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SCIENTIFIC AND SOCIAL SIGNIFICANCE OF ASSESSING INDIVIDUAL DIFFERENCES: "Sinking Shafts at a Few Critical Points"

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■ **Abstract** This chapter reviews empirical findings on the importance of assessing individual differences in human behavior. Traditional dimensions of human abilities, personality, and vocational interests play critical roles in structuring a variety of important behaviors and outcomes (e.g. achieved socioeconomic status, educational choices, work performance, delinquency, health risk behaviors, and income). In the review of their importance, the construct of general intelligence is featured, but attributes that routinely add incremental validity to cognitive assessments are also discussed. Recent experimental and methodological advances for better understanding how these dimensions may contribute to other psychological frameworks are reviewed, as are ways for determining their scientific significance within domains where they are not routinely assessed. Finally, some noteworthy models are outlined that highlight the importance of assessing relatively distinct classes of individual-differences attributes simultaneously. For understanding fully complex human phenomena such as crime, eminence, and educational-vocational development, such a multifaceted approach is likely to be the most productive.

CONTENTS

INTRODUCTION

Throughout most of this century, a broad introduction to the psychology of individual differences or differential psychology was standard background for graduate training in applied psychology. Its importance was underscored by Scott: ‘‘Possibly the greatest single achievement of the American Psychological Association is the establishment of the psychology of individual differences’’ (1920:85). Differential psychology comprises the psychometric assessment of abilities, personality, and vocational interests, with special emphasis devoted to their real-world significance and their developmental antecedents. Topics of interest included educational, interpersonal, and vocational behaviors, especially those relevant to facilitating optimal adjustment to life and work and tailoring opportunities for positive growth. Anastasi (1937), Tyler (1965), and Willerman (1979) all wrote classic texts covering these topics, and provided the conceptual underpinnings for psychologists working in educational, clinical, industrial, and military settings.

Emerging out of these early conceptual foundations, accumulating empirical evidence has made it clear that differential psychology can contribute to better understanding of academic achievement (Benbow & Stanley 1996, Snow 1991), the particulars of intellectual development (Ackerman 1996), creativity (Eysenck 1995, Jensen 1996), crime and delinquency (Gordon 1997, Lykken 1995), educational and vocational choice (Dawis 1992, Snow et al 1996), health-risk behavior (Caspi et al 1997, Lubinski & Humphreys 1997), income and poverty (Hunt 1995, Murray 1998), occupational performance (Hunter & Schmidt 1996, Hough 1997), social stratification (Gottfredson 1997), clinical prediction (Dawes 1994, Grove & Meehl 1996), and life-span development (Harris 1995, Holahan & Sears 1995, Rowe 1994, Schaie 1996). As a matter of fact, causal models of these phenomena that do not incorporate individual differences variables are likely to be underdetermined. In addition, as differential psychologists devote particular attention to socially relevant phenomena, their findings are germane to the work of medical and social scientists studying people at risk for negative outcomes or showing promise for positive outcomes.

As developments in differential psychology unfolded, however, and specialization progressed, the study of individual differences became less likely to be viewed (and reviewed) as a cohesive body of knowledge. Willerman's (1979) comprehensive text was the last of its kind. Basic researchers (and textbook writers) have tended since to restrict their activities to specific classes of attributes: e.g. either human abilities, interests, personality, or their biological and environmental antecedents. Indeed, few research programs have examined these attributes simultaneously or systematically for their collective role in explaining and predicting human psychological phenomena. Yet, a much richer picture of humanity and psychological diversity is brought into focus when constellations of individual-differences variables are assembled for research and practice. By teaming relatively independent individual-differences variables to model human behavior, it becomes easy to illustrate how they operate in many important contexts (whether they are measured or not). A new millennium marks a good time to examine the study of individual differences more holistically.

Literature Reviewed

Following an examination of Cattell's (1890) classic, wherein the term "mental test" was first introduced, Galton (1890: 380) appended two pages of profoundly influential remarks underscoring the importance of assessing psychological phenomena of substantive significance: "One of the most important objects of measurement is hardly if at all alluded to here and should be emphasized. It is to obtain a general knowledge of . . . capacities . . . by sinking shafts, as it were, at a few critical points. In order to ascertain the best points for the purpose . . . We thus may learn which of the measures are the most instructive."

The reviewed literature reveals a number of "deep shafts" that would likely impress Galton himself. First, three classes of dispositional attributes will be reviewed: abilities, interests, and personality. To keep this review down to manageable dimensions, abilities will be restricted to cognitive abilities, interests will focus on educational and vocational interests, and omitted from consideration in personality dimensions are the familiar psychopathological traits (e.g. schizophrenia, manic depressive disorders, etc). Without this curtailment, a wide-angle view of differential psychology would be prohibitive. Some research combining ability, interest, and personality variables will be reviewed, followed by a discussion of methodological issues pertaining to mis-specified causal modeling. This chapter concludes by explicating some ideas behind the concept of "niche building" (i.e. how individuals seek out, build, and create environments that correspond to their personal attributes). This analysis may resolve conflicts between various groups, e.g. the tensions observed between Snow's (1967) "two cultures" (the humanists and the scientists) or, closer to home, psychologists who work with people (see clients) versus psychologists who do not. As the psychology of individual differences illuminates issues surrounding human diversity, it may furnish tools for facilitating cross-cultural empathy (Dawis 1992).

DISPOSITIONAL ATTRIBUTES: ABILITIES, INTERESTS, AND PERSONALITY

Cognitive Abilities

The last two decades have witnessed many ambitious examinations of cognitive ability measures and the constructs they assess. Discussion has focused on the construct of general intelligence (*g*). However, discourse has also extended into cognitive abilities beyond *g* and grappled with the full dimensionality and psychometric organization of the resulting array of intellective components. At broader levels of analysis, group differences (e.g. sex, race) have been explored, along with attendant questions about whether test bias might place certain groups at a disadvantage in the assessment process. A further topic of inquiry has been an observed tendency for scores on intelligence tests to rise cross-culturally over the century. Finally, biological correlates of *g* have been explored, leading ultimately to speculation on the evolutionary derivation of general cognitive ability. Findings from each of these areas of investigation are reviewed below.

General Intelligence ("g") Large-scale studies have addressed the psychological nature of *g*, biological interconnections, and the validity of well-known tools purporting to index *g* for predicting socially valued criteria. During the past decade, treatments have intensified exponentially (Carroll 1993, Jensen 1998, Neisser et al 1996), across both familiar (core) as well as less familiar (peripheral) criterion domains. Research has sharpened validity generalizations forecasting educational outcomes (Benbow 1992, Benbow & Stanley 1996, Snow 1996), occupational training, and work performance (Hunter & Schmidt 1996, Schmidt & Hunter 1998). More is also now known about periphery phenomena surrounding *g*'s nomological network: aggression, delinquency, and crime (Caspi & Moffitt 1993, Gordon 1997, Wiegman et al 1992); health risks (Lubinski & Humphreys 1997, Macklin et al 1998); and income and poverty (Hunt 1995, Murray 1998).

For some benchmarks, general cognitive ability covaries 0.70–0.80 with academic achievement measures, 0.40–0.70 with military training assignments, 0.20–0.60 with work performance (higher values reflect higher job complexity families), 0.30–0.40 with income, and 0.20 with law abidingness (Brody 1992, 1996; Gordon 1997). Willis & Schaie (1986) have shed considerable light on the role of general intelligence for practical intelligence in later life, and O'Toole (1990) has done the same for motor vehicle accident proneness. A nice compilation of positive and negative correlates of *g* is Brand's (1987) Table 2, which documents a variety of modest correlations between general intelligence and altruism, sense of humor, practical knowledge, response to psychotherapy, social skills, supermarket shopping ability (positive correlates), and impulsivity, accident proneness, delinquency, smoking, racial prejudice, and obesity (negative correlates), among others. These outer-layer peripheral correlates are especially thought provoking because they reveal how individual differences in *g* "pull" with them cascades of primary (direct) and secondary (indirect) effects (Gottfredson 1997).

Contemporary psychologists at opposite poles of the applied educational-industrial spectrum, such as Snow (1989) and Campbell (1990), respectively, have showcased *g* in law-like empirical generalizations.

> Given new evidence and reconsideration of old evidence, [*g*] can indeed be interpreted as 'ability to learn' as long as it is clear that these terms refer to complex processes and skills and that a somewhat different mix of these constituents may be required in different learning tasks and settings. The old view

> that mental tests and learning tasks measure distinctly different abilities should be discarded. (Snow 1989:22)
>
> General mental ability is a substantively significant determinant of individual differences in job performance for any job that includes information-processing tasks. If the measure of performance reflects the information processing components of the job and any of several well-developed standardized measures used to assess general mental ability, then the relationship will be found unless the sample restricts the variances in performance or mental ability to near zero. The exact size of the relationship will be a function of the range of talent in the sample and the degree to which the job requires information processing and verbal cognitive skills. (Campbell 1990:56)

These views are widely accepted among psychometricians (Barrett & Depinet 1991, Carroll 1997, Gottfredson 1997). They will be welcomed by researchers who have searched in vain for genuine moderator variables and felt compelled therefore to accept, however reluctantly, Ghiselli's (1972:270) influential but dyspeptic appraisal: "It is possible that moderators are as fragile and elusive as that other will-o-the-wisp, the suppressor variable." The following empirical generalization is now one of the most robust in all of psychology: The positive correlation between work performance (Y) and general intelligence (X) is moderated by job complexity (Z). Substituting general academic learning for Y and accelerated abstract-curriculum for Z, another robust empirical generalization of a moderated relationship is revealed for curriculum and instruction (Benbow & Stanley 1996).

Yet, contentious debate has been common for research pertaining to *g* (Campbell 1996). Indeed, psychologists can be found on all sides of the complex set of issues engendered by assessing general intelligence (Snyderman & Rothman 1987). This is not new, however. Heated debate has followed this important construct since shortly after Spearman's (1904) initial article (cf. Chapman 1988). Nevertheless, recently, many scientists have been determined to understand *g* and the means of assessing it better. Even prior to 1994, the date marking publication of Herrnstein & Murray's (1994) controversial book, a number of highly visible publications appeared that attempted (among other things) to explicate the social significance of *g.* For by the 1980s it was becoming clear that *g* played a prominent role in learning and work (Ackerman 1988, Thorndike 1985). This development bore out Cronbach's (1970:197) earlier evaluation: "The general mental test stands today as the most important technical contribution psychology has made to the practical guidance of human affairs." Thorndike (1994:150) summarized years of research findings on cognitive abilities: "[T]he great preponderance of the prediction that is possible from any set of cognitive tests is attributable to the general ability that they share. What I have called 'empirical *g*' is not merely an interesting psychometric phenomenon, but lies at the heart of the prediction of real-life performances . . . ." Meehl (1990:124) remarked: "Almost all human performance (work competence) dispositions, if carefully studied, are saturated to some extent with the general intelligence factor *g*, which for psychodynamic and ideological reasons has been somewhat neglected in recent years but is due for a comeback.''

By 1995, largely in response to exchanges stimulated by the *Bell Curve* (Herrnstein & Murray 1994) (both within scholarly outlets and the popular press), the APA formed a special task force (Neisser et al 1996). Contemporaneously with the work of this task force, several major psychological outlets published special issues (Ceci 1996, Sternberg 1997, Gottfredson 1997).

The final chapter to this story is far from complete. However, one thing is clear: The intensity of research on intellectual abilities continues unabated. Jensen (1998) has just unveiled his most recent book which, like Carroll's (1993), is destined to become a classic (Bouchard 1999, Neisser 1999). In Meehl's (1998) words: ''Verbal definitions of the intelligence concept have never been adequate or commanded consensus. Carroll's [1993] and Jensen's [1998] books, *Human Cognitive Abilities* and *The g Factor* (which will be the definitive treatises on the subject for many years to come), essentially solve the problem.'' In both works, general intelligence has been conceptualized through a (perhaps, the) fundamental predicate of science—covariation. General intelligence is defined by the covariation cutting across various problem solving mediums (numerical, pictorial, verbal), assessment modalities (group, individual), and populations (cross culturally); it reflects the general factor—or communality—shared by these multiple operations.

To the extent that this general factor reaches out and connects with external phenomena—covariation—a basis is formed for evaluating its scientific significance. Jointly, these two systems of covariation (internal operations of assessment tools and external links to extra-assessment phenomena) form the nexus of the general intelligence construct. *g* is viewed as the central node of this nexus, with its meaning successively clarified as conceptual and empirical interrelationships develop through research and establish the causal directionality of the network's strands. Spearman (1927:89) referred to the essence of *g* as ''mental energy,'' which manifested itself in individual differences in ''the eduction of relations and correlates.'' This was a respectable pioneering beginning but, as indicated below, there are other ways to construe this attribute.

While Meehl (1998) is correct that verbal definitions of intelligence have never been ''adequate or commanded consensus'' because writers tend to focus on the unique features of their formulation rather than the communality that they share (cf. Sternberg & Detterman 1986), literary definitions do have their place. For example, they frequently point to critical core criteria and relevant peripheral criteria that constitute differential degrees of importance for establishing construct validity of measures purporting to assess the attribute in question. Such distinctions can bring the fruitfulness of a particular line of research into focus. Early psychophysical measures of intelligence were rejected, for example, because they failed to covary with educational outcomes, rate of learning academic material, and teacher ratings—criteria thought to be central to the meaning of intelligence; for measures not to display an appreciable relationship with these criteria would violate the essence of what intelligence was intended to embody. It was natural, therefore, that when Binet and Spearman produced tests predictive of these core criteria, investigators shifted their focus and began using the new tools in their empirical research (Thorndike & Lohman 1990).

Today, for example, there is a fair amount of agreement among measurement experts that measures of *g* assess individual differences pertaining to ''abstract thinking or reasoning,'' ''the capacity to acquire knowledge,'' and ''problem-solving ability'' (see Snyderman & Rothman's 1987 survey of 641 experts and Gottfredson 1997). Naturally, individual differences in these attributes influence aspects of life outside of academic and vocational arenas because abstract reasoning, problem-solving, and rate of learning touch so many facets of life, especially now in our information intense society. These quoted characteristics fit with correlates at both the core and the periphery of *g*'s nexus. They are compatible with empirical facts. Investigators who conceptualize intelligence differently are probably talking about something other than psychometric *g,* and something less central to learning and work performance.

Dimensionality and Organization Over the past 20 years, an understanding of how cognitive abilities are organized (hierarchically) has emerged, through hierarchical factor analysis (Carroll 1993, Humphreys 1994), radex scaling (Snow & Lohman 1989), and structural equation modeling (Gustafsson & Undheim 1996). To psychological researchers working outside the field of cognitive abilities, variations across these methods mirror Allport's distinction between his and Henry Murray's view of personality: ''narcissisms of subtle difference.'' Most impressive is Carroll's (1993) treatment of cognitive abilities, which confirmed what a number of investigators have maintained all along. Cognitive abilities are organized hierarchically and, when administered to a wide range of talent, approximately 50% of the common variance in heterogeneous collections of cognitive tests comprise a general factor. There is clearly a conspicuous red thread running through variegated conglomerations of cognitive tests (and the items that form them). It reflects the largest vein of construct-valid variance uncovered by differential psychology in terms of its external connections. Yet, to be sure, there is psychological significance beyond the general factor. Quantitative, spatial, and verbal reasoning abilities all possess psychological import beyond *g.* This is especially true for predicting educational and career tracks that people self-select (Achter et al 1999, Austin & Hanisch 1990, Humphreys et al 1993), but also for individual differences in criterion performance (Carroll 1993, Jensen 1998). However, as Carroll (1993:689) has noted, the scientific significance of various abilities comes in degrees: ''[A]bilities are analogous to elements in the periodic table: Some, like fluid intelligence [''g''], are obviously as important as carbon or oxygen; others are more like rare earth elements . . . ''

Although Carroll's (1993) nomenclature is presented below, other approaches would paint a similar picture. All of the aforementioned treatments are centered by a general factor at the apex of a hierarchy (stratum III) that is defined by the communality running through a secondary tier of more content specific abilities (stratum II): mathematical, spatial/mechanical, and verbal reasoning abilities. The stratum III general factor is a global marker of intellectual complexity or sophistication, whereas the stratum II abilities are content specific strengths and relative weaknesses. There are others, but the above abilities command the most scientific significance. Finally, under these dimensions are more circumscribed abilities closely associated with specific tests (stratum I), such as arithmetic reasoning, block design, vocabulary, etc. Carroll's (1993) three-stratum theory is, in many respects, not new. Embryonic outlines are seen in earlier psychometric work (Burt, Cattell, Guttman, Humphreys, and Vernon, among others). But the empirical bases for Carroll's (1993) conclusions are unparalleled; readers should consult this source for a systematic detailing of more molecular abilities.

In view of these developments, some have concluded that a fairly comprehensive picture of the structure and forecasting capabilities of cognitive abilities has been drawn. Consequently, little is likely to come of further examining phenotypic aspects of intellectual behavior. For example, Jensen (1998) has argued that basic research needs to uncover more fundamental (biological) vertical paths and develop more ultimate (evolutionary) explanations, for genuine advances to occur. There are, however, at least two issues worthy of additional examination. The first involves the scientific significance of lower-order dimensions of human abilities (those beyond *g*) and how best to appraise their scientific worth. The second has to do with population changes and differences.

Cognitive Abilities Beyond g Specific abilities beyond *g* contribute to real-world forecasts. This becomes especially true at higher *g* levels [e.g. continuous gradations extending from bright, to gifted, to profoundly gifted populations (cf. Achter et al 1996, Benbow 1992)], where the major markers of *g* successively pull apart (dissociate). In complex educational (graduate school) and vocational (doctoral-level occupational) environments, range truncation on *g* is intense because an appreciable amount of *g* is necessary to operate with competence in these ever-changing, symbolically dense environments (Hunt 1995, 1996). Hence, the predictive power of other factors increases relative to general intelligence, but again, only for populations highly selected on *g*. This is akin to Tanner's (1965) intriguing discriminant function analysis. The physical (body build) profiles of Olympic athletes enabled Tanner to identify their domains of excellence (events they were competing in) with great accuracy. Yet, within a given event, the individual differences dimensions utilized to classify these gifted athletes were not impressive performance predictors. [That the *American Psychologist* (1998) recently devoted nine letters and 12 pages to pointing out how range truncation can attenuate correlations is commentary on the poor cumulative nature of some psychological research. Reading McNemar's (1964) article would have forestalled the need for this exchange.]

Probably the simplest model of human cognitive abilities (beyond *g*) is Eysenck's (1995) two-dimensional model: the general factor and a bipolar spatial-verbal factor. Vernon (1961) used verbal-educational-numerical (v:ed) and mechanical-practical-spatial (k:m) as major group factors subservient to *g*, while Cattell (1971) has proposed a fluid/crystallized distinction. Snow and his colleagues (Snow 1991, Snow &

Lohman 1989) have discussed verbal/linguistic, quantitative/numerical, and spatial/mechanical abilities, in addition to the general factor defined by what is common to these symbolic, problem-solving systems. Over a variety of educational/vocational contexts, these three regions represent important sectors of concentration; they have also demonstrated incremental validity relative to *g*. However, traditional factor-analytic treatments have not proceeded with incremental validity in mind. That is, factor analytic models of cognitive abilities have (for the most part) focused on the internal structure of assessment tools. Models have been based on within-instrument covariance structure.

Many factor analysts seem to hold as their implicit (if not explicit) goal accounting for all the common variance in a correlation matrix. However, this goal fails to consider the psychologically significant dimensionality that might result. For example, Carroll (1994:196) writes: ‘‘I have pointed out (Carroll 1993) that the general factor on the average contributes only a little more than half the common factor variance of a given test; thus, lower order factors can have almost as much importance as the general factor.’’ But it must be asked, Is this view plausible? Given the breadth and depth of the *g* nexus, is it conceivable that, even collectively, lower-order cognitive factors, all independent of *g*, could evince external relationships as important as *g* by itself? Mathematically, of course, it is conceivable; but is it psychologically conceivable based on what we know about various ability dimensions that are independent of *g* when in competition with the general factor for predicting important external criteria? Based on existing evidence, it does not seem likely.

Furthermore, Carroll (1994) seems to imply that all the dimensions resulting from common variance among cognitive abilities have the potential of being psychologically important. Again, although this is technically possible, it is unlikely; in fact, there is reason to suspect otherwise. This is especially true when all of the variables in a factor analysis are assessed by the same (monomethod) modality (Carroll's ‘‘a given test’’). Understanding this idea is important, because it generalizes to issues involving the number of dimensions needed to model both personality and vocational interests discussed in subsequent sections. For example, in the context of a discussion on the number of dimensions needed to characterize personality, Block (1995a:189) noted: ‘‘[T]he amount of variance ‘explained’ internally by a factor need not testify to the external psychological importance of the factor.’’

Within a domain of individual-differences measures, only a portion of the common variance should be expected to have psychological import. This can be illustrated through basic concepts from Campbell & Fiske's (1959) multi-trait multi-method matrix. When examining construct validity through multiple sources, monomethod correlations are essentially always larger than their heteromethod counterparts. Indeed, this comparison is most germane to calibrating the magnitude of methods variance operating. It indicates that some portion of common variance running through cognitive ability tests is methods variance and, as such, is construct irrelevant. Dimensions emerging primarily from this aspect of common variance are best viewed as undesirable contaminants for the ultimate psychological solution (but not necessarily for a mathematical solution aiming to account for all of the common variance regardless of construct relevance). The basic idea, carried to its logical conclusion, challenges the assumed desirability of accounting for all of the common variance in a correlation matrix through factor-analytic techniques (when attempting to understand the psychological structure underlying a representative collection of individual differences measures). It suggests that only a fraction of the common variance is construct relevant.

A factor solution accounting for 85% of the common variance among 50 variables with a three-factor solution, and reinforced by a sharp "elbowed" scree between eigenvalues three and four would constitute, by many, a clear-cut, if not elegant, triadic solution. But what if factors two and three provided little incremental validity over factor one in the prediction of relevant (group membership or performance) criteria, and none that held up under cross-validation (Lubinski & Dawis 1992, Schmidt et al 1998)? Should we consider these dimensions psychologically important too? Or, might these factors constitute nuisance variables—namely, reliable variance akin to what Cook & Campbell (1979) have referred to as construct irrelevancies, or "systematic bias" (Humphreys 1990), "constant error" (Loevinger 1954), "systematic ambient noise" (Lykken 1991), "crud" (Meehl 1990), or, "methods variance" (Campbell & Fiske 1959)? There is no a priori reason to assume that all of the common variance in a correlation matrix is psychologically significant; but to determine whether it is (and to what extent) is an empirical question (cf. Thurstone 1940:217).

If the amount of common variance accounted for in a factor analysis need not translate into the importance of a factor, what does? A proposal stemming from earlier recommendations by Humphreys (1962) and McNemar (1964) has been reinstated (Lubinski & Dawis 1992). Humphreys and McNemar stress the importance of incremental validity. That is, when attempting to ascertain the number of dimensions necessary to characterize cognitive abilities (or any domain of individual differences), consider the amount of incremental validity gleaned over and beyond what is already available. Given that the general factor accounts for about 50% of the common variance among cognitive tests (coupled with the breadth and depth of its external linkages), parsimony suggests that investigators begin here. By adding variables to multiple regression equations (following the general factor), investigators can work their way down the hierarchy of cognitive abilities and, as long as lower-tier dimensions add incremental validity to what prior dimensions provided and these increments hold up on cross-validation (Lubinski & Dawis 1992), more molecular dimensions thus achieve the status of psychologically significant parameters of individuality. Messick (1992:379) has communicated the same idea in a slightly different way: "Because IQ is merely a way of scaling measures of general intelligence, the burden of proof in claiming to move beyond IQ is to demonstrate empirically that . . . test scores tap something more than or different from general intelligence by, for example, demonstrating differential correlates with other variables (which is the external aspect of construct validity)." Just as incremental validity is important when appraising innovative measures (Dawis 1992, Lykken 1991, Sanders et al 1995), the same holds for the dimensional products of factor analysis. Innovative measures and variables worthy of scientific attention provide information not already available; nonincremental sources of variance do not.

Group Differences When Jenkins & Paterson (1961) compiled their classic book illustrating the historical development of psychological measurement and individual differences, and searched "for a topic to serve as a model problem [they] quickly settled on intelligence" (1961:v). Then, like now, intellectual assessment was the richest vein of differential psychology. Furthermore, not unlike today (Herrnstein & Murray 1994), their preface stressed how controversial this area is. Campbell (1996) provides an excellent contemporary overview (see also Coleman 1990–1991). Humphreys (1995), moreover, has maintained that it is because of the magnitude of group differences on ability measures, and the real world performances that these measures are able to forecast, that differential psychology has been a neglected area in psychology.

At the apex as well as at the lower tiers of cognitive abilities, attention toward group contrasts has arisen for several reasons. Before proceeding, however, the magnitude of overlap between various groupings of human populations should be emphasized. In standard deviation units, the range within any given population (race, sex) is many times the range between population means. One noteworthy achievement of differential psychology is that it has moved human psychological appraisals from crude nominal categories (group membership) to more refined ordinal and interval measurement (continuous dimensions of human variation), and experimental procedures for ratio measurement are underway (Deary 1996). As a result of these refinements, all human populations have revealed exceptional talent (comparable ranges). Ordinal and interval assessments of individual differences illuminate the diversity of talent within all demographic groupings, which nominal scaling systems are ill equipped to do.

Since the onset of psychometric inquiry, however, differences among various racial groupings (sometimes reaching one standard deviation or slightly more) have been both stubborn and consistent (Cronbach 1975; Jensen 1980, 1998). Furthermore, the magnitude of these differences has been relatively stable even during periods of converging educational opportunities (Gottfredson & Sharf 1988). Beyond this, it is important to understand that, like demonstrable differences, seemingly minor differences in ability level (mean) and dispersion (variability) warrant critical scrutiny. Collectively and individually, small group differences in level and dispersion frequently create huge upper tail ratios when stringent cutting scores are implemented (e.g. for select educational and training opportunities). Asian and Jewish populations, for example, typically manifest superior test scores, relative to the general population, and are overrepresented when stringent selection is applied to test scores. Feingold (1995) presents data on sex differences and considers implications for group differences more generally. For example, meta-analytic reviews focus on level or aggregating effect sizes (differences in standard deviation units), but groups may also differ in variability, which meta-analyses typically do not address. Feingold highlights the importance of examining both.

Sex Differences Most investigators concur on the conclusion that the sexes manifest comparable means on general intelligence (Halpern 1992); yet, there is some evidence for slightly greater male variability (Eysenck 1995, Jensen 1998, Lubinski & Dawis 1992). With respect to level, Jensen (1998) has provided a particularly detailed presentation of this topic, including an innovative methodology for arriving at this conclusion. However, a number of investigators—including Jensen (1998), using his new method—have reached a different consensus about sex differences in strengths and relative weaknesses on specific abilities (Benbow 1988, Geary 1998, Halpern 1996, Hedges & Nowell 1995, Stanley et al 1992). Females appear to excel in certain verbal abilities, males in certain mathematical and spatial abilities. Hedges & Nowell (1995) published probably the most compelling contemporary analysis on this topic. They analyzed data from six large-scale studies collected between 1960 and 1992. Their analysis is important because, as they point out, many studies on sex differences are based on nonrandom samples, whereas their probability samples consisted of stratified random samples of U.S. populations. This study compiled data from Project Talent, National Longitudinal Study of the High School Class of 1972, National Longitudinal Study of Youth, High School and Beyond 1980, National Educational Longitudinal Study 1988, and National Assessment of Educational Progress. Means, variances, and upper tail ratios >90% and >95% were computed. Findings were consistent with other reports: Females tend to score higher on several verbal/linguistic measures, while males score higher in certain quantitative and spatial/mechanical abilities. Moreover, with respect to spatial/mechanical abilities, males display higher means and larger variances on nonverbal reasoning tests, which, again, generate huge upper tail ratios. Hedges & Nowell (1995) discuss implications of these findings for male/female proportions in math/science domains.

Race Differences Clearly, the most contentious area of contemporary research on individual differences is found in Black/White contrasts (Gordon 1997). The most noteworthy group difference in this regard is the approximately one standard deviation difference on the general factor mean, with Whites scoring higher than Blacks. There are other group differences as well. For example, Hispanic populations tend to score intermediately between Blacks and Whites, whereas Asian and Jewish populations are score slightly higher than Whites (Gottfredson 1997). Nevertheless, Black/White contrasts have generated the best data (Humphreys 1988, 1991) and, by far, the most attention (Campbell 1996). Over the years, these differences have motivated intense study of test bias (especially underestimating the performance of underrepresented groups). Some benchmarks are found in an *American Psychologist* (1965) special issue and two APA task force reports (Cleary et al 1975, Neisser et al 1996). Jensen (1980) is still an excellent source on test bias. Given that these reports, compiled over four decades, reached the same conclusion found in two National Academy of Science reports (Wigdor & Garner 1982, Hartigan & Wigdor 1989), an empirical generalization can be ventured: Professionally developed general ability measures do not underpredict performance of underrepresented groups.

Flynn Effect Observed scores on intelligence tests have been steadily rising cross-culturally over this century. These raw-score increases on measures of general intelligence have been labeled the "Flynn effect," after the investigator who documented their occurrence (Flynn 1999). Whether these increases reflect genuine gains in *g* is, however, unclear. Increases can occur due to increases on a measure's construct relevant or construct irrelevant (nonerror unique) variance, or both. The problem is complex and has generated considerable discussion (Neisser 1998). As yet, a final answer is not available. However, evidence that changes are due, at least in part, to construct irrelevant aspects of measuring tools is available.

Across various *g* indicators, the Flynn effect is positively correlated with the amount of nonerror uniqueness. For example, gains on the Raven matrices are greater than gains on verbal reasoning composites of heterogeneous verbal tests, which, in turn, are greater than gains on broadly sampled tests of *g* (aggregates of heterogeneous collections of numerical, spatial, and verbal problems). The Raven matrices consist of approximately 50% *g* variance, whereas heterogeneous collections of cognitive tests aggregated to form a measure of *g* approach 85% (Lubinski & Humphreys 1997). (Broad verbal reasoning tests are intermediate.) Complexities are added by considering that test scores have probably increased (especially at the lower end of general intelligence) due to advances in medical care, dietary factors, and educational opportunities (Jensen 1998). Yet, at high levels of *g*, the gifted appear to have suffered some setbacks as a consequence of being deprived of developmentally appropriate opportunities—a challenging curriculum at the appropriate time (Benbow & Stanley 1996). This topic deserves intense study for a number of reasons (Moffitt et al 1993, Schaie 1996), one of which is especially noteworthy. Sorting out the complexities involved in assessing dysgenic trends (Loehlin 1997, Lynn 1996, Williams & Ceci 1997) is predicated on understanding the causal determinants of raw score fluctuations on measures of *g*.

Whatever these raw score gains are ultimately attributed to, they do not, as some have indicated, appreciably detract from the construct validity of measures of *g*. Mean gains on construct valid measures do not speak to changes in internal or external covariance structure (Hunt 1995). Populations at contrasting levels of development, for example, typically manifest the same covariance structure with respect to the trait indicators under analysis (Rowe et al 1994, 1995).

Horizontal and Vertical Inquiry The idea that constructs may be analyzed at different levels of analysis is well known. For example, Embretson (1983) has contributed an important distinction to the construct validation process. She suggests a parsing of the nomological network into two regions: construct representation versus nomothethic span. The latter denotes the network of empirical relationships observed with measures at the behavioral level, whereas the former is aimed at underlying processes or mechanisms responsible for generating these phenotypic manifestations. Jensen (1998) has likewise pointed to two lines of empirical research on *g*, one vertical and the other horizontal. Both lines dovetail with MacCorquodale & Meehl's (1948) distinction between hypothetical constructs (HC) and intervening variables

(IV). Although both concepts carry denotative and explicative meaning, hypothetical constructs stress explanation, whereas intervening variables are more restricted to description. Spearman's (1927) initial formulation of *g* as "mental energy," was a HC, whereas the parameters describing the functional relationships between conceptually equivalent measures of *g* and external criteria were IVs. When cross-disciplinary linkages are drawn, the HCs of one discipline can become the IVs of another, but that discussion is beyond the scope of this review (see Maxwell 1961). What is important for our purposes is that connecting threads have been established between *g* and several biological phenomena. Ultimately, the causal paths of these interrelationships will need to be traced.

Pooling studies of a variety of kinship correlates on IQ (e.g. MZ and DZ twins reared together and apart and a variety of adoption designs), the heritability of general intelligence in industrialized nations has been estimated to be between 60%–80% (Hetherington et al 1994, McGue & Bouchard 1998). Using magnetic resonance imaging (MRI) technology, brain size controlled for body weight covaries 0.30–0.40 with general intelligence (Bouchard 1999, Jensen 1998, Willerman et al 1991). Haier (1993) reports that glucose metabolism is related to problem-solving behavior, and that the gifted appear to engage in more efficient problem solving behavior that expends less energy. Also, highly intellectually gifted individuals evince enhanced right hemispheric functioning (Haier & Benbow 1995, O'Boyle et al 1995). The complexity of electroencephalograph (EEG) waves is positively correlated with *g*, as are amplitude and latency of the average evoked potential (AEP) (Lutzenberger et al 1992). Some investigators have determined the negative correlation between *g* and inspection times, assessed through chronometric procedures, to be a biological phenomenon (Deary 1996). Anderson (1993) suggested that dendritic arborization is correlated with *g*. Although Anderson typically examines histological data across groups of individuals with documented IQ differences, he also has conducted an intriguing case study involving Albert Einstein's brain (Anderson & Harvey 1996). In contrast to a control group of autopsied men, the frontal cortex of Einstein's brain possesses a significantly greater neuronal density (cf. Diamond et al 1985). Given this, the following was perhaps inevitable: A multidisciplinary team appears to have uncovered a DNA marker associated with *g* (Chorney et al 1998).

It is virtually guaranteed that more biological linkages will be made to *g* (Vernon 1993). Like those already uncovered, they are likely to be heterogeneous and to vary in strength of association with *g*. These biological phenomena are in no way mutually exclusive and can be complementary to one another. Some may transcend phylogenetic orders and thus enhance our comparative understanding of general learning phenomena (Anderson 1993, 1994a,b, 1995). One provocative conjecture is the myelination hypothesis (Miller 1994): Individual differences in cognitive efficiency are a function of individual differences in the amount of myelin (the fatty substance coating the neurons).

Proximal and Ultimate Examinations of g Given the biological connections to *g* (Vernon 1993), some researchers have gone beyond these proximal associations to speculate on their ultimate evolutionary basis. Bouchard et al (1996) have revised experience producing drives (EPD) theory, which speaks to human intellectual development. EPD theory-revised is a modification of an earlier formulation by Hayes (1962), a comparative psychologist and pioneer in language and socialization capabilities of nonhuman primates. His idea was that, like all organisms, humans were designed to do something, and that they possess EPDs to facilitate ability and skill acquisition through inherited dispositions that motivate individuals toward particular kinds of experiences and developmental opportunities. Such evolutionary selective sensitivities can operate, moreover, in a wide range of functionally equivalent environments (which fits with the idea that humans evolved in a highly fluctuating environment).

Other investigators have sought a synthesis between evolutionary psychology and chronometric procedures for measuring inspection time (Deary 1996). Inspection time is a measure of speed of perceptual discrimination on "simple" elementary cognitive tasks (responses to stimulus configurations that typically take less than one second for average adults to perform with essentially zero errors). Theoretically, performance on elementary cognitive tasks indexes the time course of information processing in the nervous system. There are a variety of technical measurement issues surrounding this area of research, but it does appear that the temporal dynamics of performance on elementary cognitive tasks covaries negatively with *g* (faster processing is associated with higher *g* levels). Washburn & Rumbaugh (1997) used inspection time measures to successfully assess individual differences in cognitive sophistication among nonhuman primates.

This intriguing line of research might provide a vehicle for comparative psychological inquiry into the biological underpinnings of general cognitive sophistication, comparable with what the sign-language modality fostered for language learning in nonhuman primates. This is certainly not far-fetched. Investigators have long remarked on the range of individual differences within primate conspecifics. For example, Premack (1983:125) noted in his discussion of language versus nonlanguage-trained groups of chimpanzees, "Although chimpanzees vary in intelligence, we have unfortunately never had any control over this factor, having to accept all animals that are sent to us. We have, therefore, had both gifted and nongifted animals in each group. Sarah is a bright animal by any standard, but so is Jessie, one of the non-language trained animals. The groups are also comparable at the other end of the continuum, Peony's negative gifts being well matched by those of Luvy."

Individual differences in processing stimulus equivalency (verbal/symbolic) relationships have been postulated by some experimentalists to index general intelligence (Sidman 1986). If such individual differences are ultimately linked to individual differences in central nervous system microstructure within and between the primate order, and these in turn are linked to observations like Premack's "teacher ratings," all of the ingredients are assimilated for advancing primate comparative psychology. The language-communicative performances now routinely displayed by chimpanzees and, especially, pigmy chimpanzees are truly remarkable (Savage-Rumbaugh et al 1993, Savage-Rumbaugh & Lewin 1994, Wasserman 1993). They encompass sign-language reports of emotional states and conspecific tutoring (Lubinski & Thompson 1993). Savage-Rumbaugh et al (1993) have connected these nonhuman primate findings with those from child language-development research. Will primate comparative-examinations someday provide clues to human individuality? If individual differences in acquiring cognitive skills could be linked to more fundamental biological mechanisms (like the phenomena discussed above), we might have an especially powerful lens through which to view common phylogenetic processes involved in cognitive development. Research developments on this front will be interesting to follow. Perhaps they might even obviate Wilson's (1998:184) recently expressed concern: ''[S]ocial scientists as a whole have paid little attention to the foundations of human nature, and they have had almost no interest in its deep origins.''

Interests

Interests have played a large role in differential psychology since the 1920s. Longitudinal inquiry comprising both temporal stability analyses (reliability) and forecasts of occupational group-membership (validity) established these measures as among the most important in applied psychology (Harmon et al 1994, Savickas & Spokane 2000). Going beyond adult populations, assessments conducted at more developmentally inchoate stages revealed that interests begin to crystallize during adolescence. They can forecast antecedents to occupational choice (e.g. college major) and, as such, serve as important tools in educational contexts (Dawis 1992). An especially critical aspect of these longitudinal studies is their incremental validity (Austin & Hanisch 1990, Humphreys et al 1993): Interests contribute important information relative to abilities. Further, the validity generalization of the unique contribution of interests has been extended to special populations. For example, Achter et al 1999 recently reported that age 13 interest assessments, among intellectually gifted students, forecast educational choice (four-year degree) over a 10-year temporal gap and add incremental validity to ability assessments. These are scientifically significant tools, which (like cognitive abilities) are predictive of a broad spectrum of criteria ranging from (core) educational/vocational settings to (more peripheral) activities in everyday life (Dawis 1992, Hogan et al 1996).

Although early research on interests was atheoretical, using empirical keying (group contrast) methodology to literally form a scale for every occupation, over the past few decades the push for deriving a general model of interest dimensions has intensified. A hexagonal structure of interest dimensions emerged (Holland 1996), which is helpful for understanding how people approach and operate within learning and work environments. Holland's model is defined by six general interest themes known as RIASEC: *r*ealistic [working with things and gadgets], *i*nvestigative [scientific pursuits], *a*rtistic [aesthetic pursuits and opportunities for self-expression], *s*ocial [people contact and helping professions], *e*nterprising [corporate environments: buying, marketing, selling], and *c*onventional [office practices and well-structured tasks].

While RIASEC is not embraced by everyone (Gati 1991), it is the most popular model available and, like the hierarchical organization of human abilities and personality's five-factor model (discussed below), innovative frameworks will need to be measured against it. RIASEC has emerged repeatedly in large samples (Rounds & Tracey 1993, Tracey & Rounds 1993), and its generalizability has held up cross-culturally (Day & Rounds 1998). RIASEC is organized around Holland's (1996) calculus assumption, which states that adjacent themes are most highly correlated, and opposite themes least correlated. Prediger (1982) has argued that Holland's model can be reduced to two relatively independent dimensions: people versus things, and data versus ideas. The former runs from Holland's social (people) to realistic (things) themes, whereas the latter runs perpendicular to people versus things splitting enterprising and conventional (data) and artistic and investigative (ideas). Prediger's two-dimensional model fits, as he maintains, within RIASEC, but most investigators feel that the parsimony achieved through this two-dimensional collapse does not offset the richness that is lost. Nevertheless, Prediger's work is important.

While the sexes do not appear to differ appreciably on data versus ideas, they routinely differ by a full standard deviation on people versus things (females tend to gravitate toward the former, males toward the latter). For example, Lippa (personal communication) computed all the effect sizes (female minus male) in his interesting multi-study article on the people versus things dimension (Lippa 1998). For all three studies, effect sizes were ≥ 1.20 on people versus things. This is typical, reflecting perhaps the largest of all sex differences on major psychological dimensions.

To be sure, there are more specific interest dimensions beyond RIASEC that carry psychologically significant import [religiosity being a noteworthy example (Waller et al 1990; see also Harmon et al 1994, Savickas & Spokane 2000)]. Nevertheless, RIASEC constitutes a cogent outline of this important arena of psychological diversity. Interestingly, like the constituents found in the hierarchy of human cognitive abilities, antecedents to RIASEC may be traced over many decades. RIASEC exemplifies how, through careful research (including cross-cultural inquiry), the nature and organization of an important domain can be successively clarified. Guilford (1954), for example, examined and discussed very similar structures: mechanical, scientific, aesthetic expression, social welfare, business, and clerical. Holland's (1996) model stands on the shoulders of much that has gone before it.

As in our earlier discussion of range truncation (Olympic athletes), the most important dimensions for steering individuals to specific opportunities and settings are often uniformly high. With respect to forecasting continuous work-related criteria, range truncation among incumbents may generate equivocal empirical findings. So, with respect to predicting job satisfaction,

> A number of explanations can be advanced to account for the mixed results found for interests. If . . . subjects of follow-up studies were the survivors of a selection process, one might infer that in this process, the dissatisfied would have tended to leave, whereas the satisfied—and satisfactory—would have tended to remain. The restriction of range that would result could contribute to

> the lowering of the true correlations. Unfortunately, the means and standard deviations of variables frequently go unreported so that a straightforward check on this simple explanation is often thwarted (Dawis 1991:851–52).

Indeed, psychological research would be more informative if it routinely described samples with means and standard deviations on major dimensions of abilities, interests, and personality for purposes of ecological validity. Doing so would reveal that some perplexing findings stem from nonrepresentative sampling.

Personality

A consensus has emerged on the major personality dimensions, but it is more opaque than for cognitive abilities and interests. Although the dimensions reviewed here appear relatively independent of abilities and interests (Ackerman 1996, Ackerman & Heggstad 1997), it is something of a misnomer to reserve the term "personality" for them. One could argue that abilities and interests are salient aspects of personality. (Cattell [1971], for example, thought so.) Like garden-variety personality measures, abilities and interests are enduring features of one's psychological make-up (Bouchard 1997, Rowe 1994, Scarr 1996). A complete understanding of one's character or reputation (Hogan et al 1996) is incomprehensible without them. Thus, while thinking about personality, it is important to keep in mind the wisdom of the great counseling psychologist, Roe, whose words are as true today as they were when she published them:

> I have become more and more convinced that the role of occupation in the life of the individual has much broader psychological importance than has generally been appreciated. I believe that psychological theory could profit greatly from the kinds of satisfactions that can be found in work. This is as true for developmental theory as it is for motivational theory . . . If one wishes to understand the total psychology of any person, it is at least as important to understand . . . occupational behavior as it is to understand . . . sexual behavior. (They are not unrelated.) . . . The fact is, of course, that one can start with any facet of human behavior and work through it to the 'total personality' (1956:vi).

With this in mind, and acknowledging that some of the best contemporary evidence for the scientific significance of broad dimensions of personality is found in predicting vocational criteria (Hogan et al 1996, Hough 1997), an examination of recent advances in personality follows.

The Big Five The intensity of work on the dimensionality of personality during the 1980s and 1990s is comparable to that of validity generalization in abilities during the 1970s and 1980s. This work has been productive. For the most part, examinations of personality have followed the "lexical" approach suggested by Galton (1884), namely, that important dimensions of human behavior will be encoded in natural language for economy of thought. Hence, the dictionary, when systematically examined, should prove an invaluable source for identifying personality characteristics (Allport & Odbert 1936). A working model of descriptors from the dictionary is available: the "big five" (McCrae & Costa 1997) [but see Block's (1995a) "contrarian view" and replies from Costa & McCrae (1995) and Goldberg & Saucier (1995), and Block's (1995b) rejoinder].

Labels for the big five have varied, but include Extraversion (surgency, positive emotionality), Neuroticism (anxiety, negative emotionality), Agreeableness (antagonism reversed), Conscientiousness (will to achieve), and Openness (culture, intellect). Like abilities and interests, these five generic factors have a long history in psychology. For years, they were simply referred to as "Norman's five," following Norman's (1963) seminal treatment. However, the same dimensions surfaced at least 50 years ago (Fiske 1949) and were subsequently supported by large-scale analysis of military samples (cf Tupes & Christal 1992, initially published in 1961). It should be noted that Eysenck (1995) felt that conscientiousness and agreeableness can be combined to form his psychoticism (reversed) dimension, thus supporting his preference for a three-dimensional model (the "big three"): extraversion, neuroticism, and psychoticism.

The Big Seven Waller (1999) has traced decisions concerning the item pool that Allport & Odbert (1936), Cattell, and Norman considered relevant to "authentic traits." Subsequent investigators who consulted Allport and Odbert's categorical lists apparently excluded practically all evaluative terms from efforts to develop scales of the basic dimensionality of personality. Terms such as special, important, immoral, disloyal, and nasty were not routinely examined in attempts at mapping personality.

For several years now, Tellegen and Waller have studied evaluative terms by systematically sampling from the dictionary (Tellegen 1993, Tellegen & Waller 2000, Waller 1999). They have a questionnaire purporting to assess evaluative traits and the Big Five dimensions (Tellegen et al 1991). Their analysis appears to warrant seven dimensions: the big five and Positive and Negative Valence. Positive Valence depicts a dimension with positive loadings on "outstanding," "first-rate," "excellent," "remarkable," which form a continuum from ordinary-to-exceptional, or common-to-impressive. Negative Valence is captured by terms such as "cruel," "evil," "wicked," and "sickening," which portray a continuum from worthy-to-evil, or decent-to-awful. These two dimensions have held up cross-culturally (Almagor et al 1995, Benet & Waller 1995). Because these highly evaluative terms were prematurely jettisoned from empirical analyses until recently, there has not been an opportunity to demonstrate their importance.

Interpretation and Future Directions Tellegen (1993) has suggested that major dimensions of personality have adaptability import. Individual differences reflect one's "preparedness" or "tuning" to affordances in the social landscape (see also Snow 1991). Tellegen's (1993) big seven studies motivated him to adopt somewhat different labels (with the following interpretations). "Positive and Negative Valence reflect primal readiness to encode power and evilness; Positive Emotionality and Negative Emotionality reflect built-in responsiveness to signals of emotion and emotional-temperamental dispositions; and Dependability, Agreeability, and Conventionality (vs. Unusualness) reflect protoscientific propensities to encode a person's predictability, controllability, and comprehensibility, respectively" (1993:126). Tellegen also has advanced the idea that we consider these "folk concepts" as distinguished from psychological concepts advanced to describe or explain psychological phenomena and processes. Recent advances have placed personological inquiry into the broader context of evolutionary theory (Hogan & Hogan 2000).

CONSTELLATIONS

Hogan et al (1996) have recently cautioned against examining personality dimensions individually because the manner in which each operates depends on the full constellation of personal characteristics. Two extroverts will operate quite differently, for example, if their standings on conscientiousness are diametrically opposed. The point is well-taken, but the evidence indicates that we should move beyond Hogan et al's (1996) recommendation (sound as it is) and intermingle cross-domain attributes. Like contrasting constellations of personality attributes, similar interest and ability patterns often produce markedly different phenotypes as a result of differences on dimensions from other classes. The paths traveled by two spatially gifted students are likely to be quite distinct if, for example, they occupy contrasting locations on "people versus things." Assuming that more comprehensive assessments will enhance psychological theory and practice, some approaches that go beyond domain-constrained treatments follow.

Intellectual Development

Ackerman (1996, Ackerman & Heggstad 1997) has proposed an intriguing model of adult intellectual development that orchestrates abilities as process, personality, and interest dimensions simultaneously to describe changes in cognitive content and processes throughout the life span. Content denotes the pedagogical aspects of learning (knowledge), whereas process is more restricted to power of intellect [or e.g. working memory capacity (Carpenter et al 1990, Kyllonen & Christal 1990), perhaps a modern conceptualization of Spearman's (1927) mental energy]. Ackerman's theory is called PPIK, for intelligence-as-process, -personality, -interests, and -knowledge. Interests and personality attributes channel the development of knowledge structures down different paths, for example, CP Snow's (1967) two intellectual cultures, while intelligence-as-process determines the complexity and density of the knowledge assimilated. Ackerman's approach is reminiscent of Cattell's (1971) early formulation of investment theory, where fluid abilities are invested in the development of crystallized abilities as a function of nonintellectual personal attributes. Intellectual bodies develop from a common multidimensional core (abilities, interests, and personality) that are seemingly quite generic cross-culturally (Carroll 1993, Day & Rounds 1998, McCrae & Costa 1997).

This model provides an insightful basis for uncovering why individuals with similar cognitive profiles can, and frequently do, vary widely in their knowledge base or "crystallized abilities." Ackerman (1996, Ackerman & Heggstad 1997) has compiled ability/interest, ability/personality, and interest/personality correlates to support PPIK. Analysis has distilled four across-attribute (ability/interest/personality) trait complexes. They are social, clerical/conventional, science/math, and intellectual/cultural. Intellectual/cultural, for example, reflects light correlations between verbal ability and aesthetic and investigative interests, whereas science/math reflects light correlations between math/spatial abilities and realistic, investigative and social (reversed) interests. The psychological import behind these trait complexes is similar to Snow's (1991) aptitude complexes (ability + interest constellations for classifying educational treatments), and Dawis & Lofquist's (1984) taxons (ability + preference constellations for conceptualizing transactions between individuals and work environments; see below).

PPIK might be especially relevant to contexts where knowledge is more important than intellectual processing abilities for predicting performance (Ericsson 1996). Examinations of expert performance (Rolfhus & Ackerman 1996), for example, have often revealed that the greatest difference between experts and nonexperts is in the richness and depth of the knowledge structures of the former. Ackerman also has developed a typical intellectual engagement (TIE) measure for assessing how much an individual is likely to invest in developing his or her intellectual abilities. However, this measure tends to covary more deeply with humanistic than scientific knowledge domains (Ackerman 1996). Therefore, multiple TIE measures might be required to capture the multiple motives involved in developing intellect. Perhaps distinct TIE should be developed for each PPIK trait complex. Given that the current TIE is primarily relevant to the humanities, a more descriptively apt label might be "TIE-verbal/humanistic" (for trait complex: intellectual/cultural). A TIE measure focusing more on nonverbal ideation might better forecast development in more technical domains: "TIE-science/math" (for trait complex: science/math).

What one knows (knowledge) and how sophisticated one is at manipulating what one knows (thinking) are ostensibly two different things. Yet, with respect to measurement operations, content and process (knowledge and thinking) always have been inextricably intertwined (Roznowski 1987). As Ackerman (1996:245) remarks: "[A]n individual can strive for breadth of knowledge or depth of knowledge, but there is a trade off between these two orientations. Only the most exceptional intellectual talent will allow for high levels of knowledge domain depth and breadth.'' Does ''exceptional intellectual talent'' primarily stem from one dimension or two? Perhaps breadth and depth combine to map *g* in a manner analogous to area; or perhaps speed should be added to assess this central dimension akin to measuring volume? It seems as though we always return to Spearman's *g* in one way or another—a dominant dimension whose scientific significance is central. These observations notwithstanding, PPIK clearly takes an important step forward in conceptualizing the nature of intellectual development.

Vocational Adjustment

Are you able to do it? Are you happy doing it? Throughout most of this century, in one form or another, vocational psychologists have been asking clients these two questions. Often data were collected to help clients whose reactions were initially uncertain or unclear. Dawis & Lofquist (1984, Lofquist & Dawis 1991) developed a system to conceptualize vocational adjustment and counseling, the theory of work adjustment (TWA). TWA is helpful for understanding why abilities and interests show incremental validity relative to each other in learning and work settings. Katzell (1994), reviewing volumes one through three of the *Handbook of Industrial and Organizational Psychology*, used TWA as an integrative framework to synthesize research literature in I/O psychology. TWA has been applied to designing learning environments throughout the life span (Lubinski & Benbow 2000), and the *Journal of Vocational Behavior* (1993) has a special issue on TWA.

TWA is predicated on two dimensions: satisfaction and satisfactoriness. Satisfaction is a function of the correspondence between a person's preferences (needs, interests, and values) and the rewards offered in a particular occupational setting or career path. Satisfactoriness is determined by the correspondence between one's abilities and the competency requirements needed for effective performance in a given occupation. Equal emphasis is placed on assessing the individual and the environment; both are assessed in commensurate terms; and, when a high degree of correspondence is achieved across both dimensions (i.e. the individual is feeling satisfied and is performing satisfactorily), a symbiotic relationship develops to sustain the joint person-environment interaction. When satisfaction is high but satisfactoriness is low, the environment is likely to terminate the relationship; when the inverse occurs, the person is more likely to break off the relationship.

TWA uses the term ''taxon''—akin to Ackerman's ''trait complexes'' and Snow's ''aptitude complexes''—to depict ability-preference constellations related to differential performance and enjoyment outcomes within the world of work. Supporting data are found in two books (Dawis & Lofquist 1984, Lofquist & Dawis 1991), as well as throughout the applied psychological literature examining how ability/preference constellations fit into relatively well-defined ecological settings (e.g. educational tracks, military classification systems, occupations). As Katzell (1994:13) noted, ''[a]though not derived specifically from the theory, there have been many practical applications of parts of it in industry, such as the prediction of turnover from job satisfaction and the matching of ability with job requirements to predict performance.'' Support for TWA's validity is seen in positive results for Schneider et al's (1995) attraction-selection-attrition (ASA) model and the gravitational hypothesis (Dunnette 1998, Wilk et al 1995, Wilk & Sackett 1996). The basic idea is that people select environments congenial to their personal attributes and style of life and migrate from those that are not good fits.

Work Performance

The opening sentence of Schmidt & Hunter's (1998:262) review of 85 years of research on selection methods in personnel psychology is consistent with the desire of applied psychologists to uncover longitudinally stable dimensions: ''From the point of view of practical value, the most important property of a personnel assessment method is the predictive validity.''

Work performance is an important area of applied psychology, not only in terms of a society's economic well-being in internationally competitive markets, but also in terms of the emotional and physical well-being of citizens within a society (Hunter & Schmidt 1996, Schmidt & Hunter 1998). For a poignant example, see Hunter & Schmidt's (1996) powerful and compelling illustration of factors associated with the time it takes to catch a rapist (measured in number of crimes committed). Huge individual differences are found between competent and excellent police officers, in the effectiveness of their work and how expeditiously justice is served. When consulting with legal officials, Hunter & Schmidt point out that lawyers frequently appreciate individual differences between competent and poor workers, but they have a rather poor appreciation of differences between competent and exceptional workers.

Laypersons are unaware of the two primary ways to assess individual differences in performance: dollar value of output and percent of mean output. At minimum, the standard deviation of the dollar value of output across individuals has been found to be 40% of the mean salary of the job. Hence, if the average salary for a job is $50,000, the standard deviation of employees' dollar-value output is $20,000. The difference, therefore, between above-average workers (e.g. one standard deviation above the mean) and below-average workers (e.g. one standard deviation below the mean) would be: $70,000 − $30,000 = $40,000. Work performance measured as a percentage of mean output would be estimated as follows: An employee's output would be divided by the output of workers at the 50th percentile and then multiplied by 100. The standard deviation of output as a percentage of average output is moderated by job level. Schmidt & Hunter's (1998) review found that percentage to be around 19% for unskilled and semi-skilled jobs, 32% for skilled jobs, and 48% for managerial and professional jobs. There is an old saying in applied psychology: For a difference to be a difference it must make a difference.

In view of these important differences, uncovering predictors to model work performance has attracted much attention. This was anticipated in Lerner's (1983) discussion of ''human capital.'' Research has added to validity generalization studies of the past two decades by combining personality measures with abilities. Conscientiousness, for example, adds incremental validity with probably as much breadth (but not quite as much depth) as general ability measures to predictions for many occupations. The longstanding belief that personality measures do not contribute to individual differences in work performance is not true. 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. Moreover, the troubling group differences on abilities reviewed earlier are not found on these measures, so personality measurement has the potential to minimize adverse impact. There are, however, differences in opinion on how best to carve up personality for predicting work performance (Hough 1997). Nevertheless, there is widespread agreement that increments in predicted performance beyond ability are achievable through personality assessment. These increments are especially evident when studying peak performance.

Creativity and Eminence

A number of dimensions relevant to creativity have been identified. Interestingly, they are similar to Galton's (1869) necessary ingredients for eminence. Investigators operating within frameworks distinct from differential psychology have confirmed many of these (Gardner 1993). A deeper appreciation of this area is gleaned by combining the differential psychology of Eysenck (1995) with the work of Gardner (1993) and Simonton (1990, 1994). These treatments are not incompatible and, in many respects, the latter two attach idiographic flesh to the normative skeleton outlined by Eysenck (1995). They also enlarge classics such as Roe's (1953) *The Making of a Scientist* and Zuckerman's (1977) *Scientific Elite.*

Galton defined genius (the ultimate label for one's track record of creative accomplishments leading to eminence) in terms of reputation: "those qualities of intellect and disposition, which urge . . . acts that lead to reputation, I do not mean capacity without zeal nor zeal without capacity, nor even a combination of both of them without an adequate power of doing a great deal of very laborious work. But I mean a nature which, when left to itself, will, urged by an internal stimulus, climb the path that leads to eminence, and has the strength to reach the summit—one which, if hindered or thwarted, will fret and strive until the hindrance is overcome . . . " (1869:33).

For criterion measurement, Eysenck (1995) and Simonton (1990, 1994) have adopted Galton's view for calibrating eminence. In Simonton's (1990) investigations into the psychometric properties of reputation assessments (using informed judges), he has reported internal consistency reliability coefficients >0.85 for artistic distinction, philosophical eminence, and scientific fame.

The dispositional package that Galton outlined is in agreement with modern views, although Galton went too far in attributing eminence almost exclusively to personal attributes. Today, spectacular forms of creativity, like lesser forms, are seen as confluences of endogenous and exogenous determinants, rather than primarily the former. Cultural factors and the zeitgeist play critical roles.

What attributes predict eminence? The personal attributes of individuals at the top of their respective domains include the anticipated (ability + interest) constellations (aptitude complexes, trait complexes, and taxons) that distinguish individuals in their chosen domain or profession from the general population. However, more intense abilities are characteristic (and more is better) (Benbow 1992). For example, extraordinary engineers and physical scientists possess pronounced quantitative-spatial abilities and interests in investigative and realistic pursuits, whereas humanists possess higher verbal abilities, relative to nonverbal abilities, and preferences for artistic and social arenas. Yet, what appears to move the highly creative apart from their peers is their passion for work. They are exceptional in their industriousness and perseverance; they tend to be almost myopically fixated on work. This is something well-known among academic scientists who train academic scientists (cf Wilson 1998:56). (Edison's familiar 1% inspiration 99% perspiration also comes to mind.) The sheer amount of time devoted to their area of excellence is one of the most exceptional things about them. Zuckerman's (1977) account of the extraordinary efforts that Nobel Laureates displayed to reach the right teachers (who were almost always Laureates themselves) supports this.

On the other hand, some antecedents contributing to the enormous energy reserves of certain individuals are not necessarily positive. For example, Jamison (1993) has observed a higher incidence of manic-depressive disorders among creative writers and artists. Jensen (1996) has discussed other endogenous factors pertinent to cortical stimulation, for example, blood serum urate (a cortical stimulant) level (SUL). Interestingly, SUL covaries positively with achievement. Eysenck (1995) focuses on other neurochemical underpinnings posited to give rise to "zeal" (Galton 1869).

In part because of the intensity with which these individuals approach their work, the highly creative, as a group, are also known to be difficult in interpersonal relationships, socially harsh, and abrasive. Gardner (1993) has discussed the "casualties" surrounding these individuals as they steadfastly focus on their work to the exclusion of other aspects of life. He discusses the "mixed blessings" associated with being close to such individuals. This supports Eysenck's (1995) view that the highly creative are, on average, high on trait psychoticism (or conscientiousness + agreeableness in reverse). Following Eysenck, this, among other things, enables the highly creative to look at things quite differently (unconventionally).

What appears to draw individuals toward particular environments, people, and opportunities is, in part, the personal attributes that they possess; but once in these arenas, what actually happens is contingent on opportunity. It might be helpful to construe dispositional antecedents to exceptional forms of creativity as "emergenic phenomena" (Lykken et al 1992), namely, the proper configuration of personal attributes [including the psychological endurance necessary for developing and maintaining exceptional performance (Ericsson 1996)]. When such constellations find supportive environments, then, and only then, does Galton's depiction hold. Jensen (1996) maintains that: genius = high ability × high productivity × high creativity.

Underpinning this equation, ability = information processing efficiency, productivity = endogenous cortical stimulation, and creativity = trait psychoticism (unconventional ideation). This suggests kinds of inquiry that must at least be entertained for understanding how products that change culture develop and, ultimately, how such achievements are best facilitated, as well as inadvertently suppressed.

Crime

When Cronbach & Meehl (1955) introduced construct validation, they exemplified the process by compiling a heterogeneous collection of findings all related to the psychopathic deviate (*Pd*) scale of the Minnesota Multiphasic Personality Inventory. How, they asked, could a scale developed to isolate criminals and delinquents from the general population also reveal elevated scores for: Broadway actors, high-school dropouts, deer hunters who accidentally shoot people, police officers, and nurses who were rated by their supervisors as not especially afraid of psychotic patients? (Note this was before wide use of psychoactive drugs, when patients routinely experienced frightening psychotic episodes.) *Pd* also covaries negatively with trustworthiness ratings. What underlying construct representation could possibly support this nomothetic span?

Two years later, Lykken (1957) published positive findings for what these groups have in common: Relatively speaking, they are fearless or in possession of a "low anxiety IQ." Using a Pavlovian paradigm, Lykken showed that, as a group, hardened criminals, when contrasted with random samples of inmates, were "retarded" when it came to developing conditioned responses to neutral stimuli paired with shock. This has been replicated and studied in several laboratories, albeit with somewhat different labels and measures: "socialization" (reversed), "danger seeking," or "sensation seeking" (Wilson & Herrnstein 1985, Lykken 1995).

As Lykken (1995) points out, however, being fearless does not prescribe a particular developmental path. This is the stock from which astronauts, poised law enforcement officials, firefighters on elite rescue teams, war heroes, and fighter pilots are grown. When coupled with other attributes and opportunities, being fearless can be an asset. However, it can also be a liability because it makes conventional socialization procedures difficult. For instance, when low fearfulness is combined with agreeableness + conscientiousness (reversed), a 75–90 IQ range, mesomorphic body build, and reared in an abusive crime-ridden environment, a high-risk liability emerges (Lykken 1995, Wilson & Herrnstein 1985). One of the handicaps faced by individuals within lower IQ ranges is a limited temporal horizon, a deficit in foreseeing temporally remote consequences of actions.

Fortunately, however, if Lykken (1995) is correct, a "type like" psychopath is relatively infrequent, relative to the proportion of individuals engaged in criminal behavior. He suggests that most criminal behavior stems from a larger group of individuals—sociopaths who, with proper parenting, could have been socialized away from a life of crime. He adds that, while the behavior genetic data are compelling (for the major individual-differences dimensions of his model), typical twin and adoption studies do not include families deeply enmeshed in illegal activities. The behavior genetic studies are restricted to environmental ranges not abnormally deviant from the population norm. Lykken (1997) argues, however, that interventions are most likely to be effective in these maladaptive environments (but see Rowe 1997).

Health Risk Behavior

"If public health officials understood the characteristic behaviors, thoughts, and feelings of those young persons who engage in health-risk behaviors, they could be in a better position to design health campaigns and educational programs that would appeal to their target audience" (Caspi et al 1997:1053). Repeatedly, longitudinal inquiry has uncovered the significance of individual differences in channeling the development of harmful maladies not only to the individual at risk (Gordon 1997, Lubinski & Humphreys 1997, Schaie 1996) but to others occupying their purview.

Like contemporary treatments of creative achievement and crime, contemporary discussions of health risk behaviors are related to "delay of gratification" phenomena, which can have multiple (ability + personological) antecedents. Outcomes emanating from both wise and unwise actions, and conscientious versus risky behavior, are often not precipitous. They frequently develop slowly over time to result in a life threatening condition, an ostensibly discrete arrest, or a seemingly effortless masterpiece. Short-lived behavioral episodes are often products of years of development. Just as the development of excellence is in part traceable to comprehending the temporally remote consequences of immediate practice, aspects of maladaptive behavior are due to a limited temporal horizon.

Life Span Development

Scarr (1992, 1996; Scarr & McCartney 1983) has drawn on three kinds of genotype-environment (GE) correlations distinguished by behavioral geneticists—active, passive, and reactive—to build a developmental theory of individuality. Her formulation builds on what differential psychologists have uncovered about the normative dimensionality of human variation (abilities, interests, and personality) to gain a purchase on the development of the idiographic particulars of each individual. Scarr's formulation fits well with treatments of how personal-attribute constellations (aptitude complexes, trait complexes, or taxons) serve to guide behavioral development down distinctive paths (Harris 1995).

Personal dispositions interact with the environment in three ways: (*a*) Passive GE correlations are in operation, for example, when the genetic antecedents for the development of verbal reasoning ability covary with the vocabulary size of rearing environments. Above average parents, for example, provide the genetic basis for complex verbal reasoning as well as a stimulating learning environment for its development. (*b*) Reactive GE correlations come about when children, because of their genetic differences, evoke different responses from their environment (e.g. when a painfully shy child attenuates the likelihood of spontaneous social/verbal engagement). (*c*)

Active GE correlations are produced when a person takes an active role in seeking out particular environments—for example, when children, at promise for achieving excellence in athletics or the performing arts seek out, through their own initiative, opportunities for athletic participation or musical instruction. This kind of GE interaction has been especially prominent in Scarr's recent writings, in which she has explicated how this mechanism operates in niche building.

Scarr maintains that people (especially as they mature) seek out or strive to create environments for themselves—environments that are congruent with their personal point of view and which, in large part, reflect their abilities, interests, and personality. Finding appropriate niches facilitates positive development, an idea that has been a longstanding supposition in differential psychology (Lubinski 1996). Scarr (1996) drew on this literature to offer recommendations for parenting. She suggests that children need and deserve supportive loving environments to ensure that they become happy individuals adjusted to the complexities associated with the demands of societal roles. However, she cautions parents against trying to shape children's enduring characteristics reflexively; instead, parents should tailor educational curricula and opportunities for positive development to the unique assets of each child's individuality.

METHODOLOGICAL ISSUES

Causal Modeling

In structural equation modeling, designs that omit key determinants of phenomena under analysis are called mis-specified (the term used to depict errors of omission) or neglected aspects. One compelling aspect of Herrnstein & Murray (1994) worth underscoring is their simultaneous examination of two putative causal sources (viz. general intelligence and SES). Many social scientists found the concurrent competition of these two factors unfamiliar, as the social science literature is replete with causal inference stemming from correlations between SES and important outcome measures (Bouchard et al 1996), but *g* is seldom assessed concomitantly in such designs.

Causality and Confounds

Removing (partialing out) SES from ability-performance correlations has been repeatedly criticized because general intelligence and SES share common antecedents (Bouchard 1997, Bouchard et al 1996). Meehl's (1970) ex post facto design is the general rubric for this methodological shortcoming. Yet, Murray (1998) has offered a clever methodology for untangling the causal influence of SES on ability-performance and ability-outcome functions. Using 15-year longitudinal data, Murray studied income differences between biologically related siblings (reared together) who differed in general intelligence. As ability differences between siblings increased, so did their income differences; moreover, these income differences mirrored those in the general population at similar ability ranges. This investigation corroborates a handful of studies using a similar control for family environment (Waller 1971).

Total Evidence Rule

The same year Burks (1928) published her landmark treatment on decomposing environmental and hereditary sources of variation, Ellis (1928) introduced psychologists to a more general refinement. "The logicians point out that a cause of much incorrect thinking is what is known as the fallacy of *the neglected aspect.* Early students of certain diseases considered them to be due to hot weather or excessive rain—neglecting the activities of the fly or the mosquito in spreading the bacteria. Neglecting aspects of problems often hide variable agencies that must be understood before the problem can be solved" (Ellis 1928:9). Subsequently, Carnap (1950) formalized this fallacy as the total evidence rule, which maintains that, when evaluating the plausibility of a particular hypothesis, it is imperative to take into account all of the relevant information (Bouchard 1997, Lubinski & Humphreys 1997). As commonsensical as this seems, it frequently is not done.

For example, investigators readily assume that the covariation between parent and child in abilities, interests, and personality is due to parent nurturing (cf Thompson's 1955 review of Hart & Risley 1994). Yet, biometric analyses reveal that covariation among broad individual differences approaches zero as adulthood is reached among biologically-unrelated siblings reared together. As unrelated individuals who were reared together grow older, they appear to "grow apart" (McCartney et al 1990), with respect to the attributes examined here. It appears that an inconspicuous cause, namely shared genetic make-up, is responsible for the phenotypic covariation between biologically related parents and children. Parents do, indeed, have an influence on their children with respect to the major dimensions reviewed herein; however, this influence is transmitted through a different reared-in mechanism than many presupposed. This is also supported by a variety of kinship correlates, such as finding that, on "environmental measures" (e.g. Home Observation for Measurement of the Environment (HOME): Plomin & Bergeman 1991), identical twins reared apart assess their reared-in home environments as similarly as fraternal twins reared together do (Scarr 1996). This is not to say that abusive environments are not detrimental to optimal development; recall Lykken's (1997) point about the kinds of families that are typically not found in biometrically informed psychological studies. What these studies do speak to, however, is that, overall, many families are functionally equivalent in terms of fostering the development of broad individual differences (Harris 1995, Hetherington et al 1994).

CONSILIENCE

In *Consilience: The Unification of Knowledge,* Wilson writes:

> Today, the greatest divide within humanity is not between races, or religions, or even, as widely believed between literate and illiterate. It is the chasm that

> separates scientific from prescientific cultures . . . . Without the instruments and accumulated knowledge of the natural sciences—physics, chemistry, and biology—humans are trapped in a cognitive prison. They invent ingenious speculations and myths about the origin of the confining waters, of the sun and the sky and the stars above, and the meaning of their own existence. But they are wrong, always wrong, because the world is too remote from ordinary experience to be merely imagined.'' (1998:45)

By consilience, Wilson (1998) means the joining together of ideas across disciplines in order to paint a more comprehensive picture of the nature of the universe. He bemoans how over-specialization among the educated elite makes important conceptual syntheses unlikely, and suggests that professional misunderstandings often arise from ignorance of other disciplines, ''not from a fundamental difference in mentality''(1998:126). He cites Snow's (1967) ''two cultures'' as a familiar example, while also noting that social scientists frequently neglect modern biological findings.

Dawis (1992) has remarked that psychometric tools for assessing the attributes reviewed here provide unparalleled windows on humanity—akin to the microscope in biology and the telescope in astronomy. Over psychology's short history much has been learned about human diversity, especially for understanding the niches people seek out, as well as those that people attempt to avoid, build, or change. This body of knowledge has interconnected beautifully with other disciplines, yet frequently, individual differences are neglected in research design and interpretation. Whereas biologists interested in protein molecules are unlikely to say: ''But I am not interested in carbon atoms. I'll leave that for others,'' many psychologists appear content in examining human behavior while neglecting relevant scientific information.

Kimble (1994) has scolded psychologists in ''Anti-Intellectualism Masquerading as Human Sensitivity,'' for their use of huge jargon-to-substance and feeling-to-thinking ratios on politically correct topics. ''How you feel about a finding has no bearing on its truth'' (Kimble 1994:257). In reviewing Sternberg & Grigorenko's (1997) *Intelligence: Heredity and Environment*, Hunt (1997) sees certain chapters as excellent overviews, but others as nonscientific ''cultural perspectives.'' Is there a way to render this variance in psychological discourse more understandable?

If psychological practice is the application of scientific principles to individuals and groups, perhaps the psychology of individual differences, combined with the history of psychology, can illuminate such contrasting points of view. Here, I suggest that contrasting points of view held by certain groups of psychologists reflect the individual differences that they possess, the niches they selected for professional development, and the scientific standards (role models) found therein. With respect to selection for professional training, for example, psychology, relative to other disciplines, clearly draws on multiple attribute patterns (aptitude complexes, taxons, trait complexes). Psychologically speaking, APA is a heterogeneous lot, relative to other disciplines. Some psychologists work with people, others do not, and yet, this seems reasonable. Distinctive sets of skills and interests are needed for psychology's multifaceted roles. Boring's (1950) familiar distinction between clinical and experimental psychologists (viz the former ''like people'') comes to mind. But are some psychologists becoming too specialized? Is some practice and writing drifting away from a scientific base only to result in a *House of Cards* (Dawes 1994)?

Although marked group differences in ‘‘people interests’’ across psychological specialties are conspicuous and familiar, ability profiles often vary too, sometimes in level (in contrast to Wilson’s view), but more often in pattern (something not considered by Wilson). Indeed, it appears that group differences within the main historical branches of psychology, across people and their intellectual products, become more understandable by considering individual-differences profiles. Further, it is suggested that people attracted to certain specialties tend to approach problems with different criteria for what constitutes a satisfying explanation. This has intensified to the point of becoming scientifically problematic. Consider the following.

The history of systems of psychology may be traced to England (differential), Germany (experimental), and France (clinical); the three systems differentially emphasize quantitative, spatial, and verbal reasoning, respectively. They can be seen as subtle divides across Snow’s (1967) two cultures. Over time, specialization in these areas increased. Clinical psychologists slowly drifted more toward people contact and intellectual content restricted to verbal reasoning and literary skill, whereas differential psychologists and experimentalists drifted toward quantitative models and technical instrumentation. These all depict niche building (Scarr 1996), a powerful tool for conceptualizing ‘‘climate’’ and organizational change (Bouchard 1997, Dunnette 1998).

It is important to keep in mind, however, that psychological diversity is not necessarily problematic. Individual differences can be enriching. When individual differences are anchored by common ground, they routinely give rise to effective solutions through different strategies. Consider Thurstone’s (1935) *Vectors of the Mind* and Burt’s (1941) *Factors of the Mind.* Thurstone, a former engineer, chose to highlight concepts with line drawings (spatial configurations: ‘‘vectors’’), whereas Burt, a brilliant algebraist, used copious formulas (‘‘factors’’) but few diagrams. Factor analysis can be presented either algebraically or geometrically, so both approaches are complementary (and one may serve some students better than others). Either is fine. But when disciplines become more complex and critical tools are difficult to master, psychological diversity can be problematic. Sometimes migration is necessary. As Terman (1954:222) noted: ‘‘Thorndike confessed to me once that his lack of mechanical skill was partly responsible for turning him to mental tests and to the kinds of experiments on learning that required no apparatus.’’ Whereas of BF Skinner, it was said that all he needed to build an apparatus was cardboard, string, and a piece of chewing gum. Clearly Freud and William James were primarily literary in their approach (Freud’s literary skills earned him the Goethe Prize, and James was arguably a better writer than his brother Henry). All were excellent psychologists, yet most certainly they possessed different individual-differences profiles. Nevertheless, along with their uniqueness, they were all highly scientific (investigative) in orientation. Has this latter interest changed in some modern psychological specialties? Have certain segments of the psychological community become scientifically problematic?

These considerations may shed light on contentious debate beyond the biological bases of human behavior. If this analysis has verisimilitude, marked group (individual-differences) profiles should be observed among individuals with contrasting views on facilitated communication, recovered memory, qualitative (versus quantitative) methods, clinical (versus statistical) prediction, and numerous alternative formulations of human intelligence (emotional, multiple, etc.). Perhaps one group places a premium on characterizing unique nuances attendant with all psychological phenomena (measured against criteria of eloquence and verbal cohesiveness), while another emphasizes the communality cutting across scientifically significant dimensions of human behavior and their external linkages (graphed or measured quantitatively). If so, the seeds for communicating at cross-purposes are planted and germinate from deep differences in fundamental qualities—nurtured and supported by distinct niches.

Differential psychology not only fosters consilience, it offers understanding for some of the most critical social issues of our time. A coherent picture of the human condition is incomprehensible without individual differences concepts and methods. Finally, and perhaps most profoundly, differential psychology might point to ways to enhance the scientific integrity of psychology, and the social sciences more generally, by revealing (through multidimensional models) ways to develop, select, and train students for coming to terms with human behavior from a scientific point of view.

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