Current Issues in the Assessment of Intelligence and Personality

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In this chapter, we discuss current trends in the assessment of intelligence and personality that we believe have implications for the future of these disciplines. However, the present is always illuminated by the past; indeed, sometimes it is comprehensible only when seen in the context of antecedent events. Therefore, when possible, we identify some of the threads that tie current controversies to previous debates. Although we believe that the issues we have identified will help shape future developments, we refrain, for the most part, from specific speculations about the future of intelligence and personality assessment. Very near term predictions are easy: things will stay much the same as they are now. In some cases, we might even make reasonable predictions slightly further out by extrapolation. Our reading of others' past predictions about the future of psychological theory and research, though, is that interesting predictions (i.e., those that are more than simple extrapolations) usually look at best charmingly naive in retrospect.

We present this chapter in three major sections, one focusing primarily on the assessment of intelligence, one focusing primarily on the assessment of personality, and one addressing issues at the intersections of intelligence and personality. The juxtaposition of our discussions of assessment in intelligence and personality illustrates both points of contact and points of real difference between the two domains, which we discuss in a final section. The structures of this chapter reflect our personal, no doubt somewhat idiosyncratic, views of what is important to say about each domain. As it turns out, we find ourselves with a little to say about a lot in the intelligence domain and a lot to say about a little in the personality domain. Others would certainly choose other emphases.

Current Issues in the Assessment of Intelligence

Historical summaries are exercises in story telling (Bruner, 1990). Like all stories, the story of the construct intelligence and of the development of tests to measure it can be told differently by selecting, emphasizing, and juxtaposing events in ways that give new meaning to the whole. Indeed, if Goodman (1984) is correct, there may be as many worlds as there are ways to describe them. However, alternative world views are not equally defensible. Nor are they equally instructive for the tasks of understanding the present and predicting future trends, since

different perspectives on the past entail different interpretations of current events and shape different expectations for the future. For example, some of the characters who would be main players in any story of the development and use of intelligence tests often would not even be mentioned in a story of the search for a viable theory of intelligence, and so their story would not much illuminate current debates about the nature of intelligence. More importantly, the former tale would be told differently by one who views mental tests as instruments of cultural oppression than by one who sees them as instruments of social change (see Cronbach, 1975). Similarly, the story of theorizing in the U.S. about intelligence follows a different plot from the parallel story in the U.K., and the joint Anglo-American tale differs even more from the continental European tale, particularly one that would be told from Germany or Russia. Indeed, the story of intelligence reads more like a convoluted Russian novel than a tidy American short story. There are general themes to be sure, but also divers subplots that crop up, some unexpectedly, others at regular intervals. Sometimes a new cast of characters, in mute testimony to Santayana's epigram for those unable to remember the past, unwittingly repeat controversies played out earlier. Others play a variation on this theme and foist old constructs with new names on a generation of psychologists lost in the present. But even when the old reappears, the context has changed, and so the result is never exactly the same.

In this necessarily brief account, we can do no more than point to what we consider to be some of the more interesting paths through this large and variegated forest. Other, equally instructive paths could and should be followed. We begin with a thumbnail sketch of the controversy between intelligence as a unitary trait and intelligence as a collection of separate traits. This is a struggle not only of theory and method, but also of value, particularly what criteria to use to arbiter among competing theoretical positions. Should psychological meaningfulness prevail? Or should parsimony? Or should it be utility? Test users opted for utility. In America at least, psychological meaningfulness prevailed over parsimony in the theoretical debate. This, then, is the first major plot. It began with Thorndike, found clearest expression in Thurstone, and culminated in Guilford. However, the comprehensiveness of

Guilford's model was also its most glaring weakness. The next phase in our story describes the emergence of the criterion of parsimony and the subsequent resurgence of G in the guise of a hierarchical model of abilities. This phase ends, predictably it would seem, with attempts by Horn (1985), Gardner, (1983), and others to reassert the criterion of psychological meaningfulness.

The second plot is the tale of two intelligences: fluid and crystallized, and of how Cattell's (1943) theory moved from a little-noticed hypothesis about adult intellectual development and decline to a central feature of several modern theories of intelligence and the guiding framework for many intelligence tests.

The third plot is the search for physiological correlates of intelligence and, in some quarters, of a physiological explanation for intelligence. The siren call of reductionism has seduced others as well, notably cognitive psychologists who sought to understand intelligence in information processing terms. We discuss the work of cognitive psychologists in some detail because the limitations we note have implications for research on personality, which is the topic of the second section of this chapter. Discussion of physiological measures is postponed until the third section of the paper, since it clearly applies to both domains. Efforts to reconceptualize intelligence to include affect and conation are also deferred to this final section, as are speculations about the overlap between the two domains of personality and intelligence.

Meaningfulness, Parsimony, or Utility

From G to multiple abilities. Early in this century, tests of general intelligence gained ready acceptance in schools and industry (Tyack, 1974) even though the meaning of construct of general intelligence was as hotly debated then as it is today. By the 1930's, though, success of Terman's revision of the Binet scale and of the group-administered tests developed during and after World War I overshadowed disagreement about what intelligence might be. This was the heyday for intelligence testing and for those whose fledgling tests gained a foothold in the burgeoning test market. However, the dissenting position, early championed by Thorndike (see Thorndike, Lay, & Dean, 1909) and Kelley (1928) in the U.S. and by Thomson (1916) in the

U.K., gained a new respectability with the introduction of Thurstone's (1935) methods of factor extraction and rotation. Thurstone, using psychological meaningfulness as a criterion, showed how arbitrary factor axes extracted by his centroid method could be rotated to define a small set of correlated "primary" ability factors, thereby dispensing with G. There followed an explosion of factorial studies by Thurstone (1938, 1944, 1949), his students (Carroll, 1941; Botzum, 1951; Pemberton, 1952), and others, notably Guilford and his coworkers in the Army-Air Force (AAF) Aviation Psychology program (Guilford & Lacey, 1947), decomposing primary abilities into still narrower factors or identifying other factors not previously known.

But it became increasingly difficult to comprehend the whole. Wolfe (1940) attempted an early summary. French (1951) followed with an even more comprehensive review in which he noted how difficult it was to determine whether factors with different labels were indeed different or whether some with the same labels represented different ability dimensions. He proposed that investigators include common reference or marker tests in their studies, a procedure already followed by Thurstone in his studies and by the AAF workers in theirs. Tests selected as markers showed high loadings on one rotated factor. Typically these were homogeneous, speeded tests. Thus, Thurstone's criterion of simple structure and the use of marker tests lead to a gradual shift in the type of tests included in factorial investigations. The heterogeneous, complex tasks of Binet and Spearman were replaced by the homogeneous, simple tasks of Thurstone and Guilford. The fractionalization of abilities that occurred during this period would not have been possible without this change in the universe of tasks used to define intelligence.

By the mid 1950's the continued proliferation of factors was making it difficult to summarize existing work or to know where to look for new ability dimensions. Guilford (1956), reviving an earlier suggestion of Thorndike, Bregman, Cobb, and Woodyard (1926), posited a three-facet scheme for classifying existing factors and directing the search for new ones. Although many accepted Guilford's model, a few were openly skeptical. Spearman's (1927) claim that the ability space could be spanned by g and four group factors was not much more parsimonious than Thurstone's (1938) claim that seven factors would do the job if psychological

meaningfulness were given priority. Indeed, Thurstone explicitly invoked parsimony when he argued that the number of common factors should be relatively small even though the number of ability tests was large, even unbounded (see Guttman, 1958). However, with the prospect of Guilford's 120 independent abilities, hierarchical theories and multiple-ability theories were not equally parsimonious. McNemar (1964) in a critical review dubbed the SI model "scatterbrained" and advocated a return to G via the hierarchical model of Vernon (1950) and other British theorists. Indeed, Humphreys (1962) had earlier shown how a facet model such as Guilford's could be made conformable with a hierarchical model by averaging over rows and columns to define higher-order abilities, a solution Guilford ignored at the time but accepted 20 years later (Guilford, 1985).

Resurgence of G. Thus, the construct of general intelligence was at first embraced by many American psychologists, then cast aside as Thurstone's methods of multiple factor analysis won favor, then rediscovered again in the guise of a hierarchical model of abilities, and, most recently, challenged once again by those who would extend the domain of intelligence in old and new ways. General and special abilities have thus alternately dominated the field, one ascending while the other declined, one in favor while the other challenged. The loyal opposition has always been close at hand.

Reasons for the recurring rise and fall of different theories of intelligence are many. Those who arrived at different conclusions often started with more or less variegated samples of subjects and tests, used different methods of factor analysis, adhered to different social and political philosophies, or held different personal theories about the nature of human abilities (Fancher, 1985). On this view, then, as long as there is controversy over method, or differences in the social, political, and personal philosophies of individuals, there will be controversy about the nature of human abilities. The expectation that one theory will triumph is seen as a hold over from turn-of-the-century logical positivism. Indeed, when competing views alternately gain and lose favor in a discipline, it may indicate that changes that on the short view seem like advances may on the long view look more like traveling in circles. One need not read too much of the

history of differential psychology to see much that is old in the new, and so such pessimism is not entirely unfounded. For example, Carroll (1989) after surveying the extant literature wondered why recent factorial studies of abilities rarely even approached the sophistication and comprehensiveness that Thurstone achieved in the 1930's, or that Thorndike had approximated even earlier.

When rival views persist, it may also signal that each has merit, but important limitations as well (see Hunt, 1986). A hierarchical model that posited both broad and narrow abilities thus seemed to preserve the best of both worlds, while uniting them in a common framework. In reality, however, the hierarchical model has enhanced the status of G and diminished the status of narrower ability factors. This may or may not be a good thing. Certainly there is less tendency to attribute effects to special ability constructs that could more parsimoniously be attributed to general ability. However parsimony is only one of several criteria that may be used to arbiter such decisions. Psychological meaningfulness is perhaps equally important, but has been given less weight of late. Indeed, one could argue that psychological clarity declines as factor breadth increases. In other words, the broadest individual difference dimension -- although practically the most useful -- is also psychologically the most obscure. There has never been the sort of hand wringing over the meaning of factors such as verbal fluency or spatial ability that routinely attends discussion of G.

It is ironic that many latter-day advocates of Vernon's (1950) hierarchical model seem unaware that he never claimed psychological validity for the model or for the factors it specified.

> I do not think it is correct to say that I regard, or have ever regarded, hierarchy as a psychological model. It is . . . simply . . . a convenient way for classifying test performances . . . Qua psychological model, I think it is open to a lot of difficulty because successive group factors do not have any very obvious psychological meaning. Thus, my verbal-educational and spatial-mechanical factors do not represent mental abilities; they are the residual common variance left when one has taken out . . the g factor. Similarly, the minor factors are residuals of residuals. (Vernon, 1973, p. 294)

Interestingly, he claims that "the same sort of difficulty would arise if we started from in oblique primary factors and calculated . . higher-order factors from correlations between the primaries" (p. 294). However, "Burt's hierarchy is different in that . . . it does owe a good deal to neurological and psychological theory . . . But then his model is not a straight representation of the correlations of a battery of tests." (p. 294) Thus, the theoretical parsimony and practical utility of Vernon's hierarchical model were purchased at the price of psychological meaningfulness.

But there were also practical reasons why the theories of Thurstone and Guilford fell into disfavor. Much to the dismay of defenders and publishers of multiple aptitude test batteries, it was discovered that predictions of course grades from one or more special ability scores was usually no better than prediction from G (McNemar, 1964). Even more discouraging was the finding that tests of general abilities were also more likely to interact with instructional manipulations (Cronbach & Snow, 1977). In personnel psychology, Schmidt and Hunter (1977) also touted the virtues of general ability, and argued that the importance of special abilities for the prediction of job performance had been grossly overstated by a common failure to attend to sampling variability of small-sample correlations.

There are, of course, dissenters. Horn (1985) argues that "what is called intelligence is a mixture of quite different things -- different attributes having different genetical and environmental determinants and different developmental courses over the life span" (p. 268). He argues that, like facial beauty, intelligence is composed of distinctive components. Evidence for heritability of the whole does not confer ontological status. In a similar vein, Cronbach (1977) argues that intelligence, like "efficacy", is a word that describes the system. One cannot locate the efficiency of a factory in one of its many departments. It is not a thing but rather one of many indices that describe the functioning of the whole. Neither Horn nor Cronbach argues that the statistical dimension commonly called G lacks utility. Rather, they claim that practical utility does not imbue psychological meaningfulness. These and other critics claim that Thorndike, Thomson, and their followers were more nearly right than were Spearman and his followers.

Some would even expand the domain of intelligence tasks to include not only social intelligence, which Thorndike (1920) and Guilford (1956, 1985) recognized, but also to include musical and bodily-kinesthetic abilities as well (Gardner, 1983). Thus, the ongoing battle between advocates of G and of multiple abilities is probably the major theme in the story of intelligence. A more recent theme is the tale of two intelligences.

Fluid and Crystallized Abilities

In 1943, Cattell first outlined the theory of fluid and crystallized intelligences. The basic idea was that the construct intelligence (G) was really an amalgam of two separate, albeit highly correlated intelligences: fluid intelligence (Gf) and crystallized intelligence (Gc). Although interpretation of these constructs changed importantly between initial proposal of the theory and later tests of it (see Lohman, 1989), fluid intelligence came to be interpreted as that aspect of intelligence most closely tied to physiological processes. Crystallized intelligence, on the other hand, was thought to reflect the cumulative effect of education and experience, or the result of investing fluid intelligence in particular experiences. It was then a short step to the inference that Gf represented the true intelligence of the individual whereas Gc represented, at best, wisdom, or, more commonly, general verbal knowledge and skills acquired through formal schooling and other tutelage.

The theory received little attention when initially proposed, due in part to Cattell's failure to elaborate and promote it, but also to the dominance of Thurstone's (1938) and later Guilford's (1956) theories of multiple abilities. In the 1960's, however, Cattell and others (notably Horn), conducted a series of studies that tested the early theory and elaborated it considerably. However, in keeping with Cattell's original theme, the theory was most commonly discussed in the context of the growth and decline of intellectual competence during the adult years.

By the late 1970's the theory had attracted a wider audience. Continued elaboration of the theory by Horn (1985) suggested not two, but as many as ten higher-order factors. Other theorists, notably Snow (1981), sought to describe the differences between fluid and crystallized in information processing terms. Later Sternberg (1985) incorporated the distinction into his triarchic theory of intelligence.

Testing was not far behind. 1983 saw the introduction of the Kaufman Assessment Battery for Children (K-ABC; Kaufman & Kaufman, 1983). Although primarily advanced as the first intelligence test based on the Das-Luria theory of simultaneous and successive processing, the authors also claimed that the Mental Processing Scale (simultaneous plus sequential)

measured fluid ability whereas the achievement scaled measured crystallized ability. In 1986, the Stanford-Binet, which had steadily lost ground to its competitors, was completely revised along the lines of Gf-Gc theory (see Thorndike, Hagen, & Sattler, 1986). Other test publishers, particularly of the K-ABC and of the Weschler scales, began to claim conformity with Gf-Gc theory as well. However, the most ambitious attempt to develop a test along the lines of the Horn-Cattell version of the theory came with the revision of the Woodcock-Johnson (Woodcock & Johnson, 1989). This battery contains tests that estimate seven group factors: Fluid Reasoning (Gf), Comprehension-Knowledge (Gc), Visual Processing (Gv), Auditory Processing (Ga), Processing Speed (Gs), Short-term Memory (Gsm), and Long-term Retrieval (Glm). Scores on one or more tests that estimate each ability can be compared to each other or to scores on a companion achievement battery.

Thus, the constructs of fluid and crystallized intelligence have gained considerable popularity in recent years, no doubt in part because they have been interpreted differently by different theorists. Some interpret them as endpoints on a continuum of cultural loading such as that described by Anastasi (1937), Cronbach (1970) and many others -- with Gc tests being more culturally loaded and Gf tests being less culturally loaded. This seems closest to Horn's (1985) interpretation that Gc reflects "acculturation learning" whereas Gf reflects "casual learning" and "independent thinking" (pp. 289-290). Others, in keeping with Cattell's (1963) investment theory of aptitude, confer a primary status on Gf. These theorists tend to speak of Gf as the real intelligence, a conclusion supported in part by Gustafsson's (1984) claim that Gf=G in a hierarchical model. Critics point out that, contrary to expectations of this model, tests of Gf do not routinely show higher heritabilities than tests of Gc. Further, educational interventions (Stankov, 1986) and cohort effects (Flynn, 1987) are typically larger for tests of fluid than for tests of crystallized ability. Indeed, some see fluid abilities as among the most important products of education and experience (Snow & Yalow, 1982; Lohman, 1993). On this view, the idea that Gf is the true or physiological intelligence is nothing more than the long discredited view of innate intelligence dressed up in a modern guise.

Finally, others see the fluid-crystallized distinction primarily in terms of novel versus familiar problem solving, an idea originally proposed by Stern (1914), discussed at some length by Thorndike et al. (1926), most commonly embedded in discussions of aptitude-achievement discrepancies (Thorndike, 1963; Green, 1974; Snow, 1980), and expressed in information processing terms by Snow (1981):

> [Crystallized ability] may represent prior assemblies of performance processes retrieved as a system and applied anew in instructional or other . . . situations not unlike those experienced in the past, while [fluid ability] may represent new assemblies of performance processes needed for more extreme adaptations to novel situations. The distinction [then] is between *long term* assembly for transfer to *familiar* new situations vs. *short term* assembly for transfer to *unfamiliar* situations. Both functions develop through exercise . . (p. 360)

Although not explicitly derived from this theory, attempts to develop curriculum-based assessments can be informed by this view of intelligence. Barnett and Macmann (1992) argue that those who would use tests in professional contexts must not only answer questions about construct validity (i.e., "What can be said with confidence?") but also questions about consequential validity (i.e., "What can be said that might be helpful?") On the second point, they argue that IQ scores have little instructional utility. But what form should instructionally-useful tests assume? Lohman (1993) argues that those who would tie such tests firmly to the curriculum would estimate only a part of crystallized intelligence and an even smaller part of fluid intelligence. On this view, then, what are needed are instructionally-useful measures of fluid abilities, i.e., tests that estimate how well students can transfer their knowledge and skills to novel and open-ended problems.

However, it is unlikely that this view will ever completely displace intelligence tests modeled after the Binet and its progeny. Most lay persons and many professionals believe that a good intelligence tests measure -- or ought to measure -- the innate potential or capacity of the learner. Such beliefs are reborn with each generation, and are difficult to change without

inducing an even more naive environmentalism. Nonetheless, continued legal challenges to intelligence testing may force changes in beliefs that are impervious to rational argument. The concepts of fluidization and crystallization of abilities (Snow, 1981) provide a useful way to envision these changes. Thus, the tale of fluid and crystallized abilities has many implications, some fully realized, some yet to come.

Cognitive Psychology and Testing

The third plot in the story of intelligence has already been mentioned several times. It is the attempt to understand the cognitive processes and knowledge structures that generate those behaviors we label as more or less intelligent.

The rapid rise of the information processing paradigm gave new meaning to the perennial call to explain "the process . . . by which a given organism achieves an intellectual response" (McNemar, 1964, p.881). Cognitive processes were modeled as information processes (Lohman & Ippel, 1993). Ability constructs were investigated either by searching for differences in information encoding, transformation, or storage between individuals identified as exhibiting high or low levels of some ability (Hunt, Frost, & Lunneborg, 1973), or by searching for differences in the manner in which such individuals solved items on tests taken as markers for particular ability constructs (Sternberg, 1977). The former came to be known as the cognitive correlates and the latter as the cognitive components approach (Pellegrino & Glaser, 1979).

However, what began with parades down main street eventually petered out in a hundred side streets. Once again, some began to question whether experimental psychology and differential psychology might be fundamentally incompatible. Most researchers, after a brief flurry of interest, quietly moved on to other topics. A large part of the difficulty in relating the two domains stems from the widespread failure to understand that constructs are often defined differently in experimental and differential psychology. Consider, for example, the most important (or at least the most well-studied) construct in each domain: learning in experimental psychology and intelligence in differential psychology. Learning is defined by changes over trials (or columns in a basic person by item data matrix). Intelligence is defined by variation

between persons (or rows in that same matrix). In other words, constructs in experimental and differential psychology (and analogously, in social and personality psychology) are often defined by partitioning the basic data matrix in different ways. Failure to appreciate the statistical independence of row and column deviation scores has lead to much confusion in attempts to relate these two domains, from Woodrow's (1946) failure to find much relationship between learning on laboratory tasks and intelligence, to the efforts of Gulliksen and his students (e.g., Allison, 1960; Stake, 1961) to relate learning rate measures to a Thurstonian model of abilities, to the more recent efforts of Sternberg (1977) and Hunt, Frost, and Lunneborg (1973) to correlate scores for component mental processes and ability constructs.

Like earlier learning scores, measures of component processes are defined by subtracting one score from another. Gain scores have an unsavory reputation among psychometricians. Cronbach and Furby (1970) went so far as to argue that investigators should learn to pose their questions in ways that would not require the computation of such unreliable scores. This advice, while reasonable to psychometricians, is astonishing to experimentalists who, from Donders to PET scan watchers, have defined psychological constructs by differences between the performance of subjects in different conditions. However, the reliability problem is not what it seems. It is easily shown that, if all subjects show the same improvement, then the reliability of the gain is zero, even though one can with complete confidence say precisely what each person gained. The key here is that what interests the differential psychologist is not reliability in some absolute sense, but rather the dependability with which individuals can be rank ordered on the score. If individual variation is small or nonexistent, then people cannot be ranked with confidence on the basis of their gains. It is this unswerving fixation on individual differences that blinds differential psychologists and their technical ally, the psychometrician. Their most cherished methods for evaluating tests and the constructs tests measure begin and end with rank orders of individuals.

The experimentalist, on the other hand, has built a psychology of particular tasks. He or she often attempts to generalize treatment effects across situations, but rarely attends to the extent

to which these effects generalize across tasks. The differential psychologist knows how to estimate the generalizability of individual differences across tasks, but that is not the same thing. In addition to the generalizability of individual differences across tasks, one can examine the consistency across tasks of treatment effects or even of score profiles (see Cronbach, 1957, for an example; also Cattell, 1966). In other words, the experimentalist should be more interested in covariation of response patterns between rows; not between columns, like the differential psychologist. Unfortunately, since the psychometrician is usually more adept at multivariate statistics, efforts to link experimental and differential psychology usually end up playing by differential rules. Entire research programs attempting to link experimental and differential psychology have risen and then collapsed on the basis of a few between-person correlation coefficients.

But the two disciplines do meet, or overlap. Non-independence of row and column variation shows up in the interaction term. When considering the relationship between learning and intelligence, the most important cause of the interaction is an increase in score variation across trials, or what Kenny (1974) called the fan effect. Statistically, the fan effect occurs when true gain on the learning task is positively related to initial status on the learning task. If initial status on the learning task correlates with intelligence, then gains will also show a correlation. There are, of course, other possibilities, but this is the typical scenario. Thus, the interaction term is the key. Unfortunately, both differential and experimental psychologists have been taught to minimize the interaction term. Differential psychologists evaluate the dependability or reliability of individual differences by the proportion of the between-person variance attributable to the person variance component (Cronbach, Gleser, Nanda, & Rajaratnam, 1972). A large person component and a comparatively small person x item interaction component are the goal. For the experimentalist, differences between conditions (or i) are judged relative to the size of the p x i interaction.

On the other hand, diagnostic information about how subjects solved tasks is most informative when the interaction term is large. In such cases, the single rank order of individuals

or of conditions does not give all of the interesting information. Influential developmental psychologists have long built their psychology around tasks that induce subjects to reveal important, preferably qualitative differences in knowledge or strategy by the type or pattern of responses they give. Furthermore, these differences in knowledge or strategy must then be shown to generalize to other tasks or even to be indicative of broad thinking competencies. Piaget was particularly clever in inventing or adapting such tasks. Siegler (1988) has continued the tradition.

Put another way, the primary contribution of an information-processing analysis of a task or problematic situation is information on how subjects understood that situation or solved that task. Although such analyses usefully inform interpretation of test scores even when all subjects follow a uniform strategy, such analyses are most useful for understanding individual differences when there are interesting differences in the way subjects perceive a situation or solve a task. However, most tasks studied by experimental psychologists and most tests developed by differential psychologists are not designed to elicit such qualitative differences in knowledge or strategy or to reveal them when they occur. In fact, they are constructed with exactly the opposite goal in mind. For example, information processing analyses of mental rotation tell us that a major source of individual differences on such tasks is to be found in the speed and accuracy of the rotation process. Did anyone seriously doubt this? What is news is when we find subjects who do not rotate stimuli, or who persist in rotating them in one direction when rotation in the other direction would be shorter, or when some rotate along rigid axes while others perform a mental twisting and turning at the same time. These strategy differences are of no enduring interest unless they can be related to more global indices of ability or development, as indeed they have been (e.g., Kerr, Corbitt, & Jurkovic, 1980).

Most research in the past 20 years attempting to relate cognitive and differential psychology has assumed that connections between the two disciplines would be more straightforward. Investigators fitted information processing models to each subject's data, then estimated component scores for different mental processes (such as the slope parameter from the regression of latency on angular separation between stimuli in the rotation paradigm), and then

used these process-based parameters as new individual difference variables (see Lohman & Ippel, 1993, for a critical review). However, consistent individual differences will be located in the intercepts of the individual regressions, not in the slopes or other component scores, as commonly assumed. Indeed, individual differences in component scores only succeed in salvaging a portion of the variance typically relegated to the error term. Component scores do not decompose and therefore cannot explain the main effect of individual differences on a task (Lohman, in press). Thus, the intercept, which is the residual or wastebasket parameter in componential models, is actually the locus of individual difference variance that is consistent across trials, whereas component scores, which capture consistent variation in item or trial difficulty, can only help salvage individual difference variance from the error term.

Such complexities complicate but by no means embargo traffic between the two disciplines of scientific psychology. We discuss this issue further below. First, however, we summarize developments in the assessment of personality.

Issues in the Assessment of Personality

We turn our attention now to the assessment of personality. Here, too, we note that the story we tell is one of many possible stories. It is a story with two major plots. Both are plots with approximately half century histories. The first plot is of insurrection. It is a plot motivated by a continuous undercurrent of dissatisfaction with the dominant model for personality assessment: the nomothetic approach. Our sense of this plot is that while it may continue far into the future, it is unlikely to end in successful revolution. The second plot relates, at least loosely, to the story of the controversy between intelligence as a unitary trait and as a collection of separate traits. Here, though, the history starts not with a single trait model, but rather with a confusion of separate traits and reaches the present with a growing consensus on a quasi-hierarchical model of the structure of personality differences.

We begin this section in earnest by borrowing an equation from Lamiell (1981). This equation represents a generic description of the process of personality assessment.

$$S_{pa} = \overset{m}{\underset{i=1}{f}}(V_{pi})(R_{ia}) \qquad (1)$$

In equation 1, S is a score, for a particular person p on an attribute a. V represents a variable for which a measurement on person p is made (there are m such variables for attribute a). V might be an item on a self report inventory or a rating form, or it might be any other indicator of the underlying attribute[1]. R is a measure of the relevance of variable i for attribute a. Measures of personality have most commonly used unit weights for items, but other schemes are also possible. Finally, we note that the function sign is used loosely here. Most commonly, the function used to combine observations is summation, but we allow for any function, including holistic judgment. The current trends we identify in personality assessment and our speculations about the future all relate to the ways in which elements of this simple equation are defined.

One clear trend in personality assessment is a reconsideration of the value of idiographic approaches. The debate over the relative value of nomothetic and idiographic approaches to personality assessment has waxed and waned over the half century or so since Allport (1937) proposed an idiographic science of personality. The most recent incarnation of this debate was fueled in part by controversy that raged in the 1970's and 1980's over the relative roles of personality factors and situational factors (not to mention their interaction) in determining behavior. A general dissatisfaction with logical positivism and logical empiricism (see e.g., Rorer, 1990) also contributed to the field's interest in idiography. In fact, a distressingly large array of issues has come to be subsumed under the heading "Nomothetic vs. Idiographic". For example, in a recent putatively ideographic study (Pelham, 1993), subjects and their roommates or friends rated themselves on a set of explicitly normative scales. The correlation, across scales

[1]Our focus, however, will be on indicators, such as responses to self-report items or rating scales that rely on humans as sensitive transducers. This reflects both our pessimism about physiological measures of personality (for all the reasons mentioned in our discussion of intelleigence) and the general lack of success in the use of "objective" data (Block, 1977).

between each subject and the roommate or friend served as an "ideographic" measure. By the definition of idiography we adopt below, the correlation is not an ideographic measure.

Two issues in particular are often confounded and deserve to be distinguished from one another in distinguishing ideographic from nomothetic measurement. Briefly, idiographic and nomothetic approaches differ both on whether a common set of attributes is used to describe all people and also on whether comparisons are made between an individual and other individuals in order to understand that individual's personality. When a common set of attributes is employed and meaning is assigned to those scores by comparison to the scores of others, we speak of nomothetic measurement. When a common set of attributes is not used and (necessarily) no formal comparison to others' scores is made, we speak of idiographic measurement. The combination of a common set of attributes with something other than a comparison to others' scores yields several less familiar measurement paradigms including idiothetic measurement (Lamiell, 1981) and others. In the sections that follow, we discuss the consequences of choices concerning each of these issues.

The attributes to be measured

The first issue distinguishing idiographic from nomothetic measurement rests on a consideration of the particular attributes to be measured. In the classic statement of the idiographic approach Allport (1937) writes of individuals having different traits (in particular, different morphogenic traits, Allport, 1961). Thus, the uniqueness that we attribute to individuals arises from the fact that they have unique constellations of traits. For Allport, then, an idiographic approach to personality is one in which the attributes to be measured vary from individual to individual.

In fact, the task of personality assessment begins with the identification of the a's in equation 1 for each individual. Further, all the other elements can differ from person to person as well. The particular variables observed (V) and the relevance assigned to each (R) for one person need not be same as for any other individual. For that matter, the integrating function need not be the same for each individual.

In contrast, nomothetic measurement, which has been the dominant paradigm in personality research for at least the last fifty years, insists on a single common set of attributes. Although the identification of a's is an important task in developing a system for assessing personality (as we will discuss below in the context of the development of the big five), that task precedes the measurement of any particular individual's personality. Once the set of common attributes have been identified or defined, the task of assessing an individual's personality reduces to the task of finding a score (S, in equation 1) that represents the extent to which that attribute characterizes that individual. Here, each individual's uniqueness comes from his or her particular location in a multidimensional space defined by the attributes selected for measurement. In summary, an idiographic description of an individual's personality would specify the structure of that person's traits. The description would identify which traits characterize the individual and what relation each bears to the others. A nomothetic description of an individual's personality, on the other hand, would specify the extent to which he or she was characterized by a set of attributes shared by all people. In short, the two approaches differ on the usefulness of using a single vocabulary to describe all people. Although this debate has continued unabated throughout the history of scientific research on personality, it has only recently arisen in research on intelligence in attempts to assess individual differences in knowledge structures (see Snow & Lohman, 1989, for one summary).

Some (e.g., Lamiell, 1981, Rorer, 1989) have argued that the distinction we have just described, between description of the structure of an individual's personality and description of the ways in which individuals' personalities differ, corresponds to the distinction between personality theory in the first case and differential psychology in the second. This leads to the conclusion that the psychology of personality is necessarily idiographic. For reasons upon which we will expand we reject both the implied isomorphism (i.e., we hold open the possibility that nomothetic assessment might be a necessary condition for understanding any truly differential construct and a helpful adjunct for interpreting constructs grounded in other domains).

Assigning meaning to measurements

The second issue separating idiographic form nomothetic measurement concerns the way in which meaning is assigned to whatever score is assigned to a person. Equation 1 generates a number, but the meaning of that number emerges only when it is compared to some referent. To say that $S_{pa} = 50$ is not at all informative without more information. In general, meaning can be assigned to the measurement characterizing a particular individual by a variety of comparisons.

How, then, do we assign meaning to the S_{pa} values yielded by a personality measurement procedure? Five quite different approaches have been taken in personality research. The first of these, and the most commonly used, has been the normative embedded within the nomothetic tradition. In this approach, whatever score we assign to an individual ultimately derives its meaning from its position in a distribution of scores assigned to relevant others. To the extent that personality is about individual differences, this is an abundantly appropriate approach. Given our broad experience with people, knowing that a particular individual's extroversion score is greater than the scores of 90% of people to whom that individual can be appropriately compared (e.g., agemates, people of the same sex, people from the same cultural background) is quite meaningful. The key, of course, to understanding a normative score whether it refers to personality or ability or any other characteristic is understanding the norming group. To say that "He is not particularly bright" has very different meanings when the comparison is to faculty members at one's university than it does when the comparison is to unselected adults.

Still, the typical normative statement leaves a great deal unsaid, and may even mislead. For example, one of the arguments against norm-referenced interpretations of interest inventories is that one can obtain a score that suggests real interest in a domain only because one expressed dislike for that domain with less vehemence than others in the norm group. Furthermore, to locate a score within a distribution of scores without specifying anything about the processes that generated that those scores is psychologically sterile. In fact, there are at least two kinds of information missing. First, the normative statement provides no information about the items or tasks to which the individual responded in generating the score. Even among those who have built personality scales with almost blind empiricism, item content has sometimes been seen as a

clue to the psychological nature of the construct (Gough, 1965). The second kind of missing information relates to the question of how the individual responded to the item or task. As we discuss below when we address cognitive styles, individuals may respond in qualitatively different ways, and still receive the same score. More importantly, information about how individuals think and behave in situations that they summarize in a self rating provides the crucial link between an individual difference construct and general psychological theory.

This central characteristic of nomothetic assessment, the comparison of an individual's score to those of others, has been criticized by proponents of idiographic and other strategies. To say that he meaning of a S_{pa} value depends on the scores obtained by others is, in some sense, to ignore the uniqueness of the individual. Idiographic proponents (who essentially reject the idea that personality constructs are inherently differential) have instead advocated methods that understand an individual's personality on its own terms. In the classic work of idiography, Letters from Jenny, Allport (1965) analyzes his subject's personality without any explicit reference to others at all. In analyzing a large corpus of letters from the pseudonymous Jenny Masterson to a young couple, Allport asked a panel of judges to identify Jenny's traits. Of the 198 traits identified by judges, 185 could be categorized into one of 8 categories (e.g., self-centered, aesthetic-artistic). These eight separate traits, then, describe Jenny's personality uniquely and without reference to others.

Or do they? Just as a purely normative description of an individual is only partially satisfying, this purely idiographic description leaves something out. Let us consider what it means to say that Jenny Masterson is self-centered. It might mean any of several things, in fact. For a moment, let us focus on the possibility that the statement means that she is more self centered than most women of her time, culture, and age. This translation makes (partly) explicit an ascription rule (Rorer & Widger, 1983) that the judges may have used. One very plausible model of how the judges went about their task is that they considered many traits that might describe individuals' personalities. In considering self-centeredness, the judges recognized that Jenny was outstandingly self-centered, and therefore ascribed that trait to her. In considering

other traits, the judges may have felt that Jenny Masterson was unremarkable (i.e., not particularly different from the average woman of her time, culture, and age). They chose not to mention these traits.

The ascription rules for traits differ one from another (Rorer & Widiger, 1983). In some cases, for example, the ascription rule depends on the number of times a person engages in a particular behavior. Rorer & Widiger cite the examples of "murderous" and "honest." A single (or perhaps at most two) instances of murder would lead us to describe a person as murderous, even though murder is an atypical act for the person. On the other hand, one or two instances of honesty, against a backdrop of general dishonesty would not lead us to describe an individual as honest. Though the ascription rules for honesty and murderousness may both depend on absolute number of instances, the rules differ substantially in terms of what that number is. Other traits (e.g., nervousness) might depend on proportion. A person will be described as nervous if his or her ratio of instances of nervousness to instances of calmness is outstandingly high.

The ascription of the trait "murderous" can, in fact, be better understood when it is combined with knowledge about the base rate of murder in some relevant comparison group. Part of the reason that one or two acts of murder leads us to describe a person as murderous is has to do with our knowledge of the meaning of the act of murder in our culture. Another part of the reason, though, has to do with the fact that a score of one corresponds to the 99th percentile or beyond. Normative interpretations, done well, automatically incorporate base rates (as well as other characteristics of the distribution). Saying that someone's "honesty" score is in the 80th percentile (with the norm group specified) takes into account the fact that most people are honest most of the time.

On the other hand, trait scores are simply summaries of (usually self-reported) behavior over many situations. Those with extreme scores are well-characterized since they exhibit the behavior in most (or few) of the situations sampled. But what about those with average scores?

> A middling score implies no lack of individuality. Rather, the person's behavior is not organized along the dimension we chose to score. The description "50 percent honest"

> inevitably is inadequate; when is the person honest?... A personalized description would replace the general trait dimension with dimensions that describe situations the person sees as calling for an honest act (and the opposite). (Cronbach, 1990, p. 564).

Thus part of the dissatisfaction with the nomothetic approach lies in its inability to capture individuality. But there is more. Those who would make predictions about behavior on particular tasks or in particular situations would like to anchor the scale by sampling from a domain of tasks or situations. If they are even more cognitively oriented, then they would like to understand the cognitions that generated the behavior. In short, what they would like is a theory-based, domain-referenced scale. Indeed, with systematic sampling, one could more likely make statements that further conditioned interpretation by specifying under what class of situations certain behaviors or cognitions were more and less probable. This would not in any way preclude normative interpretations of the same score. Nor would it preclude reporting of scores that averaged across classes of situations. But defining the domain of situations --- aye, there's the rub!

Neither normative nor idiographic comparisons are completely satisfying. In response to this dissatisfaction, Lamiell (1981) has proposed an idiothetic scheme for personality measurement. The goal of idiothetic measurement is an S_{pa} value for each individual that is interpretable without reference to the S_{pa} value of any other individual. To accomplish this goal, idiothetic measurement begins with a sample of indicators ($\underline{V}_i$) from the domain of interest. In Lamiell's (1981, p. 281-281) example, these are 11 specific behaviors (e.g., drinking beer/liquor, studying/reading) which have been empirically demonstrated to span a dimension that might be called adolescent rebelliousness versus compliance. The score assigned to each $\underline{V}$ is simply a zero if the respondent denies engaging in the activity during the past week and a one if the respondent admits engaging in the activity during the week. The weights to be assigned to each variable were determined by a multidimensional scaling study, though in principle there is no reason that unit weights (both positive and negative) could not be used. The S_{pa} for an individual is given by equation one, with the function sign representing summation.

So far, nothing in the idiothetic procedure described by Lamiell is inconsistent with traditional nomothetic practice. The departure comes in the way in which the S_{pa} is interpreted. In order to make this interpretation without any reference to any other person, Lamiell proposes the calculation of an I_{pa} score. To compute this score, we first calculate the minimum and maximum S_{pa} obtainable from this set of V and R. I_{pa} is then calculated as the difference between the observed S_{pa} and the minimum S_{pa}, divided by the difference between the maximum and minimum S_{pa}. In other words, a particular person's score on a particular attribute is interpreted by reference to the items used to measure that attribute.

Though unusual in the personality domain, understanding a score by reference to the items attempted by the respondent is well known in the ability and achievement domains where it goes by the name of "domain referenced testing." A necessary, but not sufficient, condition for building a domain-referenced test is that the domain to be measured be well-defined (Nitko, 1984). For example, it is a relatively straightforward matter to define the domain of two number two digit addition problems. It consists of all possible combinations of two digit numbers joined by a plus sign. Obtaining a random sample of this domain is just a matter of randomly generating digits and joining them into addition problems. Assuming that the sample is of adequate size, it is reasonable to make such statements as "The examinee can correctly respond to only 20% of two number two digit addition problems." Further, for at least some purposes, that statement has a clear interpretation. Clearly, for example, the examinee has not mastered the skill involved in these problems.

This example raises two issues when translated to the personality domain. The first is the question of whether the domain of behavior representing any personality trait is sufficiently well-defined to allow for domain referencing. Even in achievement testing, domain-referenced tests are built on domain definitions less well-defined than our example. For example, tests built on the Taxonomy of Educational Objectives (Bloom, 1956) may be domain-referenced (Nitko, 1984). Still, one has to wonder what definition of rebelliousness-compliance would lead a group of psychologists to generate even substantially overlapping behavioral indicators. As we shall

discuss below, careful construction of tasks with known characteristics has been relatively rare in personality research, but would make non-normative interpretations more meaningful.

The second issue that our achievement example raises is more central to a consideration of idiothetic measurement. Although the interpretation that the examinee in our example has not mastered the class of addition problems we defined is clear, it raises as many questions as it answers, and those questions other sorts of information in order to be answered. For example, the most basic question of what, if anything, we should do about the examinee's lack of mastery depends on comparisons to others. If the examinee is a kindergartner, we would probably be willing to assume that mastery will increase with maturation and exposure to the normal school curriculum. If, on the other hand, the examinee is in the third grade, we would probably consider some sort of remedial curriculum. We draw these conclusions from knowledge of what is typical in a group of examinees to which the target examinee belongs. We might also find idiographic information of use in interpreting this score. For example, it would be helpful to know something about the importance of performing arithmetic problems to this person.

Just as the 20% correct score is only partially informative, knowing only, for example, that a hypothetical respondent named Mary receives an I_{pa} of .802 (Lamiell, 1981) is only partially informative . The score tells us that she is 80% as compliant as the scale would have allowed her to be. That statement is roughly equivalent to the statement that an examinee passed 80% of the items on a criterion referenced test[2]. Examination of the items making up the scale would help in interpreting the score. In this case, we see for example, that most rebellious thing Mary did during the past week was "doing nothing in particular." On the compliant side, she participated in volunteer work and extracurricular activities. These items have meaning partially because we (implicitly) bring to bear our knowledge of the rates at which adolescents engage in

[2]Indeed, if unit weights were used, it would be even more nearly equivalent. One difference remains. While it makes sense to talk of a zero point on a skills test (the examinee can do no two number two digit addition problems), it does not make sense to speak of zero compliance. Thus, in general, personality scales cannot, logically, yield ratio scores.

these behaviors. If we knew nothing about adolescents, or did not know that Mary was an adolescent these statements about Mary would lose much of their meaning.

So far, we have argued that normative, idiographic, and idiothetic measurement depend heavily upon each other for support in assigning meaning to S_{pa} scores. For completeness, we describe two other, less common, reference points for interpreting personality scores. The ipsative approach (e.g., Block, 1961) depends upon comparisons between an individual's score on a particular variable and that same individual's score on other variables. For example, we might say that among the varieties of self-concept domains, for a particular individual, academic self concept is more salient or central than the others. Just as with the other interpretive approaches we have described this approach captures some, but not all, of the information we might like to know about he individual. Some of the missing information is available from normative comparisons. For example, we might want to know, if the individual is a student, how common it is for students of the same age to place academic issues at the center of their self-concepts. Ipsative comparisons across norm-referenced scales are problematic because the shape of the profile depends on the norm group. Absolute scales such as response latency (see e.g., the Riding & Dyer, 1980, study discussed above) avoid this problem, which is one of the reasons why such measures are popular among experimentally-oriented psychologists. Domain-referenced scores provide an intermediate case. Profiles change when the domain definition or sampling of elements from it is changed, but not with each new sample of subjects.

Finally, personality scores can be interpreted by comparison to the scores of the same individual at other times. We might, for example, note that a child engaged in very many impulsive acts per day at school during the first grade, fewer during the third grade, and even fewer during the fifth grade. Assuming comparability of the measures (a non-trivial assumption in some cases), it makes sense to say that the child is becoming less impulsive. Again, this particular interpretive framework provides only part of the information we might want. For example, in addition to absolute change, we might be interested in relative change. Probably

most children become less impulsive as they mature. Is the child we are assessing becoming less impulsive at the same rate as other children? Here, normative information would help us.

To summarize, nomothetic, idiographic, idiothetic, ipsative, and developmental approaches each provide useful information in moving from an observed S_{pa} to a meaningful description of an individual's personality. None is uniquely informative; each has something to offer and so combinations are stronger than any method alone.

The Structure of Individual Differences in Personality: The Big Five

As we mentioned earlier, the prerequisite for nomothetic measurement is the identification of the attributes to be measured. Much (most?) of the published literature in personality continues to have a "trait of the month" flavor. That is, various traits become interesting to the personality research community, dominate the literature for a period and then fade from view. Historical examples might include authoritarianism, manifest anxiety , type A personality , locus of control, depression, and achievement motivation. The current favorites might include self-esteem and self-concept. Clearly, as London and Exner (1978) point out "there has been no overarching plan or theory, implicit or explicit, guiding the selection of topics for trait researchers" (p. xiv). In fact, they acknowledge, they were forced to order the chapters of Dimensions of Personality alphabetically for lack of a better scheme.

The history in personality has been, in one respect, quite opposite to the history in intelligence. Successive descriptions of the structure of intelligence broke G into more and more smaller and smaller parts. In contrast, the history of structural descriptions of personality involves creating fewer, broader constructs. The framework which has emerged generally referred to as the "Big Five," has a very long history (see John, Angleitner, & Ostendorf, 1989). For most of that history, the research leading to this five dimensional model of the structure of individual difference in personality was ignored by most researchers in the field. We can only speculate about why this is changing, but it seems likely that the commercial availability of a respected measure of the big five constructs (Costa & McRae, 1992) combined with a mix of empirical results (particularly those demonstrating the generalizability of the model, e.g., Digman

& Takemoto-Chock, 1981), effective proselytizing (e.g., John, 1989), and frustration with the lack of cumulation of research results all contributed.

In this section, we will not provide a detailed account of research on the big five. The interested reader is referred to almost any of the excellent papers by John for an overview. Historically important papers in the big five literature include those by Norman (1963), Tupes and Christal (1961) and Digman and Takemoto-Chock (1981). Our goals in this section are to characterize the big five model of the structure of personality, then illustrate, with an example, how investigators interested in a particular trait that is not among the big five can connect their research to the big five structure and the value of such an endeavor.

The factors identified as the big five emerge from a strand of research rooted in Allport and Odbert's (1936) study of the representation of personality in the English language. The premise behind this research is that language must surely have evolved in ways that allow people to describe each others' personalities (Goldberg, 1981). Thus, the full range of individual differences in personality is available in language. The basic methodology in these studies of the representation of personality in language has been to select some subset of personality descriptors and then ask respondents to use them (in the form, for example, of rating scales) to rate their own or others' personalities. These ratings are then factor analyzed, and the emerging factors identified as major underlying traits of human personality.

What traits emerge from such an exercise? Various investigators have proposed various names for the traits arising from their analyses, and these names often seem rather different. As John (1990) points out, this is perhaps not surprising given the very broad nature of the traits. Nonetheless, the names John suggests (see Table 2) convey a sense of the factors better than the traditional roman numerals. As he points out, the first letters of the factor names allow for the mnemonic device of an OCEAN of personality traits. We (perhaps optimistically) suggest the alternative that the big five may provide a CANOE in which further explorations of the personality wilderness can take place.

Particularly in the context of this chapter, it is worth noting that of these factors, perhaps the least well defined is Factor V, Openness. This is the factor that Norman (1963) originally called "culture." Others have called this factor "intellect" (Digman & Takemoto-Chock, 1981; Peabody & Goldberg, 1989), "openness" (McRae & Costa, 1985) and other names. In a clever study in which judges used the Adjective Check List to describe prototypes of high and low scorers on each of the big five dimensions (John, 19xx), the low end of the fifth dimension was characterized by such adjectives as "narrow interests," "shallow," "simple," and "unintelligent." The high end of the dimension was characterized by a broad range of adjective including "artistic," "civilized," "dignified," "ingenious," "inventive," "intelligent," "original," "polished," "sophisticated," "wise," and "witty." Clearly, this factor encompasses a very broad notion of intelligence as well as a notion of cultural sophistication. To a certain extent, this factor may simply reflect lay people's naive conceptions of intelligence (Sternberg et al., 1981; Fitzgerald & Mellor, 1988).

Just as in the intelligence domain, these broad factors can each be divided into several subtraits. There is, however, an interesting difference between structural models of the personality and intelligence domains. In the intelligence domain, it makes sense to speak of a genuine hierarchical model, with G occupying a central position at the top of the hierarchy. It is, in other words, sensible to describe a person as highly intelligent, where "intelligent" is interpreted as a reference to the very broad construct of G. On the other hand, there is no single central construct at the epitome of the hierarchical model of personality. We have no single term for someone who is high is each of the five personality factors. Thus, the big five model really represents five different, probably partially overlapping, hierarchies.

The lexical approach to identifying the dimensions of personality is a thoroughly nomothetic enterprise. One of the goals of a nomothetic science of personality is a common vocabulary for the description of personality, and herein lies the greatest contribution of the big five model. For many years now, the bulk of personality research has been conducted in narrow and isolated domains leading to the development of theories and supporting research of single

traits. Though one frequently gets the sense that two traits, each with their own literature and theory bear some remarkable similarities, there is no clear way to evaluate the validity of this suspicion.

Perhaps now we approach the point at which the field can settle on single set of dimensions to which individual traits can be referenced. If the big five model is substantially valid, all personality traits are either included among the big five or their components or, more commonly, can be defined in terms of a composite of the big five. A recent study by Goff and Ackerman (1993) provides an illustration. The study was designed to investigate the relation between a personality trait the investigators call "typical intellectual engagement" and various aspects of intelligence. The investigators selected well-validated existing measures to span the ability and personality domains, and also included newly constructed measures of typical intellectual engagement and related personality constructs.

Because they included measures of the big five as marker variables, they were able to assess the relation between typical intellectual engagement and each of these dimensions. Typical intellectual engagement was relatively highly related to openness (r, corrected for attenuation, = .72), but Goff and Ackerman point out that that leaves a substantial proportion of the variance in typical intellectual engagement that is not shared with openness. This finding suggests a potential deficiency in the big five model. Here is a trait (with demonstrated interesting relations to intelligence) that lies outside the space defined by the big five.

This correlation alone, however, is inadequate to address the distinctiveness of typical intellectual engagement and the big five framework. There are a number of reasons other than unreliability that two measures of the same construct might be less than perfectly correlated (Rocklin, 1994). For our purposes, chief among them is that each measure might be less than perfectly construct valid. Thus, the exercise of justifying a putatively new construct is fundamentally one of construct validation. To see, in detail, what such a effort might look like, the interested reader is referred to the original article (Goff & Ackerman, 1993), a comment (Rocklin, 1994) and a reply (Goff & Ackerman, 1994).

Given the level of acceptance that the big five is gaining, efforts such as Goff and Ackerman's deserve to become the norm for personality research. An early step in the development of a new construct ought to be a thorough investigation of the location of that construct in the space defined by the big five. In some cases investigators may find that the trait they are investigating is well-subsumed in one of the big five hierarchies. In other cases, they may find that a combination of big five variables are needed to describe the construct in which they are interested. In this case, the investigator has, perhaps, identified a particularly interesting vector within the big five space. Finding such a vector may be quite valuable. Vernon's point, quoted earlier, that the factors emerging from factor analyses of test batteries have no claim to psychological meaningfulness holds with equal force here. There is no guarantee that the axes of the big five space are psychologically meaningful and it may well be that the most interesting traits, for some purposes, are just such composites. As in the history of theories of intelligence, there will no doubt always be disagreements about the number of traits and the hierarchical (or other; see ??, 19xx) arrangement of those traits. The big five framework, though holds the promise of at least allowing these disagreements to occur within a common context.

Issues at the Intersection of Intelligence and Personality

How shall we conceptualize the domains of personality and intelligence? Are they two intersecting sets? Is one (intelligence) a subset of the other (personality)? Or is each defined by emphasizing the spheres of influence of other constructs, such as conation, affection, and volition? Are both necessarily differential constructs? Or are each admixtures of constructs defined over persons and over tasks/situations? In short, discussion of the overlap between these two domains presumes something about the content and purview of each domain and something else about their relative status. In this section we discuss these issues from several perspectives. Mostly we start from intelligence and seek contacts with personality, but could have as easily started from the opposite shore. Physiology provides a good starting point.

Physiological Mechanisms

Advances in neuropsychology have been linked to improved techniques for measuring brain activity, especially for locating regions of the brain that show changes in activation across conditions. Inevitably, each new technique for measuring brain activity has been applied to the task of understanding individual differences in intelligence or personality or both (see, e.g., Matarazzo, 1992). Sometimes the results conform nicely to existing theory, such as when Haier et al. (1992) found that changes in glucose metabolic rate correlated with the amount of improvement subjects showed on a computer game. Of the eight subjects studied, those who showed most improvement on the computer game showed the greatest reduction in glucose metabolic rate. Such findings conform well with theories of skill acquisition (Anderson, 1983; Shiffrin & Sneider, 1977), although they do not explain how automatization of skills occurs. Nevertheless, most would view such findings as interesting corroboration of psychological theory. Similar examples (e.g., Bullock & Gillialand, 1993) can be cited in the personality literature.

Some have advanced more forceful claims. Harking back to Galton (1869), they have sought to show the physiological basis of individual differences in intelligence. While few would

deny that observed differences in intellectual performance must eventually be grounded in physiological processes, the hope that intelligence or personality can be explained at the physiological level is, as Thorndike et al. (1926) concluded, a measurement pipe dream. Why? Physiological measures must always be validated against behavioral criteria. No one would assess individuals' intelligence or personality using one or more physiological measures that had not shown high correlations with corresponding existing measures of intelligence or personality or with the criteria such tests predict no matter how theoretically well-grounded the physiological measures might be. Those who have most assiduously sought physiological correlates of intelligence, in particular, often have other agenda. For example, one goal is to find new measures that show high correlations with the old, but that can not be criticized for "reflecting only differences in cognitive contents and skills that persons have chanced to learn in school or acquire in a cultured home" (Jensen, 1980, p. 704). More concretely, the goal is to find a culture-free, perhaps even experience-free measure of intelligence. Those who view intelligence as a term inextricably bound to value and culture see this as a modern Holy Grail.

Reductionism has always held allure for scientists in all disciplines, but with equal persistence has been challenged by philosophers, such as Dewey (1896) in his early critique of the claim that the reflex arc (or stimulus-response bond) could explain all of human behavior. Today, however, it is not only philosophers who challenge reductionism, but cognitive scientists as well. For example, the neurologist Sperry (1993) put it this way:

> The cognitive revolution represents a diametric turn around in the centuries-old treatment of mind and consciousness in science. The contents of conscious experience, with their subjective qualities, long banned as being mere acausal epiphenomena or as just identical to brain activity or otherwise in conflict with the laws of the conversation of energy, have now made a dramatic comeback. Reconceived in the new outlook, subjective mental states become functionally interactive and essential for a full explanation of conscious behavior. Traditional micro determinist reasoning that brain function can be fully accounted for in neurocellular-physiochemical terms is refuted. (p. 879)

Unfortunately, correlations between physiological indices and IQ scores are often significant, and sometimes substantial, especially when samples are small and vary widely in ability, and the correlations are corrected and massaged in various ways. Reports of such newfound relations usually spread like rumors of gold among impoverished miners. However, larger samples, tighter controls, and less massaged correlations inevitably show smaller relationships than initially envisioned. Indeed, the best predictor of correlation in such studies is year of publication: initial reports of a strikingly high correlation are followed by a succession of ever-lower correlations which usually stabilize in the $\underline{r} = .2$ to $\underline{r} = .4$ range. By then, though, a new candidate has entered the field, usually in the form of a preliminary report from physiological lab on a handful of subjects, and the cycle begins anew.

Although we reject the view that either intelligence or personality will someday be explicable in purely physiological terms, we see a continued role for investigation of the neurological and even biochemical bases of cognitive functioning. In part this research will be fueled by continued advances in brain imaging techniques. Probably the most useful type of studies will be those that go beyond attempts to locate cognitive functions and instead describe the time course of their action. Even more useful would be studies that show qualitative differences in patterns of brain activity over time between individuals who differ in an ability, personality, or style.

Expanding intelligence to include Affect and Conation

One recurring theme in the story of intelligence is the attempt to account for those affective, motivational, and volitional aspects of cognition long recognized as central to the development and expression of intelligence but with equal persistence ignored in formal theories of human abilities. For example, in the same 1921 symposium in which Thorndike gave the oft-cited definition of intelligence as "the power of good responses from the point of view of truth or fact" (p. 124), he also noted:

> It is probably unwise to spend much time in attempts to separate off sharply certain qualities of man, as his intelligence, from such emotional and vocational qualities as his

> interest in mental activity, carefulness, determination to respond effectively, persistence in his efforts to do so; or from his amount of knowledge; or from his moral or esthetic tastes. (p. 124)

Similarly, in the same symposium, Freeman (1921) noted that a listing of cognitive traits provides an incomplete model of intelligence, which must also include "The characteristic . . . sometimes called temperament or moral character" (p. 134).

Those actively involved in the administration and interpretation of individual intelligence tests (e.g., Binet, 1903; Wechsler, 1950, 1975) have been the most vocal advocates for inclusion of affect. Indeed, the weight given to such "non-intellective factors" (Weschler, 1943) in the interpretation of intelligence first declined with the introduction of group administered tests, and then again with the introduction of factorial methods of analyzing correlational data. Intelligence as a behavioral style was replaced with intelligence as one or more intellectual powers or latent variables that could be inferred, but not observed.

Messick (1987) notes that one of the major ways in which personality impacts cognition is through the influence of affect:

> One of the prime sources of personality influence on cognition is the pervasive impact of positive and negative affect. The positive affects of interest and surprise, along with . . . intrinsic motivation and curiosity, are critical in the initiation and maintenance of cognitive functioning, in the selectivity and duration of attention, and in the differentiation and integration of cognitive structure. In contrast, negative affects such as fear and anxiety lead to interference and disorganization of function, to disruption and pre-emption of attention, and to dedifferentiation and primitivization of structure. Furthermore, mechanisms of defense against anxiety and negative affects, being not only self protective but often self-deceptive, introduce distortions of their own into cognitive processing. (p. 36-37)

Trait-trait correlations. Differential psychologists who have recognized the overlap between the domains of intelligence and personality have attempted to explore it in several ways.

The simplest has been to search for correlations between ability and personality traits, the most oft-reported of which is the correlation between intelligence and the factor Costa and McCrae (1985) call Openness. A recent example can be found in a study of Goff and Ackerman (1992), discussed above. Following earlier leads of Gough (1953), they hypothesized that intelligence would show stronger correlations with a personality construct called Typical Intellectual Engagement (TIE) if abilities were measured as typical performance variables rather than as maximal performance variables (CF Cronbach, 1970). Results indeed showed that measures of fluid ability (presumably an index of maximal performance) showed no correlation with TIE whereas measures of crystallized ability (presumably a better index of typical performance) did. Also noteworthy are studies that show correlations between patterns of abilities and personality constructs (see, e.g., Cattell, 1971). For example, the contrast between spatial and verbal fluency abilities has repeatedly shown correlations with Extroversion, with high fluency-low spatial subjects showing higher levels of Extroversion and low fluency-high spatial subjects showing higher levels of introversion (Smith, 1964; Riding & Dyer, 1980). However, patterns of abilities are probably better understood as predisposing certain styles of thought, which we discuss next.

Styles. The second approach to understanding the intersection of cognition and affect has been through the study of styles of thought which Messick (1987) defines as “stable individual differences in the manner or form of psychological functioning" (p. 37). Three major classes of styles are typically distinguished: cognitive styles, learning styles, and defensive styles. Cognitive styles include constructs such as field articulation versus global style, extensiveness of scanning, cognitive complexity versus simplicity, leveling versus sharpening, category width, reflection versus impulsivity, automatization versus restructuring, and converging versus diverging.

A variety of learning styles have also been hypothesized (Weinstein, Goetz, & Alexander, 1988). The most general distinction concerns whether strategies lead to deep versus surface processing during learning (Entwistle, 1987; Snow & Swanson, 1992). However, such strategies cannot be understood in isolation from motivation for learning (Biggs, 1987; Ainley, 1993).

Further, different subject-matter domains may also require or lead learners to develop different global strategies for organizing their knowledge (Pask, 1976).

Finally, defensive styles refer to "consistent . . . ways of organizing and channeling affect in cognition" (Messick, 1987 p. 51). As such, they are primarily ego-protective, "but also serve the important adaptive function of maintaining cognition, in the face of intense affects" (p. 51). Four broad defensive styles have been proposed: obsessive-compulsive, hysterical, paranoid, and impulsive, which, in the normal range of personality, are called rigid, impressionistic, suspicious, and unintegrated cognition, respectively (Messick, 1987).

However appealing style constructs have been to theorists, they have not fared as well empirically (see, e.g., Vernon, 1973; Tiedemann, 1989). Surely part of the difficulty is that styles are, by definition, situationally labile in a way that abilities are not. But a larger difficulty stems from the application of an inappropriate measurement model. By definition, styles concern not "how much?" but "how". Further, measures of style should yield scores that are bipolar and value differentiated rather than unipolar and value directed (Messick, 1984). However, most measures of cognitive styles have inappropriately followed the ability-factor model, which is better suited to value directional questions about unipolar dimensions that ask "how much." Early mental testers -- particularly Binet, but others as well (see Freeman, 1926) -- were as much concerned with <u>how</u> children solved problems as with the answers they gave. This concern with process was picked up by developmental psychologists, but gradually abandoned by psychometricians, especially with the rise of group administered tests that could be scored by a clerk, and then later, by a machine. Tests became increasing efficient vehicles for identifying those who were more (or less) able, but increasing uninformative s to what abilities might be (Lohman, 1989). Issues of process were exiled to the murky land of cognitive styles. There, isolated from the mainstream of differential psychology, promising style constructs were gradually ground into traits already known to ability theorists, but by other names. When the redundancy was finally discovered, ability theorists claimed priority and style theorists were left with the residue. Measurement models developed in cognitive psychology to estimate consistencies in strategies are, in fact,

much better suited to the task of measuring "how" (Lohman & Ippel, 1993). Thus, one of the more important contributions cognitive psychology might make to measurement would be through improved measures of cognitive styles.

Siegler (1988) reported one example of how this might be accomplished. He administered addition, subtraction, and word identification tasks to two groups of first graders. Performance on each item was classified as based either on retrieval of a response or on construction of a response using a back-up strategy. Students were then classified in one of three groups depending on the pattern of response correctness overall, on retrieval problems, and on back-up strategy problems. Siegler labeled the groups good, not-so-good, and perfectionist students. Perfectionists were students who exhibited good knowledge of problems but set high confidence thresholds for stating retrieval answers. The distinction between perfectionist and good students thus mirrors the cognitive style dimension of reflexivity-impulsivity. Note, however, that the latter dimension is typically defined by performing a median split on latency and error scores on a figure matching task and then discarding subjects in two of the four cells. Siegler, however, started with a model of strategy use that distinguished between strength of associations (a classic "cognitive" construct) and confidence criterion for stating retrieval answers (a "conative" construct). Further, the hypothesized style dimension was shown by examining response patterns across three tasks commonly used in the classroom.

Another example comes from the work of Riding and Dyer (1980). Children in their study first listened to a short story and then answered a series of questions about the passage, all of which required inference. Questions were of two types, those that depended on imagery and those that depended on semantic elaboration. For example, the story may have mentioned the fact that someone knocked on the door of a cottage. The question might be "What color was the door?" There was no right answer, since the color of the door was not specified. Response latency was recorded. However, the dependent variable of interest was an ipsative score that compared latencies on semantic and imagery questions. The idea was to identify children who were much quicker to answer one type of question than the other. Correlations were then

computed between this ipsative score and the Junior Eysenck Personality Inventory. Correlations with the Extroversion scale were r = -.67 for boys (n = 107) and r = -.76 for girls (n = 107). Thus, children who showed a preference for imagistic processing were much more likely to be introverted, whereas those who showed a preference for verbal elaboration were more likely to be extroverted.

Although different in many respects, the Siegler (1988) and Riding and Dyer (1980) studies both show consistent individual differences in strategy preference can, with proper observation designs and measurement models (see Lohman & Ippel, 1993), define style constructs that provide one important bridge between the domains of personality and ability.

Development. A third bridge between personality and intelligence has emerged from the study of cognitive and moral development, particularly in the adolescent and adult years. One of the persistent findings in this literature is that at least some young adults move from an epistemology in which knowledge is viewed as given, absolute, and fixed to an epistemology in which knowledge is viewed as constructed, contextual, and mutable (Perry, 1970; Kitchener, 1983). Further, although there is disagreement as to whether this development is best characterized as a transition through developmental stages (Kohlberg, 1984; Kitchener, 1983) or as the acquisition of increasingly complex beliefs about different aspects of knowledge (Schommer, 1990), there is some consensus that the nature of these epistemic beliefs influence not only affective responses to problems, but how they are solved.

In education, modes of cognition that Dewey (1933) called reflective thinking have been of particular concern. Philosophers such as Ennis (1991) claim that the development of such modes of reflective thought also requires the development of dispositions such as open-mindedness, caution, and tolerance for ambiguity. Others have attempted to demonstrate specific linkages between modes of reasoning and personality variables. Baron (1982) showed how a Dewean five-phase model of reflective thinking could be linked to decision rules governing the operation of each step, and how individual differences in the implementation of these rules reflected temperamental biases and values of the individual. For example, the phase called

problem enumeration is guided by rules concerning the number and type of possibilities to generate. Similarly, the phase called evaluation is guided by some rule that specifies when to stop thinking. General biases (such as impulsiveness) affect both phases, whereas specific biases (such as the standard of excellence imposed on solutions) affect one phase more than another. The model thereby provides one interesting way to conceptualize linkages between cognitive development and personality.

Cognition, affection, and conation. Conceptual categories impose arbitrary boundaries on experience. The commitment to a particular set of terms that is required to describe a domain inevitably emphasizes some elements and relationships among elements in that domain while de-emphasizing or even obscuring others. Scientists must thus endeavor, in Bacon's metaphor, "to carve nature at the joints" rather than arbitrarily. Novick (1982) made a similar point, but using the statistical concept of exchangeability:

> The essential scientific process is that of changing our identification of a person [or other element] from a large population to a relevant subpopulation . . . Our success as scientists can be measured by our skill in identifying variables that can be used to define relevant, exchangeable subpopulations. (p. 6)

The concept of exchangeability implies that different groupings are possible and is thus closer to modern constructivist theories of knowledge than is Baron's metaphor. Indeed, some domains are less well-structured than others, and so conceptual categories, no matter how elegant, are inevitably miss, and may even mislead. In such cases, other perspectives are not only possible, but desirable since they reveal relationships formerly hidden from view (Langer, 1989) . However, fundamental shifts in conceptual categories is rare in well-studied domains. Vast, socially-shared conceptual networks are constructed using these categories. Those who have acquired the crystallized knowledge necessary to participate fully in the conversation rooted in these categories may find it difficult to restructure their knowledge in new ways. Thus, this last approach is as unusual as it is challenging. The basic idea is to reconceptualize the domain using Aristotle's categories of cognition, affection, and conation (or knowing, feeling, and willing)

rather than the categories of personality and intelligence. Affection includes temperament and emotion. Conation includes motivation and volition. Snow and Jackson (in press) suggest that conation lies between affection and cognition, and thereby constitutes a significant portion of the overlap between "personality" (affection and conation) and "intelligence" (conation and cognition). Following Kuhl and Beckman (1985), motivation and volition are viewed as forming a continuum within the conative category, a continuum that symbolizes a commitment pathway from wishes to wants to intention to actions (see Corno & Kanfer, 1993).

The principal advantage of this scheme is that it replaces the broad, fuzzy concepts of "personality" and "intelligence" with narrower concepts that have clearer psychological referents. However, neither cognition, affection, nor conation are explicitly differential constructs. Whether these new constructs span the same space as the old constructs depends not so much on the conventional meanings of each term but rather on the measurement models and units of analysis assumed for each. For example, Cantor (1990) argues that attempts to understand the "doing" or process side of personality can be resolved to three types of units: schemas, tasks (which includes goal structures), and strategies. Each of these units, while potentially something on which individuals could differ, is not defined by such individual differences (see Cervone, 1991, on the issue of units in personality research). Attempts to map them on to individual difference constructs depend on the psychological univocality of the individual difference construct. Thus, attempts to link cognition and either ability or personality dimensions are generally easier for narrow-band than for broad-band constructs. Cantor (1990) makes this prediction explicitly:

> The [cognitive] approach is probably best applied to show the workings of dispositions such as optimism, self-esteem, or shyness that have an identifiable cognitive-motivational component, and that translate readily into goals and self-regulatory processes. (p. 737).

Ackerman and Goff (in press) make a similar point in reply to Rocklin's (in press) argument that most of effects attributed to their Typical Intellectual Engagement factor may be more parsimoniously attributed the Big 5 factor called Openness. They note that, although higher-order factors (such as Openness) often have broader predictive utility, they do not

necessarily have more psychological reality than lower-order factors. Thurstone and Guilford repeatedly made the same point in discussions of ability factors. Indeed, as we noted above, psychological clarity of individual difference dimensions seems to vary inversely with the breadth of the dimension.

The Two Disciplines , continued

There is an old adage "There are two types of people in the world: Those who think there are two types, and those who do not." Differential psychologists have typically put themselves in the latter category and smiled condescendingly on experimental psychologists who, by virtue of inferior statistical training, routinely categorized continuous variables. But perhaps there is something else at work. The trait-factor model of differential psychology applies only when (to use Novick's phrase) all subjects can be considered exchangeable members of the same population who differ at most in the weights assigned to each of the different factors in the model. However, the experimentalist is more interested in units of analysis (such as schemas, goals, and strategies) that, while often differing quantitatively, are most interesting when they differ qualitatively. For example, Havighurst (1953) and Erikson (1950) described developmental progressions of qualitatively different life tasks; Norem (1989) described different coping strategies of defensive-pessimists and illusory-glow optimists; Kelly (1955) and later self-concept theorists described qualitative differences in self-schemas. Thus, part of the incompatibility between experimental and differential psychology may stem from the search for qualitative rather than quantitative differences. However, just as performance functions fitted to data averaged over subjects can assume a smooth form unlike that shown by any subject in the sample (Estes, 1956), so too can scores for individual subjects created by averaging over items or situations appear to differ quantitatively when item-level data differ qualitatively. This argues that the measurement models of trait psychology are in a fundamental way inadequate for the task of relating the two domains. Measurement models that represent qualitative differences in knowledge, goals, and strategies are needed (see Lohman & Ippel, 1993). So are tasks that elicit such responses.

Ultimately, the issue resolves to (a) construct definition and (b) construct validation. We previously noted that although constructs in differential psychology are invariably defined by individual differences, constructs in other domains may be defined by changes in performance across conditions, by rules that map scores on to context domains or absolute scales, and in other ways that reflect individual difference variance incidentally rather than directly, and may even obscure them altogether. Thus, attempts to discover the cognitive bases of differential constructs must first attend carefully to issues of construct definition. When constructs are defined by individual difference variance, then experimental analyses of tests may not tell us much about the source of these individual differences unless people solve the tests in different ways and the experimental analyses can identify them. Similarly, when constructs are defined by condition or stimulus variance, then correlating individual scores on tasks with other variables may not tell us much about it either. Logic and argumentation provide better avenues of commerce between these two types of constructs -- if commerce there be -- than do the statistical methods of either discipline.

The primary contribution of cognitive analyses to the understanding of differential constructs is through the validation of those constructs, particularly their internal validation. Although measurement specialists have long recognized that test validation has both an internal and an external dimension (e.g., Loevinger, 1957), methods for addressing questions about internal validity were meager compared to the sophisticated correlational techniques developed to address questions about external validity. Cognitive psychology has altered this situation through the development of new methods for addressing questions about internal validity, and theories by which to interpret their results (Embretson, 1983; Sternberg, 1977).

According to Shepard (1993), analyses of the internal validity of a test should address two aspects: (a) the expected relationships among dimensions of the construct, and (b) the process believed to underlie test performance. The first aspect encompasses Allport's (1937) concern for idiographic assessment, and thus is a seminal issue in the validation of personality constructs. The second aspect encompasses the array of techniques that are used to infer (and sometimes

provide formal models of) cognitive processes and knowledge structures by which subjects generate their responses on tests or the knowledge they use to answer test questions.

Although one can sometimes show statistical relationships between the products of an internal validity study and the construct itself (and other individual difference constructs), connections are more often logical than statistical. For example, one can support the interpretation of a test score as a measure of spatial ability by showing how well the performance of each examinee is described by models that compare spatial and non-spatial strategies for solving items. There is no easy way to reduce such information to a single number that can be correlated with other variables, nor does the correlation much address the issue of how individual scores can be interpreted (see, e.g., Macmann & Barnett, in press). Rather, connections are made through argument, inference, and systematic testing of plausible rival hypotheses.

One source of controversy among ability theorists is whether intelligence is best characterized as a noun (e.g., a structural property of the brain or a trait possessed in a certain amount), an adjective (e.g., identifying certain types of people), a verb (e.g., denoting certain varieties of cognition or action), or an adverb (e.g., describing the qualities of cognition or behavior, such as its speed or efficiency). Those who search for those cognitive processes and knowledge structures that generate behavior labeled intelligent often assume that some nouns will be needed, but place most emphasis on verbs and adverbs (i.e., how and how well one thinks). Those who study social and cultural variations in intelligence generally assume that an adjective is needed. Sternberg's (1984) componential and contextual subtheories nicely capture this divergence. On the other hand, trait-based theories of personality characterize the domain as a collection of adjectives, and when traits are thought to inhere in the individual, as nouns. The interesting question, though, is whether personality also can be understood using verbs and adverbs. Some (e.g., Cantor, 1990), see this as the wave of the future; others (e.g., Cervone, 1991) are less sanguine about the possibility of a rapprochement between the experimental and differential approaches. If recent attempts to apply cognitive theory to ability constructs are any guide, then bridges will be more difficult to build than initially seems possible. However, careful

attention to issues that were insufficiently addressed in ability-process research -- particularly those issues we have discussed concerning the definition and measurement of constructs -- will surely improve the chances of meaningful progress.

Summary and Conclusions

We have discussed much in this chapter -- indeed, too much to summarize neatly. At the risk of misleading by omission, we offer the following list of main points.

1. In the domain of intelligence, the controversy over whether intelligence is unitary or multiple has a long history, and promises to have an even longer one. In large measure this is because the debate is not only about evidence but also about value, such as whether parsimony, utility, or psychological meaningfulness should be given priority. Hierarchical theories offer a compromise, but, as Vernon (1973) pointed out, may better meet statistical than psychological criteria. We also noted that, by emphasizing predictive utility over psychological meaningfulness, such theories have enhanced the status of broad factors and diminished the status of narrower factors. However, tests of narrower abilities have never fared as well as tests of broader abilities when utility was the criterion. It is unlikely that new tests will fare better, in spite of the fact that they are more firmly grounded in theory than many of the older classics. Nevertheless, newer tests (such as the Woodcock-Johnson - Revised) are a boon for researchers, and may someday show utility as aptitude variables that interact with instructional or other treatment variables.

2. The theory of fluid and crystallized abilities has attracted a wide following. We predict that interest in this theory will continue, for reasons good and bad. For some, the fluid-crystallized distinction provides a congenial justification for a belief in innate intelligence versus achievement, which is bad. For others, though, the theory has provided a useful way to reconceptualize abilities in terms of cognitive processes and task affordances (Snow, 1992), which is good.

3. Cognitive psychology has enormously enriched our understanding of human intelligence, and has given us new methods for investigating it. However, building bridges

between cognitive and differential psychology has proved more difficult than once imagined, primarily because researchers have focused on quantitative differences in component processes rather than on qualitative differences in solution strategy. However, we do not believe that broad constructs in either personality or intelligence can be explained as the action of one or more physiological processes, even though we believe that the neuropsychologist has an important place at the table.

4. In the personality domain, recent consensus over the Big 5 represents an important landmark in the development of the field. Although elaboration and refinement of this system will surely be forthcoming, it provides a useful frame of reference for such discussion. Because of this, studies of ability and personality constructs should include measures of the major dimensions of personality (Big 5) and ability (broad group abilities). New individual difference constructs are often at least partially redundant with constructs already in the catalog. Reference measures also help us interpret results by showing where new scores and constructs are located in this more familiar space. Such studies also allow for the revisions of our understanding of the space by allowing for the identification of inadequacies in existing models.

5. Controversy over the meaning of nomothetic scales will likely increase as cognitively-inspired research continues, and as more investigators attempt to bridge the gap between purely differential and purely experimental/cognitive approaches to the study of personality. However, both internal and external analyses of performance are needed. External analyses tend to involve normative interpretations of test scores; internal analyses tend to involve ipsative and domain-referenced interpretations. Both are needed, although linkages between them are not as straightforward as some have imagined.

6. Internal or process-based analyses tend to be task specific. This is in part an unavoidable consequence of the requirements of such analyses. It is also why experimental psychology is often criticized as a psychology of isolated tasks. For example, it is difficult to say much about how subjects are solving a task unless items or trials are varied systematically along

sources of difficulty hypothesized to influence cognitive processes. Process models of heterogeneous tasks are thus impossible, unless the analysis focuses on meta-level constructs.

7. The selection/prediction model that guided construction of current ability and personality tests is not very informative for decisions about interventions to encourage growth or change. Process-based theories are more informative, but overly optimistic since they rarely examine the extent to which changes in performance transfer outside the bound of the experimental task or situation. Therefore, new ability and achievement measures are needed that have instructional implications beyond selection. There is already some call for this among school psychologists under the guise of curriculum-based testing. Clinical and counseling psychologists could well use similar measures that described personality constructs in units such as strategies, schemes, and goal structures that have more obvious implications for change. Such measures will be difficult to develop and will likely look very different from today's measures.

8. Intensive analysis of individual cases is worthwhile. Perhaps the most interesting analyses will be those of individuals with extreme scores on one or more dimensions of personality or ability. These intensive analyses of individual cases are the most direct way to identify qualitative differences between individuals. They provide avenues both for understanding what it means to be an extreme scorer and for understanding the variety of ways in which one might achieve an extreme score.

9. The overlap of ability and personality is more evident when these variables are represented as control processes and strategies than when they are represented as trait dimensions. As Vernon pointed out, a hierarchical model of the traits of ability or of personality can only tell us about the relations among tests. These relations have no particular claim to psychological meaningfulness. Further, the research that has led us to consensual descriptions of ability and personality dimensions was almost guaranteed to yield ability factors with little or no relation to personality factors, because of the way in which variables to be factored were chosen. In contrast, variables that describe what people do and how they do it have much greater potential for coordination. Furthermore, although style constructs have long provided a useful way to

conceptualize the intersection between the domains of personality and ability, new categorization schemes (such as cognition, affection, and conation) suggest broader overlap than was once imagined.

* * * * *

Now our story is told. Though the plots are diverse and interwoven in ways we have only been able to suggest, they are hopeful plots. Current trends in intelligence and personality assessment allow for the hope of a future integrated understanding of the ways (to paraphrase Kluckhohn and Murray, 1953) that each person is like all other people, some other people, and no other person.

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Table 1

The Big Five Personality Factors

]	] Extraversion, Energy, Enthusiasm
I	⁄ Agreeableness, Altruism, Affection
Il	(Conscientiousness, Control, Constraint
I'	] Neuroticism, Negative Affectivity, Nervousness
\	(Openness, Originality, Open-mindedness