occupations, and has influenced the development of interest measures (Campbell & Borgen, 1999). By matching an individual's interests to occupational characteristics by Holland category, it is possible to identify potential career choices for career counseling clients (McDaniel & Snell, 1999). A spatial model of the types was proposed by Holland, Whitney, Cole, and Richards (1969), using a hexagon to represent the inter-relations between the types ordered clockwise, resulting in what is frequently termed the R-I-A-S-E-C model. As illustrated in Figure 1, the degree of similarity between any two of the types is inversely proportional to the distances between them on the hexagon. Areas of the spatial model where the individual's interests are strongest can be identified using the results of an interest inventory, and the level of congruence for an occupational choice can be assessed by the distance between the location of strongest interests and an occupational choice (Rounds & Day, 1999).

Meta-analyses of studies reporting correlations between RIASEC interest types have generally supported the structure of Holland's theory (Rounds & Tracey, 1993; Tracey & Rounds, 1993). Day, Rounds, and Swaney (1998), for example, examined the fit of Holland's model with large representative samples of students who completed the ACT Interest Inventory (UNIACT; Swaney, 1995), and found a good fit for the Holland model with both male and female samples representing different U.S. racial-ethnic groups. Fouad, Harmon, and Borgen (1997) reported similar results to those of Day and colleagues with large representative samples of successfully employed adults from different U.S. racial-ethnic groups who completed the Strong Interest Inventory (SII; Harmon, Hansen, Borgen, & Hammer, 1994). Anderson, Tracey, and Rounds (1997) found that the fit of the RIASEC data to be similar for both males and females who completed the SII. This research provides evidence for the construct validity of Holland's RIASEC types and structural hypothesis.

However, there continues to be some debate about the fit of the Holland model in U.S. minority group and international samples. For example, in a comprehensive meta-analysis, Rounds and Tracey (1996) compared the fit of RIASEC correlation matrices from 20 U.S. ethnic group samples and 76 international samples to a U.S. benchmark group of 74 matrices. Rounds and Tracey reported that Holland's model was a better fit for the benchmark samples than for the U.S. ethnic groups and international samples, and found that an alternative model proposed by Gati (1979, 1991) was a better fit than the Holland model.

Armstrong, Hubert, and Rounds (2003) re-analyzed the Day et al. (1998) and Fouad et al. (1997) data using recent statistical methods developed to fit circular structures (Hubert, Arabie, & Meulman, 1997), and found the fit of the Holland model to be lower for African American and Hispanic samples than for Caucasian and Asian American samples. As illustrated in Figure 2, by

examining the pattern of unequal distances between types for racial-ethnic groups, it may be possible to identify areas of improvement for RIASEC-based measures. Armstrong and colleagues identified two patterns of structural inconsistency across racial-ethnic groups, *type isolation* and *type compression*. Both patterns suggest that additional work is needed improve the construct validity of the measures for use with diverse groups. Type isolation occurs when the distances between a type and its two adjacent types account for more than 50 percent of the circumference of the circular structure, effectively isolating that type on one half of the circumplex. This structural pattern can be seen with the Artistic scale for the Hispanic American men and women who completed the Strong Interest Inventory, which suggests that additional work is needed to increase the integration of the isolated types into the work continuum being represented by the six RIASEC scales.

In comparison, type compression occurs when the distances between two scales is very small. This occurs for Realistic-Investigative and for Enterprising-Conventional with African American men and women and also for Hispanic American women who completed the SII. Realistic-Investigative type compression was also observed for female students in a longitudinal study by Darcy and Tracey (2007), and is also an issue in samples drawn from China (Long & Tracey, 2006). Overall, these results suggest that distinctions between types made in Holland's model may not be as salient for members of diverse racial-ethnic groups.

Interests can also be assessed more narrowly by focusing on basic interests rather than RIASEC types (Day & Rounds, 1997). The first set of widely used basic interest measures were developed by Campbell, Borgen, Eastes, Johansson, and Peterson (1968) for the Strong Vocational Interest Blank (Campbell, 1971, Strong, 1943). Basic interest scales were created to provide interpretive information to enhance the use of the Strong's empirically developed

Occupational Scales, by providing insight into the “organization of an individual’s choices” (Campbell et al. p. 54). Campbell et al. noted that the Occupational Scales were effective for identifying potential interest in specific occupational titles, but the heterogeneous content of these scales made it difficult to expand the interpretation of results to other occupations. By grouping items into homogenous content areas, Basic Interests provided a structured, standardized way to begin a discussion of how interests can be expanded beyond the scope of a specific occupation. When examining the validity of the Basic Interest Scales of the 1994 edition of the Strong Interest Inventory, in comparison to the Holland-based General Occupational Themes, Donnay and Borgen (1996) found the basic interest scales to be the most valid predictors of occupational group membership, and concluded that “basic interest scales more effectively deal with the reality of a complex multivariate space” (p. 288).

To augment information obtained from interest assessments, measures of other noncognitive constructs, such as personality and self-efficacy can provide information that is useful for predicting work performance, job satisfaction, and career choices. For example, Gasser, Larson, and Borgen (2004) found that after controlling for gender, the California Personality Inventory scales of Achievement via Independence, Conceptual Fluency, and Insightfulness, as well as the Strong Interest Inventory Investigative and Learning Environment scales all provided unique information for predicting future educational aspirations. Betz and Rottinghaus (2006) reported that basic interest measures had higher validity in predicting occupational membership than a set of corresponding self-efficacy measures, but the combined use of both sets of measures was more effective than using either set independently (see also Donnay & Borgen, 1999). Ralston, Borgen, Rottinghaus and Donnay (2004) reported similar incremental validity results for combining interests and self-efficacy measures when predicting

major program of study in a sample of college students. However, a recent meta-analysis by Judge, Jackson, Shaw, Scott, and Rich (2007) demonstrated that self-efficacy measures provide little incremental validity for predicting job performance after controlling for GMA and the big five personality factors. Thus, self-efficacy beliefs may add incremental validity to interests in predicting occupational and college major choices, but may not add above GMA and various personality characteristics (e.g., conscientiousness) in predicting work performance, especially for complex work tasks.

Meta-analytic research on the correlations between interest and self efficacy support the unique contributions of each measure (Rottinghaus, Larson, & Borgen, 2003). This research also suggests that there is a strong association between individuals' liking of an area of work and having confidence in their ability to do the work. In short, people tend to like doing things they are good at, and dislike things they are not good at, but there is unique information provided by measures of both interests and self-efficacy (Betz & Rottinghaus, 2006). Therefore, addressing discrepancies between interests and efficacy beliefs can be very effective in counseling for career choices, because a focus on discrepancies can provide an opening for expanding the range of careers considered by individuals, and also for developing interventions to increase self-efficacy beliefs in areas of higher interest than confidence. Interest and self-efficacy data can also be used to help clients consider the accuracy of their occupational knowledge in areas where self-efficacy is higher than interests. The latter is suggested by Social Cognitive Career Theory's (SCCT, Lent, Brown, & Hackett, 1994) interest model whereby interests are seen as a joint function of self-efficacy beliefs and outcome expectations (i.e., expected outcomes of occupational pursuit). Thus, in areas where self-efficacy is higher than interests, SCCT would suggest that outcome expectations for that occupational area may be somewhat low and that the

client should search out more information on the occupation to ensure that his or her outcome expectations for that occupation are accurate (see Brown & Lent, 1996).

Linkages between personality, as measured by the five factor model of personality (Goldberg, 1992), and interests as measured by Holland's (1997) RIASEC types, have been explored in meta-analyses by Mount, Barrick, Scullen, and Rounds (2005), and Larson, Rottinghaus, and Borgen (2002). Mount et al., reported a clear distinction between personality and interest measures in their analyses. Their results support the distinctiveness of the two sets of constructs, providing a mandate for the continued use of both personality and interests in vocational research and practice. Mount et al. proposed and identified from a motivational perspective, two higher-order dimensions among the Big Five personality traits and Holland's RIASEC interests. One dimension represented a contrast between *striving for accomplishment* (i.e., desire and motivation for getting things done) and *striving for personal growth* (i.e., seeking new experiences, venturesome encounters with life, creative expression, and new ideas). When compared to Prediger's (1982) interest-based Data-Ideas dimension, the accomplishment-personal growth dimension reflects more general individual differences in the relative importance of intrinsic (for personal growth-oriented individuals) versus extrinsic (for accomplishment-oriented individuals) rewards and may have important implications for job satisfaction and performance. The second dimension, similar to Hogan's (1983) sociability dimension or Prediger's (1982) People-Things dimension, tapped social interaction versus working alone. Mount et al. suggest that combining traits and interests (e.g., Openness and Artistic interests) and developing multifaceted measures may predict motivational and performance outcomes better than either attribute measured separately.

Both interests and personality measures provide incremental validity over measures of GMA in the prediction of job performance (Astin & Hanisch, 1990; Judge et al., 1999). Additionally, there is also evidence linking personality development with work experiences (Roberts, Caspi, & Moffitt, 2003). The results of the Mount et al. (2005) meta-analysis identifying dimensions linking personality traits and interests supports the use of both types of measures in counseling and other applied settings. Their findings suggest that using a combination of RIASEC interest measures and five-factor model personality measures may be effective for helping clients connect personal goals, such as a need for accomplishment or personal growth, with their activity interests and career choices, including preferences for working with either people or things. For example, a client with a pattern of personality and interest scores suggesting an orientation to growth and working with people would likely find different types of occupations satisfying than persons with a people and accomplishments or a things and accomplishment orientation.

## INTEGRATIVE MODELS AND OTHER FUTURE DIRECTIONS

### Multiple Indicators and Prediction of Career-Related Outcomes

Ahadi and Diener (1989) suggested that there is often an implicit assumption underlying discussions of effect sizes: The assumption that behaviors are caused by single versus multiple determinants. Mischel (1968), for example, questioned the practical utility of conscientiousness as a predictor of work performance because the correlation between this personality trait and various measures of work performance rarely exceed values of  $r = .30$ . There are, however, two difficulties with Michel's argument. First, the criticism of conscientiousness as having only a .30 correlation with work behavior assumes a one-to-one relationship with the trait, and second, it ignores the role of other traits and factors that influence work behavior. If work behavior has a

single determinant, then the personality trait of conscientiousness, with a correlation of .30, does not appear to be a very good predictor of that behavior. However, if one acknowledges that multiple factors influence behaviors, then the finding that a single measure of conscientiousness has a correlation of .30 with a specific behavior is quite impressive.

Ahadi and Diener (1989) evaluated different theoretical models of the relationship between traits and behaviors using monte carlo simulations to generate upper-bound estimates for the possible correlations between traits and behaviors. When a behavior was modeled as being determined entirely by three traits, the upper-bound correlation between single behavior and trait measures was found to be approximately .50, and when the behavior was determined by four traits the upper bound correlation between a single behavior and trait measures was .45. There are two key implications of these results for vocational psychology research and practice. First, most behaviors of interest to vocational psychologists and career counselors (e.g., work performance and job satisfaction) are multiply determined. Thus, it is unrealistic to expect any single predictor to explain a large amount of variance in these multiply determined outcomes. However, a variable that does explain some variance in such outcomes represents a potentially important target for assessment and exploration in career counseling despite the fact that the correlation may seem small in an absolute sense. Second, these findings suggest that additive and integrative models of the effects of multiple traits should increasingly become the focus of research and practice.

### Integrative Models of Individual Differences

Integrative models that combine cognitive and noncognitive measures to predict important career outcomes have appeared in the literature in recent years. Ackerman and Heggestad (1997), for example, have put forward the notion of 'trait complexes' as a model to

describe the linkages among cognitive abilities, interests, and personality. As presented in Figure 3, based on meta-analytic reviews of research studying inter-relations among these individual differences domains, four trait complexes were identified: (a) The *Social* trait complex which includes the people-oriented Enterprising and Social interest types, the personality traits of extroversion and social potency, and subjective well-being; (b) The *Clerical/Conventional* trait complex which includes the Conventional interest types, personality traits of control, conscientiousness, and traditionalism, and perceptual speed ability; (c) The *Science/Math* trait complex which includes Realistic and Investigative interests, visual perception, and math reasoning ability; and (d) the *Intellectual/Cultural* trait complex which includes Investigative and Artistic interests, openness to experience, typical intellectual engagement, idea fluency, and general cognitive ability.

The work of Ackerman and Heggestad (1997) suggests that abilities, interests, and personality may develop in tandem, resulting in the emergence of important trait complexes. The socio-analytic model of personality development, proposed by Hogan (1983; Hogan & Roberts, 2004; Hogan & Sheldon, 1998), also supports the notion that the development of cognitive and noncognitive individual differences are interdependent. That is, development occurs as part of an iterative process of feedback between abilities, interests, personality, and other traits. As illustrated in Figure 3, the trait complexes proposed by Ackerman and Heggestad (1997) emerge in the context of Holland's RIASEC circumplex model of interests. In particular, the Social and Science/Math complexes appear aligned with the People/Things dimension proposed by Prediger (1982). The Clerical/Conventional and Intellectual/Cultural complexes appear to be aligned with the second interest dimension, and may be consistent with what

Armstrong, Smith, Donnay, and Rounds (2004) refer to as the Structured/Dynamic interest dimension and what Hogan (1983) refers to as the Conformity dimension.

When considering the role of individual differences in vocational psychology, integrative models (e.g., Ackerman and Heggstad, 1997), may provide effective frameworks for developing research questions and counseling applications. Ackerman and Heggstad's data, for example, suggest that counselors can obtain a more complete picture of clients' likely occupational preferences by combining cognitive, interest, and personality information to assess where they might fall in each of the trait complexes. The information provided by such integrative assessments might end up being more predictive of individuals' preferences and choices than data provided by ability, interest, or personality alone. Also generating occupational possibilities for clients on the bases of these trait complexes may yield better choices than simply generating possibilities separately on the basis ability, interests, and personality and subsequently combining them. Such possibilities are ripe avenues for future research.

Another example of an integrative model of individual differences that uses interests as an organizational framework is the Strong Ring (Armstrong, et al., 2004), which combines an occupational interest structure with occupational data from the U.S. Department of Labor's O\*NET data base. In comparison to Ackerman and Heggstad's (1997) model, which used RIASEC dimensions to operationalize interests, the Strong Ring's interest structure was developed from the SII Basic Interest scales. A hierarchical model of nine general interest areas and 19 more specific occupational clusters was fit into a three dimensional ring-like structure. Data on 62 occupational characteristics, including values, knowledge areas, skills, work activities, and work contexts were obtained from the O\*NET database, and embedded into the three dimensional structure using the technique of property vector fitting (Kruskal & Wish,

1978). Figure 4 displays the first two dimensions of the Strong Ring, with O\*NET characteristics embedded into the structure, thereby facilitating the process of linking interests with other work requirements. Additionally, the results of Armstrong et al.'s study demonstrate that adding a third dimension to their model increased the number of occupational characteristics that could be integrated into an interest structure beyond the results that are possible using a two-dimensional model like Holland's (1959, 1997) theory.

Lubinski (2000) offered an additional viewpoint on the integration of individual differences domains, focusing primarily on the areas of cognitive abilities, interests, and personality. For example, Lubinski suggests that individuals who have similar levels of extraversion may display different behavioral patterns if they vary in their level of conscientiousness, and also argues that individual differences in behavior will be determined by multiple factors that span across the traditionally discrete individual differences domains. Therefore, two students with strong spatial ability skills may be pulled in different directions academically depending on their scores on the people/things dimension of interests. The motivational dimensions identified by Mount et al. (2005) also reflect the integrative potential of trait complexes. Individuals who are oriented towards either striving for accomplishment or striving for personal growth will seek out different career opportunities and respond to different rewards offered in the workplace. Lubinski argues that the emergence of trait complexes may be important to understanding individual differences in occupational attainment when comparing individuals with similar levels of GMA: "Increments for personality measures typically range between 0.05 and 0.15, which may seem small when contrasted with what ability constructs offer, but their economic and social gains are huge" (Lubinski, 2000, p. 428).

#### Gender Differences and Career Development

The challenge of integrating information across multiple sets of individual differences measures can also be seen in the recurrent debate over gender differences in the career development process. In particular, there are ongoing concerns about potential gender differences in both cognitive and noncognitive individual differences measures, and the potential impact of these measures on the career development of women. Recent reviews of the research on gender differences have provided strong evidence that male-female difference effect sizes across a wide range of psychological constructs are small. Hyde (2005) reviewed 124 effect sizes from 46 meta-analyses of gender differences, including measures of cognitive abilities, communication, social and personality variables, psychological well-being, motor behaviors, and a miscellaneous category that includes moral behavior and job performance. Hyde reported that 78 percent of the observed gender differences effect sizes were small or close to zero. Exceptions to this trend of small differences between males and females included motor performance, incidences of masturbation, and levels of aggression.

Spelke (2005) identified three common hypotheses that are used to explain how gender differences in cognitive abilities lead to the differential representation of men and women in math, science, and engineering careers. These hypotheses include the suggestion that, beginning in childhood, males are more focused on interacting with objects and because of this are predisposed to learn more about mechanical systems. It has also been proposed that males are more likely to have strong spatial and numerical abilities that result in higher levels of math proficiency, and that the larger variability in male cognitive ability scores, when compared to females, increases the probability of males having very high levels of mathematical talent. To challenge these three hypotheses, Spelke noted that systematic research on object perception in children finds no gender differences in performance, that male and female students display equal

capacities to learn advanced college-level mathematics despite gender differences on standardized tests.

Vocational interests are one area of gender differences research that is conspicuously absent from the reviews by Hyde (2005) and Spelke (2005). Research by Lippa (1998, 2005) on gender differences in the People-Things dimension of interests (Prediger, 1982, see Figure 1) has consistently demonstrated large effect sizes of at least 1.20 standard deviations, suggesting that women tend to have substantially stronger interests in people-oriented activities and occupations than do men, while the opposite is true for interest in things-oriented occupations and activities. In a 35 year longitudinal study of individuals with high levels of math proficiency, Lubinski and Benbow (2006) reported that women with high levels of math ability were less likely than their male counterparts to pursue careers in fields such as math, science, and engineering. However, these women often chose other careers that require math ability, such as medicine and the social sciences, as well as prestigious careers in law and business administration. Lubinski and Benbow (2006) suggested that these patterns of sex differences in highly prestigious and complex fields may be largely the results of gender differences in interests and values—that men and women with equally high math abilities gravitate toward different, but equally prestigious, professional fields on the basis of gender-typed interests and values. Gender differences in interests, therefore, may have important implications for understanding the different career trajectories of men and women. However, the same may not be true for race/ethnicity differences in interests and occupational choices. For example, Fouad (2002; Fouad & Mohler, 2005) found that racial-ethnic group differences in interests were quite small compared to the differences usually found between men and women on the same interest scales.

Vocational interests are very effective for predicting the current occupation of employed individuals (Borgen & Lindley, 2003; Donnay & Borgen, 1996; Larson & Borgen, 2002) and are also very effective for predicting future aspirations of students and the occupations they choose up to 23 years later (Campbell, 1971; Hansen & Campbell, 1985). In addition to the predictive validity of these measures, there is also evidence that feedback received from interest inventory results does impact the career development of students (Luzzo & Day, 1999; Uffelman, Subich, Diegelman, Wagner, & Bardash, 2004). Prediger and Johnson's (1979) classic paper on the gender bias in interest measurement raises the issue of the importance of prediction in the career counseling, and the implications this has for the development of less sex-restrictive interest measures. They made a very interesting point about the role of predictive validity in the context of career counseling: The primary goal of career counseling, according to Prediger and Johnson, is not to predict occupational choice, but rather to generate a range of occupational possibilities for clients. Although it would be difficult to justify using measures in the career counseling process that are not related to, or cannot predict in some way, career choices (Rounds & Armstrong, 2005), the key issue is a trade-off between predictive validity and developing a measure that helps clients consider a wide as possible range of viable occupational options (Prediger, 1977). Interest measures producing the highest levels of predictive validity may, therefore, provide a good snap-shot of current gender imbalances. However, a more gender neutral measure may sacrifice some predictive validity relative to more traditional interest measures, but this loss may be more than offset by improved utility of gender neutral measures to promote a wider range of career options for both men and women.

Returning to the notion of consequential outcomes, it would appear that gender differences have the potential to impact the career choices people make and how personnel

selections are made. Reardon, Vernick, and Reed (2004) examined changes in the distribution of Holland's (1997) RIASEC interest categories in the labor market from 1960 to 1990 using census data. Their findings demonstrate that complexity of work is clearly to the Holland type assigned to an occupation: Investigative and Artistic occupations typically have the highest level of complexity, and Conventional and Realistic occupations tend to have the lowest levels of complexity. Gender is also related to Holland type because the distribution of the labor market by gender is unequal across the six RIASEC categories. Realistic and Investigative occupations tend to be male dominated, while Social and Conventional occupations are female dominated. Therefore, when Holland-based measures are used to recommend careers, there are implicit messages being communicated about the complexity of work that is appropriate for individuals based on their gender, which may have implications for the levels of intrinsic and extrinsic career success experienced by men and women.

### SUMMARY AND CONCLUSIONS

Individual differences measures are central to the field of vocational psychology, and can be used to predict job performance, career choice, and intrinsic and extrinsic career success. The research reviewed in this chapter demonstrates that there are positive correlations between general mental abilities and virtually all of the variables that are used to measure desirable work outcomes. From a personnel selection standpoint, measures of cognitive abilities can be used to select those applicants who are most likely to be successful by selecting those applicants with the highest scores. However, cognitive ability is a potentially loaded question for counseling psychologists because differences between high and low scores are often interpreted in terms of strengths and weaknesses. Unlike interests, where learning that one is interested in a particular area of work does not necessarily imply a limited future, results from cognitive assessments have

the potential to imply limits for future success. Nevertheless, the use of cognitive assessments in vocational psychology can be used to identify strengths, and also to facilitate the gravitational process of matching individuals to levels of employment where they are most likely to experience both intrinsic and extrinsic career success.

Noncognitive measures are also implicated in job performance, and provide incremental validity over measures of cognitive ability. Individuals who, relatively speaking, are more interested in performing the work activities associated with a job, are motivated to succeed, and have personalities and values that match the work are more likely to be productive workers. In comparison, from a counseling perspective the issue of how to work with individual differences measures is more complicated, because, unlike employers, counselors do not have the luxury of selecting a small number of clients from a large pool of applicants. The challenge facing vocational psychologists who work in the field of counseling psychology is to develop integrative models that combine information from cognitive and noncognitive measures. The continued development of, and research on, integrative models of individual differences offer opportunities to expand the utility of individual differences in vocational psychology.

## References

- Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin, 121*, 219-245.
- Ahadi, S., & Diener, E. (1989). Multiple determinants and effect size. *Journal of Personality and Social Psychology, 56*, 398-406.
- Anderson, M. Z., Tracey, T. J. G., & Rounds, J. (1997). Examining the invariance of Holland's vocational interest model across gender. *Journal of Vocational Behavior, 50*, 349-364.
- Armstrong, P. I., Hubert, L., & Rounds, J. (2003). Circular unidimensional scaling: A new look at group differences in interest structure. *Journal of Counseling Psychology, 50*, 297-308.
- Armstrong, P. I., Smith, T. J., Donnay, D. A. C., & Rounds, J. (2004). The Strong ring: A basic interests model of occupational structure. *Journal of Counseling Psychology, 51*, 299-313.
- Austin, J. A., & Hanisch, K. A. (1990). Occupational attainment as a function of abilities and interests: A longitudinal analysis using project TALENT data. *Journal of Applied Psychology, 75*, 77-86.
- Beruta, C., Anderson, N., & Salgado, J. F. (2005). The predictive validity of cognitive ability tests: A UK meta-analysis. *Journal of Occupational and Organizational Psychology, 78*, 387-409.
- Betz, N. E., & Rottinghaus, P. J. (2006). Current research on parallel measures of interests and confidence for basic dimensions of vocational activity. *Journal of Career Assessment, 14*, 56-76.

- Borgen, F. H., & Lindley, L. D. (2003). Individuality and optional human functioning: Interest, self-efficacy, and personality. In W. B. Walsh (Ed.), *Counseling psychology and optimal human functioning* (pp. 55-91). Mahwah, NJ: Lawrence Erlbaum.
- Brown, S. D. & Lent, R. W. (1996). A social cognitive framework for career choice counseling. *Career Development Quarterly*, 44, 354-366.
- Campbell, D. P. (1971). *Handbook for the Strong Vocational Interest Blank*. Stanford, CA: Stanford University Press.
- Campbell, D. P., & Borgen, F. H. (1999). Holland's theory and the development of interest inventories. *Journal of Vocational Behavior*, 55, 86-101.
- Darcy, M. U. A., & Tracey, T. J. G. (2007). Circumplex structure of Holland's RIASEC interests across gender and time. *Journal of Counseling Psychology*, 54, 17-31.
- Dawis, R. V. (1992). The individual differences tradition in counseling psychology. *Journal of Counseling Psychology*, 39, 7-19.
- Dawis, R. V. (1996). Vocational psychology, vocational adjustment, and the work force: Some familiar and unanticipated consequences. *Psychology, Public Policy, and Law*, 2, 229-248.
- Dawis, R. V. (2005). The Minnesota Theory of Work Adjustment. In S. D. Brown & R. W. Lent (Eds.), *Career Development and Counseling: Putting Theory and Research to Work* (pp. 3-23). New York: Wiley.
- Dawis, R. V., & Lofquist, L. (1984). *A Psychological theory of work adjustment: An individual differences model and its applications*. Minneapolis, MN: University of Minnesota Press.
- Day, S. X., & Rounds, J. (1997). "A little more than kin, and less than kind": Basic interests in vocational research and career counseling. *Career Development Quarterly*, 45, 207-220.

- Day, S. X, Rounds, J., & Swaney, K. (1998). The structure of vocational interests for diverse racial-ethnic groups. *Psychological Science, 9*, 40-44.
- Dik, B. J., & Hansen, J. C. (2004). Development and validation of discriminant functions for the Strong Interest Inventory. *Journal of Vocational Behavior, 64*, 182-197.
- Donnay, D. A. C., & Borgen, F. H. (1996). Validity, structure, and content of the 1994 Strong Interest Inventory. *Journal of Counseling Psychology, 43*, 275-291.
- Donnay, D. A. C., & Borgen, F. H. (1999). The incremental validity of vocational self-efficacy: An examination of interest, self-efficacy, and occupation. *Journal of Counseling Psychology, 46*, 432-447.
- Fouad, N. A. (2002). Cross-cultural differences in vocational interests: Between-groups differences on the Strong Interest Inventory. *Journal of Counseling Psychology, 49*, 283-289.
- Fouad, N. A., Harmon, L. W., & Borgen, F. H. (1997). Structure of interests in employed male and female members of U.S. racial-ethnic minority and nonminority groups. *Journal of Counseling Psychology, 44*, 339-345.
- Fouad, N. A., & 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*, 423-439.
- Fryer, D. (1931). *The measurement of interests*. New York, NY: Henry Holt and Company.
- Gati, I. (1979). A hierarchical model for the structure of interests. *Journal of Vocational Behavior, 15*, 90-106.
- Gati, I. (1991). The structure of vocational interests. *Psychological Bulletin, 109*, 309-324.

- Gasser, C. E., Larson, L. M., & Borgen, F. H. (2004). Contributions of personality and interests to explaining the educational aspirations of college students. *Journal of Career Assessment, 12*, 347-365.
- Gottfredson, L. S. (2003). The challenge and promise of cognitive career assessment. *Journal of Career Assessment, 11*, 115-135.
- Harmon, L. W., Hansen, J. C., Borgen, F. H., & Hammer, A. L. (1994). *Strong Interest Inventory applications and technical guide*. Stanford, CA: Stanford University Press.
- Hansen, J.C., & Campbell, D. P. *Manual for the SVIB-SCII*. Palo Alto, CA: Consulting Psychologists Press.
- Hansen, J. C., & Dik, B. J. (2005). Evidence of 12-year predictive and concurrent validity for SII occupational scale scores. *Journal of Vocational Behavior, 67*, 365-378.
- Hecker, D. E. (2005). Occupational employment projections to 2014. *Monthly Labor Review, 128*(11), 70-101.
- Hogan, R. (1983). A socioanalytic theory of personality. In M. M. Page (Ed.), *Nebraska symposium on motivation 1982. Personality: Current theory and research* (pp. 55-89). Lincoln, NB: University of Nebraska Press.
- Hogan, R., & Roberts, B. (2004). A socioanalytic model of maturity. *Journal of Career Assessment, 12*, 115-135.
- Hogan, R., & Sheldon, D. (1998). A socioanalytic perspective on job performance. *Human Performance, 11*, 129-144.
- Holland, J. L., (1959). A theory of occupational choice. *Journal of Counseling Psychology, 6*, 35-45.

- Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd Ed.). Odessa, FL: Psychological Assessment Resources.
- Holland, J. L., Whitney, D. R., Cole, N. S., & Richards, J. M., Jr. (1969). *An empirical occupational classification derived from a theory of personality and intended for practice and research* (ACT Research Report No. 29). Iowa City, IA: American College Testing.
- Hubert, L., Arabie, P., & Meulman, J. (1997). Linear and circular unidimensional scaling for symmetric proximity matrices. *British Journal of Mathematical and Statistical Psychology*, 50, 253-284.
- Humphreys, L. G., Lubinski, D., & Yao, G. (1993). Utility of predicting group membership and the role of spatial visualization in becoming an engineer, physical scientist, or artist. *Journal of Applied Psychology*, 78, 250-261.
- Hyde, J. S. (2005). The gender similarities hypothesis. *American Psychologist*, 60, 581-592.
- Judge, T. A., Higgins, C. A., Thoresen, C. J., & Barrick, M. R. (1999). The big five personality traits, general mental ability, and career success across the lifespan. *Personnel Psychology*, 52, 621-652.
- Judge, T. A., Jackson, C. L., Shaw, J. C., Scott, B. A., & Rich, B. L. (2007). Self-efficacy and work related performance: The integral role of individual differences. *Journal of Applied Psychology*, 92, 107-127.
- Kruskal, J. B., & Wish, M. (1978). *Multidimensional scaling*. Newbury Park, CA: Sage.
- Kuncel, N. R., & Hezlett, S. A. (2007). Standardized tests predict graduate student success. *Science*, 315, 1080-1081.

- Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2001). A comprehensive meta-analysis of the predictive validity of the graduate record examinations: Implications for graduate student selection and performance. *Psychological Bulletin, 127*, 162-181.
- Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2004). Academic performance, career potential, creativity, and job performance: Can one construct predict them all? *Journal of Personality and Social Psychology, 86*, 148-161.
- Larson, L. M., & Borgen, F. H. (2002). Convergence of vocational interests and personality: Examples in an adolescent gifted sample. *Journal of Vocational Behavior, 60*, 91-112.
- Larson, L. M., Rottinghaus, P. J., & Borgen, F. H. (2002). Meta-analyses of big six interests and big five personality factors. *Journal of Vocational Behavior, 61*, 217-239.
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance [Monograph]. *Journal of Vocational Behavior, 45*, 79-122.
- Levinson, D. J. (1986). A conception of adult development. *American Psychologist, 41*, 3-13.
- 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.
- Lippa, R. (2005). Subdomains of gender-related occupational interests: do they form a cohesive bipolar M-F dimension? *Journal of Personality, 73*, 693-729.
- Long, L., & Tracey, T. J. G. (2006). Structure of RAISEC scores in China: A structural meta-analysis. *Journal of Vocational Behavior, 68*, 39-51.

- Low, K. S. D., Yoon, M., Roberts, B. W., & Rounds, J. (2005). The stability of vocational interests from early adolescence to middle adulthood: A quantitative review of longitudinal studies. *Psychological Bulletin, 131*, 713-737.
- Low, K. S. D., & Rounds, J. (in press). Interest change and continuity from early adolescence to middle adulthood. *International Journal of Educational and Vocational Guidance*.
- Lubinski, D. (2000). Scientific and social significance of assessing individual differences: "Sinking shafts at a few critical points." *Annual Review of Psychology, 51*, 405-444.
- Lubinski, D., & Benbow, C. P. (2006). Study of mathematically precocious youth after 35 years: Uncovering antecedents for the development of math-science expertise. *Perspectives on Psychological Science, 1*, 316-345.
- Luzzo, D. A., & Day, M. A. (1999). Effects of Strong Interest Inventory feedback on career decision-making self-efficacy and social cognitive career beliefs. *Journal of Career Assessment, 7*, 1-17.
- McCormick, E. J., DeNisi, A. S., & Shaw, J. B. (1979). Use of the Position Analysis Questionnaire for establishing the job component validity of tests. *Journal of Applied Psychology, 64*, 51-56.
- McCormick, E. J., Jeanneret, P. R., & Mecham, R. C. (1972). A study of job characteristics and job dimension as based on the Position Analysis Questionnaire (PAQ). *Journal of Applied Psychology, 56*, 347-368.
- McDaniel, M. A., & Snell, A. F. (1999). Holland's theory and occupational information. *Journal of Vocational Behavior, 55*, 74-85.
- Mischel, W. (1968). *Personality and assessment*. New York, NY: Wiley.

- Mount, M. K., Barrick, M. R., Scullen, S. M., & Rounds, J. (2005). Higher-order dimensions of the big five personality traits and the big six vocational interest types. *Personnel Psychology, 58*, 447-478.
- Ozer, D. J., & Benet-Martinez, V. (2006). Personality and the prediction of consequential outcomes. *Annual Review of Psychology, 57*, 401-421.
- Prediger, D. J. (1977). Alternatives for Validating Interest Inventories Against Group Membership Criteria. *Applied Psychological Measurement, 1*, 275-280.
- Prediger, D. J. (1982). Dimensions underlying Holland's hexagon: Missing link between interests and occupations? *Journal of Vocational Behavior, 21*, 259-287.
- Prediger, D. J. & Johnson, R. W. (1979). *Alternatives to sex-restrictive vocational interest assessment* (ACT Research Report No. 79). Iowa City, IA: ACT.
- Ralston, C. A., Borgen, F. H., Rottinghaus, P. J., & Donnay, D. A. C. (2004). Specificity in interest measurement: Basic interest scales and major field of study. *Journal of Vocational Behavior, 65*, 203-216.
- Reardon, R. C., Vernick, S. H., & Reid, C. A. (2004). The distribution of the U.S. workforce from 1960 to 1990: A RIASEC perspective. *Journal of Career Assessment, 12*, 99-112.
- Reeve, C. L. & Heggestad, E. D. (2004). Differential relations between general cognitive ability and interest-vocation fit. *Journal of Occupational and Organizational Psychology, 77*, 385-402.
- Roberts, B. W., Caspi, A., & Moffitt, T. E. (2003). Work experiences and personality development in young adulthood. *Journal of Personality and Social Psychology, 84*, 582-593.

- Rottinghaus, P. J., Larson, L. M., & Borgen, F. H. (2003). The relation of self-efficacy and interests: A meta-analysis of 60 samples. *Journal of Vocational Behavior*, 62, 221-236.
- Rounds, J., & Armstrong, P. I. (2005). Assessment of needs and values. In S. D. Brown & R. W. Lent (Eds.), *Career development and counseling: Putting theory and research to work* (pp. 305-329). Hoboken, NJ: Wiley.
- Rounds, J., & Day, S. X. (1999). Describing, evaluating and creating vocational interest structures. In M. L. Savickas & A. R. Spokane (eds.), *Vocational Interests: Meaning, measurement, and counseling use* (pp. 103-133). Palo Alto, CA: Davies-Black.
- Rounds, J., & Tracey, T. J., (1993). Prediger's dimensional representation of Holland's RIASEC circumplex. *Journal of Applied Psychology*, 78, 875-890.
- Rounds, J., & Tracey, T. J. (1996). Cross-cultural structural equivalence of RIASEC models and measures. *Journal of Counseling Psychology*, 43, 310-329.
- Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin*, 124, 262-274.
- Schmidt, F. L., & Hunter, J. E. (2004). General mental ability in the world of work: Occupational attainment and job performance. *Journal of Personality and Social Psychology*, 86, 162-173.
- Spekle, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science? A critical review. *American Psychologist*, 60, 950-958.
- Strong, E. K. (1943). *Vocational interests of men and women*. Stanford, CA: Stanford University Press.

- .Taylor, H. C., & Russell, J. T. (1939). The relationship of validity coefficients to the practical effectiveness of tests in selection: Discussion and tables. *Journal of Applied Psychology*, 23, 565-578.
- Tracey, T. J., & Rounds, J. (1993). Evaluating Holland's and Gati's vocational-interest models: A structural meta-analysis. *Psychological Bulletin*, 113, 229-246.
- Uffelman, R. A., Subich, L. M., Diegelman, N. M., Wagner, K. S., & Bardash, R. J. (2004). Effect of mode of interest assessment on clients' career decision-making self-efficacy. *Journal of Career Assessment*, 12, 366-380.
- Wilk, S. L., Desmarais, L. B., & Sackett, P. R. (1995). Gravitation to jobs commensurate with ability: Longitudinal and cross-sectional tests. *Journal of Applied Psychology*, 80, 79-85.

## Figure Captions

*Figure 1.* Prediger's (1982) Data-Ideas and People-Things dimensions and Hogan's (1983) Sociability and Conformity dimensions embedded in Holland's RIASEC model. Gender differences in the People-Things dimension may be implicated in the different career trajectories of mathematically talented men and women (Lubinski & Benbow, 2006).

*Figure 2.* Circular unidimensional scaling of Strong Interest Inventory results for Caucasian, African American, and Hispanic American men and women. Group differences in the structure of RIASEC types suggest that additional work is needed to improve the construct validity of Holland-based measures for diverse racial-ethnic groups. From "Circular unidimensional scaling: A new look at group differences in interest structure," by P. I. Armstrong, L. Hubert, & J. Rounds, 2003, *Journal of Counseling Psychology*, 50, pp. 303-306. Copyright 2003 by the American Psychological Association. Adapted with permission of the author.

*Figure 3.* Trait complexes proposed by Ackerman and Heggstad (1997), embedded in Holland's RIASEC model.

*Figure 4.* O\*NET characteristics embedded into dimensions 1 and 2 of the Strong Ring, integrating data from the U.S. Department of Labor into an interest-based model of occupations. The integration of occupational data into interest structures facilitates its use in counseling and other applied settings. From "The Strong ring: A basic interests model of occupational structure" by P. I. Armstrong, T. J. Smith, D. A. C. Donnay, & J. Rounds, 2004, *Journal of Counseling Psychology*, 51, p. 309. Copyright 2004 by the American Psychological Association. Reprinted with permission of the author.

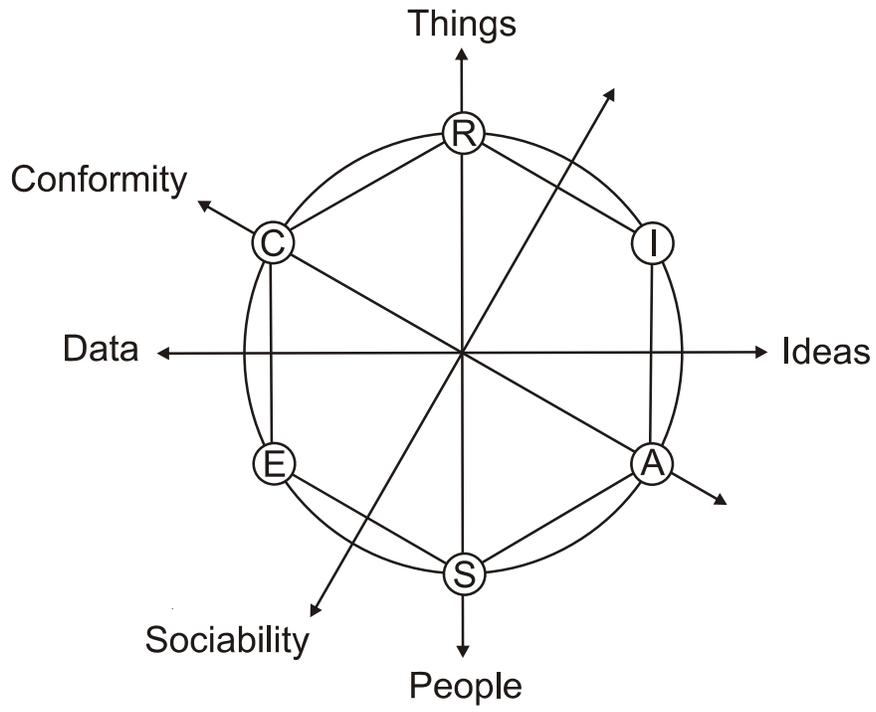


Figure 1

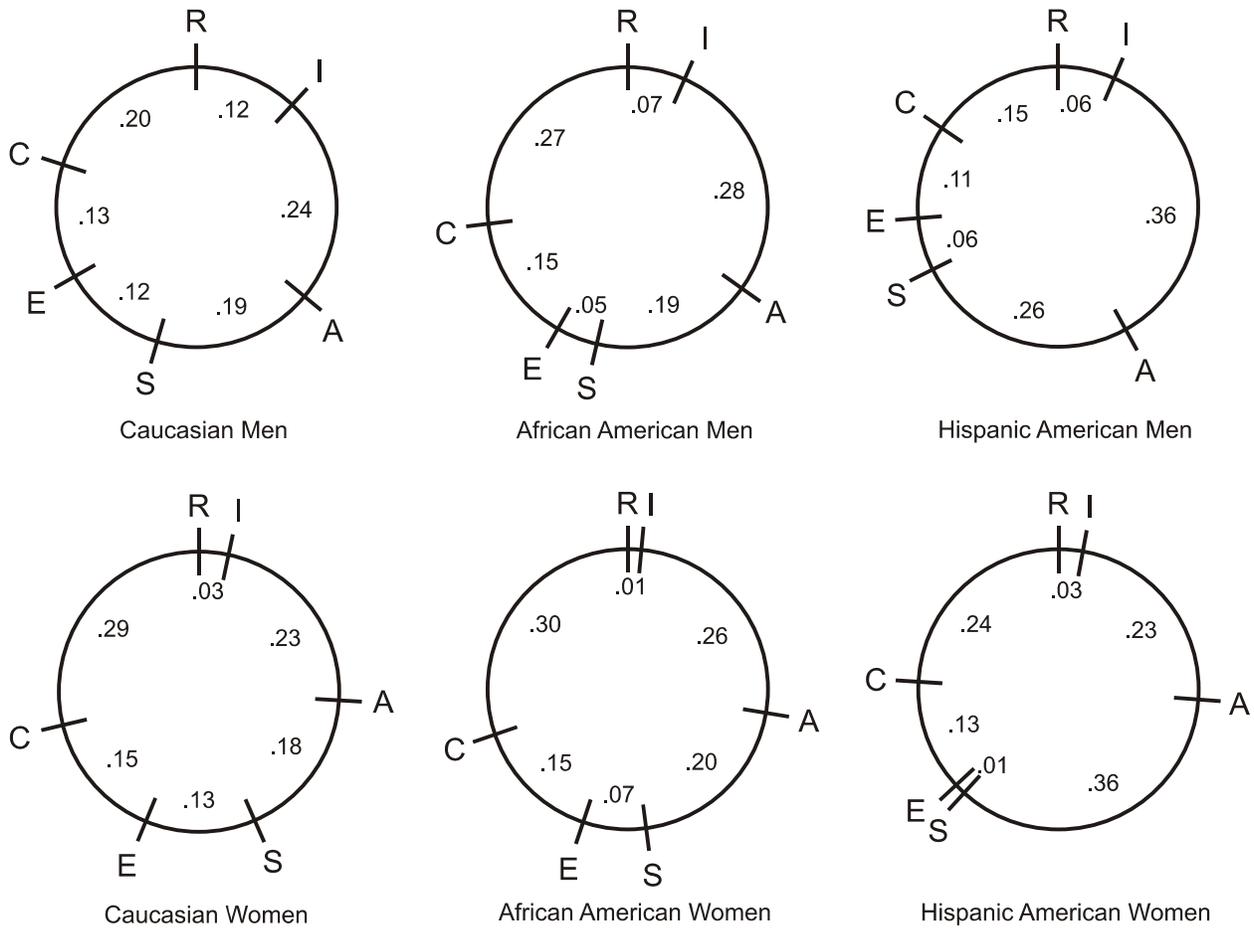


Figure 2

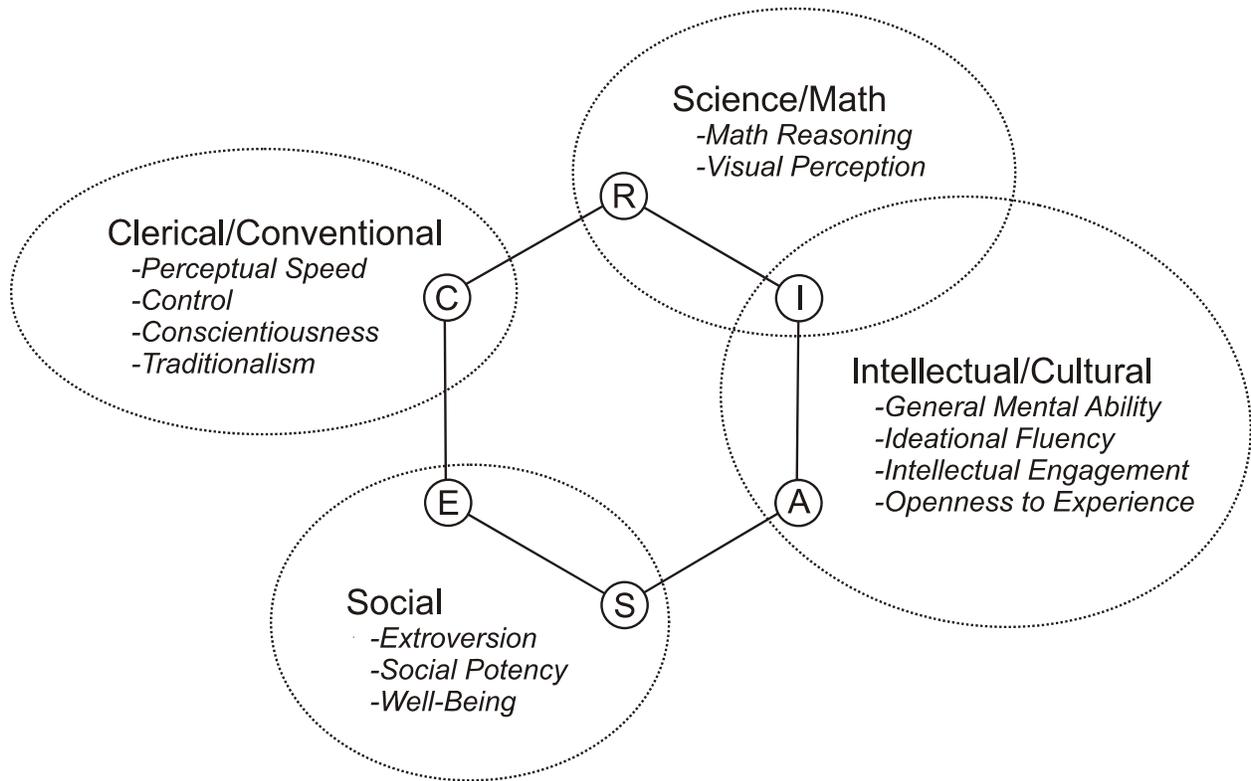


Figure 3

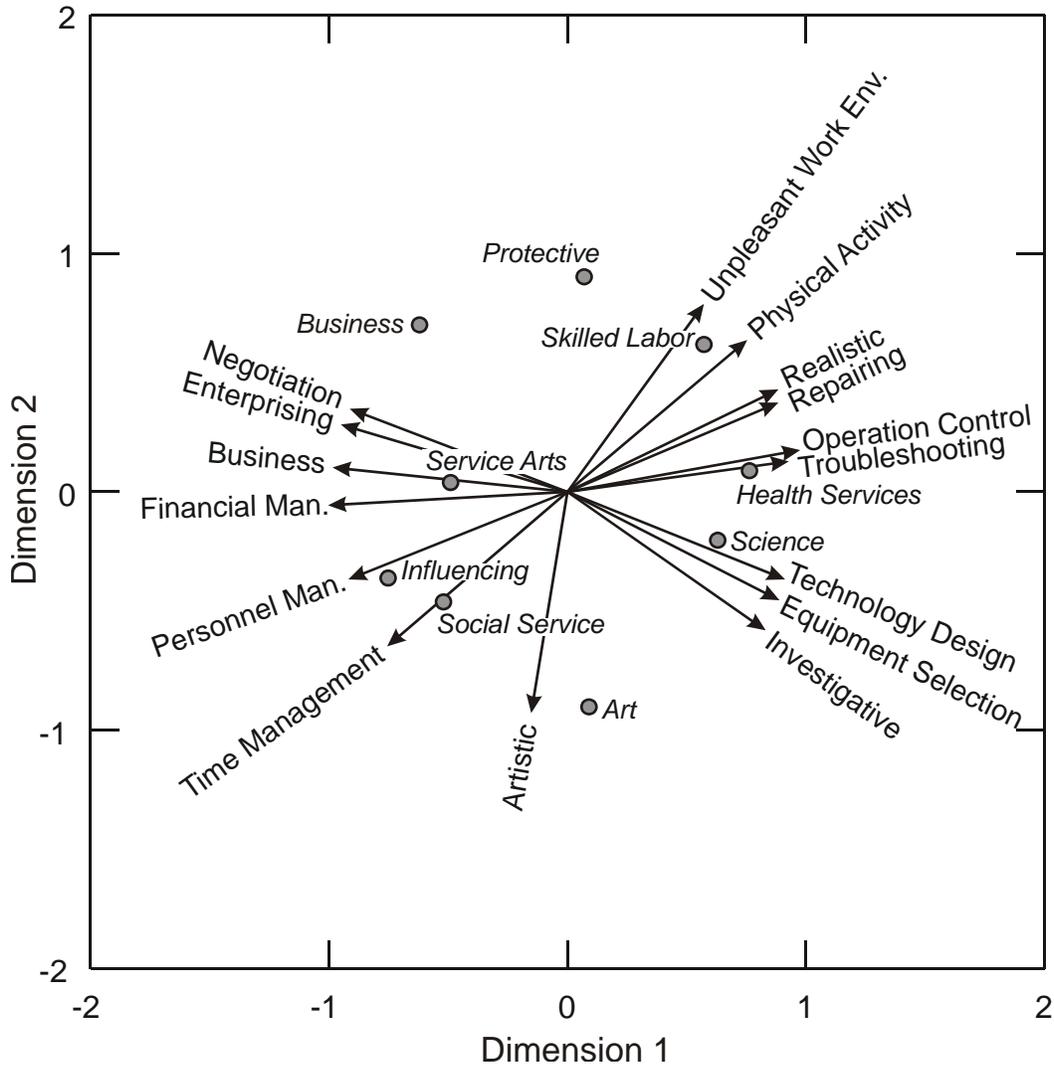


Figure 4