

Individual Differences and Differential Psychology: A brief history and prospect

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Differential psychology has been a central concern to philosophers and psychologists, both applied and theoretical, for the past several millennia. It remains so today. The proper study of individual differences integrates methodology, affective and cognitive science, genetics and biology. It is a field with a long history and an exciting future. We review some of the major questions that have been addressed and make suggestions as to future directions.

This handbook is devoted to the study of individual differences and differential psychology. To write a chapter giving an overview of the field is challenging, for the study of individual differences includes the study of affect, behavior, cognition, and motivation as they are affected by biological causes and environmental events. That is, it includes all of psychology. But it is also the study of individual differences that are not normally taught in psychology departments. Human factors, differences in physical abilities as diverse as taste, smell, or strength are also part of the study of differential psychology. Differential psychology requires a general knowledge of all of psychology for people (as well as chimpanzees, dogs, rats and fishes) differ in many ways. Thus, differential psychologists do not say that they are cognitive-psychologists, social-psychologists, neuro-psychologists, behavior geneticists, psychometricians or methodologists, for although we do those various hyphenated parts of psychology, by saying we study differential psychology, we have said we do all of those things. And that is true for everyone reading this handbook. We study differential psychology. Individual differences in how we think, individual differences in how

we feel, individual differences in what we want and what we need, individual differences in what we do. We study how people differ and we also study why people differ. We study individual differences.

There has been a long recognized division in psychology between differential psychologists and experimental psychologists (Cronbach, 1957; H. J. Eysenck, 1966), however, the past 30 years has seen progress in integration of these two approaches (Cronbach, 1975; H. J. Eysenck, 1997; Revelle & Oehleberg, 2008). Indeed, one of the best known experimental psychologists of the 60's and 70's argued that "individual differences ought to be considered central in theory construction, not peripheral" (Underwood, 1975, p 129). However, Underwood (1975) went on to argue (p 134) that these individual differences are not the normal variables of age, sex, IQ or social status, but rather are the process variables that are essential to our theories. Including these process variables remains a challenge to differential psychology.

The principles of differential psychology are seen outside psychology in computer science simulations and games, in medical assessments of disease symptomatology, in college and university admissions, in high school and career counseling centers, as well as in applied decision making.

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Early Differential Psychology and its application

Differential psychology is not new for an understanding of research methodology and individual differences in ability and affect was described as early as the Hebrew Bible in the story of Gideon (Judges 6, 7). Gideon was something of a skeptic who had impressive methodological sophistication. In perhaps the first published example of a repeated measures, cross over design, he applied several behavioral tests to God before agreeing to go off to fight the Midians as instructed. Gideon put a wool fleece out on his threshing floor and first asked that by the next morning just the fleece should be wet with dew but the floor should be left dry. Then, the next morning, after this happened, as a cross over control, he asked for the fleece to be dry and the floor wet. Observing this double dissociation, Gideon decided to follow God's commands. We believe that this is the first published example of the convincing power of a cross over interaction. (Figure 1 has been reconstructed from the published data.)

In addition to being an early methodologist, Gideon also pioneered the use of a sequential assessment battery. Leading a troop of 32,000 men to attack the Midians, Gideon was instructed to reduce the set to a more manageable number (for greater effect upon achieving victory). To select 300 men from 32,000, Gideon (again under instructions from God) used a two part test. One part measured motivation and affect by selecting those 10,000 who were not afraid. The other measured crystallized intelligence, or at least battlefield experience, by selecting those 300 who did not lie down to drink water but rather lapped it with their hands (McPherson, 1901).

Gideon thus combined many of the skills of a differential psychologist. He was a methodologist skilled in within subject designs, a student of affect and behavior as well as familiar with basic principles of assessment. Other early applications of psychological principles to warfare did not emphasize individual differences so much as the benefits of training troops of a phalanx (Thucydides, as cited by Driskell & Olmstead, 1989).

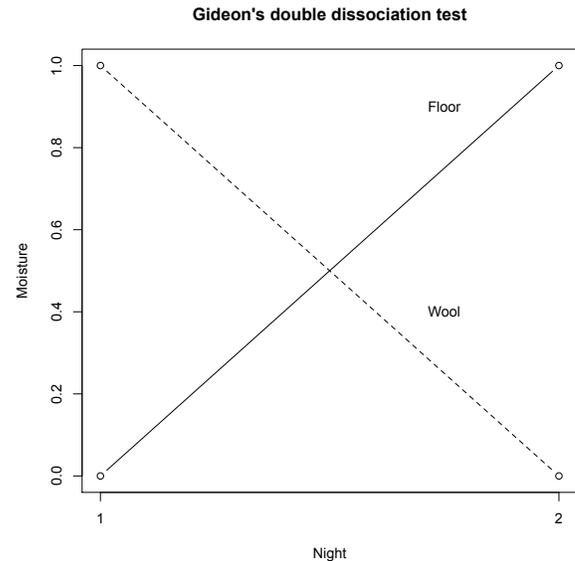


Figure 1. Gideon's tests for God are an early example of a double dissociation and probably the first published example of a cross over interaction. On the first night, the wool was wet with dew but the floor was dry. On the second night, the floor was wet but the wool was dry (Judges 6:36-40)

Personality taxonomies

That people differ is obvious. How and why they differ is the subject of taxonomies of personality and other individual differences. An early and continuing application of these taxonomies is most clearly seen in the study of leadership effectiveness. Plato's discussion of the personality and ability characteristics required for a philosopher king emphasized the multivariate problem of the rare co-occurrence of appropriate traits:

... quick intelligence, memory, sagacity, cleverness, and similar qualities, do not often grow together, and that persons who possess them and are at the same time high-spirited and magnanimous are not so constituted by nature as to live orderly and in a peaceful and settled manner; they are driven any way

by their impulses, and all solid principle goes out of them. ...

On the other hand, those steadfast natures which can better be depended upon, which in a battle are impregnable to fear and immovable, are equally immovable when there is anything to be learned; they are always in a torpid state, and are apt to yawn and go to sleep over any intellectual toil. ... And yet we were saying that both qualities were necessary in those to whom the higher education is to be imparted, and who are to share in any office or command. (Plato, 1991, book 6)

Similar work is now done by Robert Hogan and his colleagues as they study the determinants of leadership effectiveness in management settings (Hogan, 2007, 1994; Hogan et al., 1990; Padilla et al., 2007) as well as one of the editors of this volume, Adrian Furnham (Furnham, 2005). The dark side qualities discussed by Hogan could have been taken directly from *The Republic*.

A typological rather than dimensional model of individual differences was developed by Theophrastus, a student of Aristotle, who was most famous as a botanical taxonomist. However, he is known to differential psychologists as a personality taxonomist who organized the individual differences he observed into a descriptive taxonomy of “characters”. The characters of Theophrastus are often used to summarize the lack of coherence of early personality trait description, although it is possible to organize his “characters” into a table that looks remarkably similar to equivalent tables of the late 20th century (John, 1990; John & Srivastava, 1999).

1600 years after Theophrastus, Chaucer added to the use of character descriptions in his “Cantebury Tales” which are certainly the first and probably the “best sequence of ‘Characters’ in English Literature” (Morley, 1891, pg 2). This tradition continued into the 17th century where the character writings of the period are fascinating demonstration of the broad appeal of personality description and categorization (Morley, 1891).

Causal theories

Tyrtamus of Lesbos, who was known as Theophrastus for his speaking ability, (Morley,

1891), asked a fundamental question of personality theory that is still of central concern to us today:

Often before now have I applied my thoughts to the puzzling question – one, probably, which will puzzle me for ever – why it is that, while all Greece lies under the same sky and all the Greeks are educated alike, it has befallen us to have characters so variously constituted.

This is, of course, the fundamental question asked today by differential psychologists who study behavior genetics (e.g., Bouchard, 1994, 2004) when they address the relative contribution of genes and shared family environment as causes of behavior.

Biological personality models have also been with us for more than two millenia, with the work of Plato, Hippocrates and later Galen having a strong influence. Plato’s organization of the tripartite soul into the head, the heart and the liver (or, alternatively, reason, emotion and desire) remains the classic organization of the study of individual differences (Hilgard, 1980; Mayer, 2001; Revelle, 2007). Indeed, with the addition of behavior, the study of psychology may be said to be the study of affect (emotion), behavior, cognition (reason) and motivation (desire) as organized by Plato (but without the physical localization!).

500 years later, the great doctor, pharmacologist and physiologist, Galen (129-c.a. 216) organized and extended the earlier literature of his time, particularly the work of Plato and Hippocrates (c 450-380 BCE), when he described the causal basis of the four temperaments. His empirical work, based upon comparative neuroanatomy, provided support for Plato’s tripartite organization of affect, cognition, and desire. Although current work does not use the same biological concepts, the search for a biological basis of individual differences continues to this day.

1800 years later, Wilhelm Wundt (Wundt, 1874, 1904) reorganized the Hippocrates/Galen four temperaments into the two dimensional model later discussed by Hans Eysenck (H. J. Eysenck, 1965, 1967) and Jan Strelau (Strelau, 1998).

Early methodology

Besides the introduction of the cross over experiment by Gideon, Plato introduced two important

Table 1

The characters of *Theophrastus* and the adjectives of the Big 5 show remarkable similarity. Big 5 adjectives from *John* (1990). The characters of *Theophrastus* are from *Jebb's translation of Theophrastus* (1909).

Extraversion	Agreeableness	Conscientious	Neuroticism	Openness
talkative	sympathetic	organized	tense	wide interests
assertive	kind	thorough	anxious	imaginative
active	appreciative	planful	nervous	intelligent
energetic	affectionate	efficient	moody	original
-quiet	-cold	-careless	-stable	-commonplace
-reserved	-unfriendly	-disorderly	-calm	-simple
-shy	-quarrelsome	-frivolous	-contented	-shallow
-silent	-hard-headed	-irresponsible	-unemotional	-unintelligent
talker	anxious to please	hostile	coward	stupid
chatty	flatterer	shameless	grumbler	superstitious
boasful	unpleasant	distrustful		boor
ironical	feckless	slanderer		offensive
petty ambition	tiresome	penurious	mean	gross
arrogant	outcast	avaricious		
garrulous	complaisant	Reckless		
gossipy	surley	officious	unseasonable	
oligarch	evil speaker	patron of rascals		

Table 2

Greek/Roman causal theory of personality

Physiological Basis	Temperament
Yellow Bile	Choleric
Phlegm	Phlegmatic
Blood	Sanguine
Black Bile	Melancholic

concepts that would later find an important role in psychometrics and the measurement of individual differences. The concept of *True Score* and of the distinction between *observed* and *latent* variables may be found in the *Allegory of the Cave* (Plato, 1991, Book 7). For just as the poor prisoners chained in the cave must interpret the world in terms of the shadows cast on the wall, so must psychometricians interpret individual differences in *observed* score as reflecting *latent* differences in True score. Although shadow length can reflect differ-

ences in height, it can also reflect differences in distance from the light. For the individual differences specialist, making inferences about true score changes based upon observed score differences can be problematic. Consider the increases in observed IQ scores over time reported by Flynn (1984, 1987, 2000), termed the Flynn effect. It may be asked, is the Flynn effect a real effect, and are people getting smarter, or are the IQ scores going up equivalent to a change in shadow length in the cave, due to a change in position but not of height in the real

Table 3
Wundt's two dimensional organization of the four temperaments

	Changeability	
Exciteability	Melancholic	Choleric
	Phlegmatic	Sanguine

world? This inferential problem is also seen in interpretations of *fan-fold* interactions as reflecting interactions at the latent level rather than merely at the observed level (Revelle, 2007).

Differential Psychology in the Late 19th and early 20th centuries

Any discussion of differential psychology must include the amazing contributions of Sir Francis Galton. Besides considering the hereditary basis of ability (Galton, 1865, 1892), or describing the results of an introspective analysis of the complexity of his own thoughts (Galton, 1879), or introducing the *lexical hypothesis* later made popular by Goldberg (1990) by searching the thesaurus for multiple examples of character (Galton, 1884) he also developed an index of *correlation* in terms of the product of deviations from the median and the probable error of the estimate (Galton, 1888; Stigler, 1989). His measure of "reversion to the mean" was later modified to the form we now know as the Pearson Product Moment Correlation Coefficient (Pearson, 1896).

Galton believed in the power of data analysis, whether it was developing meteorological maps of Europe, the use of fingerprints for identification, or the dimensions of character (Galton, 1884)

... character ought to be measured by carefully recorded acts, representative of the usual conduct. An ordinary generalization is nothing more than a muddle of vague memories of inexact observations. It is an easy vice to generalize. We want lists of facts, every one of which may be separably verified, valued and revalued, and the whole accurately summed. It is the statistics

of each man's conduct in small everyday affairs, that will probably be found to give the simplest and most precise measure of his character. ... a practice of deliberately and methodically testing the character of others and of ourselves is not wholly fanciful, but deserves consideration and experiment. (Galton, 1884, p 185)

Expanding upon the work of Galton, Charles Spearman, in a remarkable pair of papers in 1904, introduced the correlation coefficient to psychologists as well as the concept of reliability and corrections for attenuation (Spearman, 1904b).

Psychologists, with scarcely an exception, never seem to have become acquainted with the brilliant work being carried on since 1886 by the Galton-Pearson school. The consequence has been that they do not even attain to the first fundamental requisite of correlation, namely a precise quantitative expression. (Spearman, 1904b, p 96)

In the next issue of the same journal, he then introduced factor analysis and suggested a general factor of ability (Spearman, 1904a). More than a century after these papers, much of differential psychology may be seen as a footnote to the work of Galton and Spearman.

The research of Gerard Heymans (1906) in the Netherlands unfortunately has not received the attention it deserves among American psychologists, for it is a classic set of studies on the structure of individual differences based upon observer ratings. Eysenck presented a very thorough review of Heymans work (H. J. Eysenck, 1992), as has Strelau (1998). van der Werff & Verster (1987) were reanalyzed the data using principal components analysis. Over 3,000 physicians were asked to rate the members of one family on six types of items. About 400 physicians responded. Strelau summarizes the results in terms of temperamental dimensions of activity, emotionality, and 'primary vs. secondary functioning'. This later dimension may be taken as related to the temporal aspects of behavior and the speed of switching between activities (see Atkinson & Birch (1970); Fua et al. (2010) for a consideration of the temporal component). The original data

have been reanalyzed by van der Werff & Verster (1987) and included 90 questions referring to 2,309 members of 437 families. A five and three component solution were obtained. The components represented impulsivity versus thoughtfulness, activity (with two sub components of continuous activity and not easily daunted) and a component of 'bad temper' with items of trusting and unselfish versus imperious and irritable. Strelau (1998) gives these important studies the respect they deserve.

The early 20th century also saw the introduction of the IQ test (Binet & Simon, 1905; Goddard, 1908; Terman, 1916), the hypothesis of a general factor of ability (Spearman, 1904a), and the introduction of ability (the *Army Alpha*) and emotional testing for military selection (Driskell & Olmstead, 1989; Jones & Thissen, 2007; Yerkes, 1918). Differential psychologists involved in the Army Alpha/Beta project included Terman, Otis, Thorndike, Thurstone and Whipple (Jones & Thissen, 2007). Otis went on to develop a group intelligence scale, as did Terman. The subsequent years were active times for differential psychology, continuing on with the beginning of the landmark longitudinal study on high ability children (Terman, 1925; Terman & Oden, 1947). It was also a time in which IQ tests were used to screen (non-English speaking) immigrants at Ellis Island in the United States and to argue for forced sterilization (Zenderland, 2001) for those with low scores.

Another researcher whose work has not been as appreciated by Americans as much as it should is the work of William Stern (1910, 1914). Not only laying out a theory of differences between individuals, Stern also emphasized the study of individuality which he wanted to reclaim from historical biographers (Stern, 1910). It is interesting to note that he was well aware of the problem of errors in memory that bias self reports of any kind. His lectures should be of interest to all interested in narrative approaches to the study of individuals. Stern is most known for his work on intelligence (Stern, 1914) where he developed the measure of intelligence as the ratio of mental age to chronological age. This ratio, when multiplied by 100, of course became the IQ score used in differential psychology before the change to the use of standard scores. To Stern

Intelligence is a general capacity of an individual consciously to adjust his

thinking to new requirements: it is a general mental adaptability to new problems and conditions of life. ...

Finally, the fact that the capacity is a *general capacity* distinguishes intelligence from *talent* the characteristic of which is precisely the limitation of efficiency to one kind of content. He is intelligent, on the contrary, who is able easily to effect mental adaptation to new requirements under the most varied conditions and in the most varied fields. If talent is material efficiency, intelligence is a formal efficiency (Stern, 1914, pp 3-4).

Subsequent work on the structure of ability followed the introduction of matrix algebra to Thurstone (Thurstone, 1935, 1947) and thus into psychology (Bock, 2007). With the ability to work with matrices, the process of factor analysis of correlational 'tables' became much simpler and the subsequent extraction of multiple factors of intellect more reasonable. Debates between 'g' theories (Spearman, 1946) versus multi-factor models (Thurstone, 1933, 1935, 1947) versus sampling theories of intelligence (Bartholomew et al., 2009; G. H. Thomson, 1935; S. Thomson, 1951) filled the pages of journals and the shelves of libraries.

Outside of the ability domain, empirically driven test construction in the personality and interests domains proceeded with little regard to theories of underlying individual differences. This work led to the development and validation of items that could discriminate known occupational groups from people in general. The basic model was and is that if one shares interests with those in a particular occupation, that one is more likely to do well in that occupation (Strong, 1927). Interests show strong consistencies over the lifetime (Kelly, 1955) and have moderate predictive validities. More recently, two and three dimensional structural models have been applied to the interests as measured by the Strong (Armstrong et al., 2004; Donnay, 1997). Interests in an occupation do not imply ability in that occupation (one can share interests with opera singers, but if a second monotone, unlikely to succeed).

Mid 20th Century: The high point of differential psychology?

The 1930's saw the introduction of *Psychometrika*, the pages of which were soon filled with detailed discussions on reliability theory, factor analysis, and scale construction. Most of the work was on measuring ability and the primary debates were between methods of factor extraction, validity estimation and a general theory of tests.

With the publication of Gordon Allport's text on personality (Allport, 1937), Henry Murray's integration of multiple approaches to the study of personality (Murray, 1938), and Clyde Kluckhohn and Murray's integration of personality with society and culture (Kluckhohn & Murray, 1948), empirical personality research had finally reached the United States.

Following the onset of the second world war, differential psychologists were soon involved in the problems of selection and training. About 1500 psychologists were associated with the Army Air Force selection and training program. The list of differential psychologists involved includes many future presidents of the Psychometric society (Jones & Thissen, 2007) and leaders in differential psychology. The detailed final report of the project (Dubuis, 1947) is a primer on how to do validity studies. The point biserial validities for cognitive and psychomotor tests for predicting training success for e.g., pilots, navigators and bombardiers were roughly .45 across various samples and could be presented graphically in a manner that showed the powers of selection (Figure 2).

Differential psychologists primarily associated with personality and social psychology were also involved in selection, but for a more difficult criterion. Differential psychologists assisted with the selection of agents for the Office of Strategic Services (OSS) which later became the Central Intelligence Agency. Whereas the criteria for air force pilots was clear, the criteria for success as a spy proved to be more difficult to ascertain. The predictive validities actually diminished the longer the assessment procedure lasted (OSS Assessment Staff, 1948; Wiggins, 1973).

Three more 'milestones in assessment' and prediction involving differential psychology (Wiggins, 1973) were the American Veterans Administration

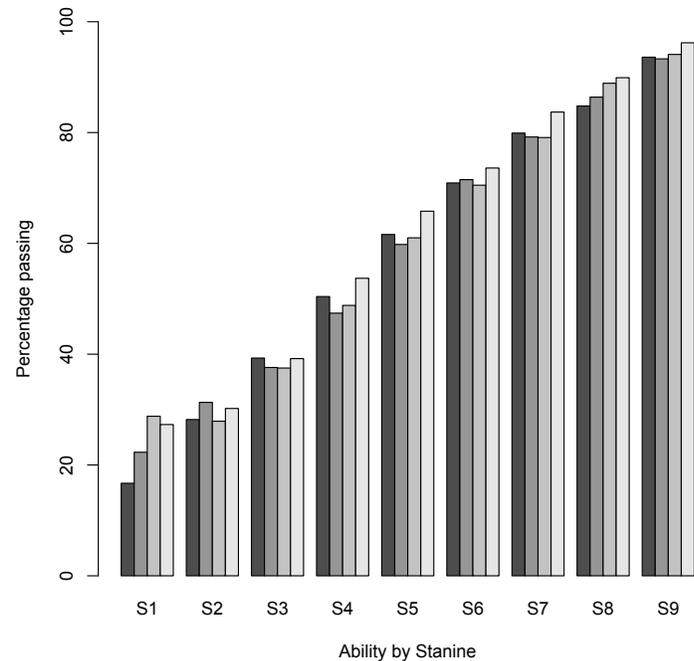


Figure 2. Success rate in the Army Airforce elementary pilot classes as a function of the ability scored in stanines. Cohorts 43 H-K. Figure adapted from tables in (Dubuis, 1947, p 119). While only about 20% of candidates with the lowest stanine succeeded, almost 95% of the top stanines did. Sample sizes in each cohort range from 9,617 to 11,010.

selection of clinical psychology graduate students in the late 1940s (Kelly & Fiske, 1951), the selection of the first American astronauts, and the selection of Peace Corps Volunteers (Wiggins, 1973).

The conclusions from the VA selection study (Kelly & Fiske, 1950) are remarkably consistent with findings reported 50 years later about predicting graduate student success Kuncel et al. (2001): A mixture of ability and objectively assessed interests and personality variables predict graduate student success with roughly equal ($\approx .25 - .30$) validities that when combined form a multiple R of about .4. More importantly and consistent with the OSS

findings, complex assessments based upon the interactions of assessors with applicants have no incremental validity. That is, people who are more able, interested in psychology, and lack nervous tension and irritability are more likely to succeed in clinical training than the less able, less interested, and more nervous. Having long interactions with an assessment board does not add information to this combination of Ability, Interests, and Temperament (AIT).

Theories of individual differences

The late 1940's through the mid 1960's were a major time for theorizing about individual differences. In terms of theories of intellect, Joy P. Guilford's attempt to cross three *modes* of thinking: operations, products, and content led to an ambitious attempt to measure 120 narrow factors of mental ability (Guilford, 1956, 1959). Each mode of thought had subcomponents such that operations could be divided into five: cognitive, memory, divergent thinking, convergent thinking and evaluation (Guilford, 1956), products could be divided into six: units, classes, relations, systems, transformations, and implications, and contents could be split into four: figural, symbolic, semantic, and behavioral.

An alternative model, suggesting a hierarchy of abilities was the *fluid, crystallized, g* model of ability (the $g_f - g_c$ model) (Horn & Cattell, 1966) which made a distinction between processing factors (fluid) and knowledge factors (crystallized).

Raymond Cattell integrated cognitive and non-cognitive personality variables when he laid out an ambitious plan to apply factor analytic methods from ability to the personality domain and commenced a long series of studies on the structure of personality (Cattell, 1943, 1946a,c,b, 1957, 1966b, 1978). To Cattell (1946c), *surface traits* were clusters of observations such as self reports of anxiety, crying or depression that needed be explained by *source traits* which could be derived from factor analysis. He elaborated the source trait distinction in terms of those that reflect ability, those that are dynamic, and those that are stable temperaments (Cattell, 1946b). Cattell (1946c) introduced the *data box* which emphasized that correlations can be taken over people, tests, or occasions. Although most research at the time emphasized the correlations of tests across people (R analysis), Cattell

proposed to consider how people varied over tests (Q analysis) and how tests varied across time (P analysis), etc. Subsequently, Cattell (1966a) elaborated the data box into a five dimensional analysis by adding observers and background conditions. In a series of studies using peer ratings of personality as well as self reports Cattell (1957) emphasized many correlated factors of personality in what would eventually become his 16PF inventory. Reflecting his belief in the power of differential psychology and the need to integrate it with experimental psychology, Cattell was a founding member and first president of the *Society for Multivariate Experimental Psychology* in 1960.

The other grand theorist of individual differences was Hans Eysenck. He searched for consistency of individual differences starting using behavioral measures (H. J. Eysenck & Himmelweit, 1947) and then attempted to explain individual differences by using learning theory (H. J. Eysenck, 1952), and then subsequently arousal theory (H. J. Eysenck, 1967). By blending experimental and correlational data with the best available theory, he inspired others to study the hard question of mechanism. Never one to avoid controversy, his popular books (H. J. Eysenck, 1953, 1964, 1965) introduced the possibility of doing rigorous research in personality and individual differences to several generations of psychologists. Eysenck was a founder and first president of the *International Society for the Study of Individual Differences* in 1983. His contributions to the field are discussed elsewhere in this handbook and do not need to be reviewed here.

Unlike later theorists, both Cattell and Eysenck emphasized individual differences broadly conceived. They both made contributions to the study of ability, to personality trait structure, and to psychometric methods. They attempted to integrate genetic, physiological, emotional, cognitive, and societal influences on human behavior. They both wrote prodigiously, with popular trade books as well as serious monographs and articles.

Less known to most differential psychologists were the contributions of John W. Atkinson who emphasized the interactive contribution of situational challenges and individual differences in *achievement motivation*. From a formal theory of risk preference (Atkinson, 1957) to a review of the effects of situational stressors on performance (Atkinson & Raynor, 1974) to a dynamic model

of motivation (Atkinson & Birch, 1970), the theory of achievement motivation integrated approach and avoidance motivational tendencies. The study of achievement motivation has now been reinvigorated with the recent studies of Elliot & Church (1997) and Elliot & Thrash (2002) who fit achievement motivation and anxiety into an approach and avoidance temperament system similar to that of Carver & White (1994); Gray (1970). Taking the expectancy-value framework even further forward is the work of Eccles & Wigfield (2002) who integrates achievement motivation with theories of goal setting and interest motivation.

Perhaps unfortunately, this period was also represented by an explosion of personality inventories. These were developed by many different research groups. Inventories were constructed using empirical (Dahlstrom, 1992; Hathaway & McKinley, 1951, MMPI), rational (Gough, 1957, CPI), (Heist & Williams, 1957; Warren & Heist, 1960, OPI), and factorial, (H. J. Eysenck & Eysenck, 1964, EPI), (Cattell & Stice, 1957, 16PF), (Comrey, 1995, CPS), (Guilford & Zimmerman, 1949, GZTZ), (Hogan & Hogan, 1995, HPI) methodologies some without any organizing theory more than alphabetical (London & Exner, 1978).

Less noticed at the time, but more recently seen as bearing some very rich fruit were a series of longitudinal studies started in the late 1920s through 1950s, e.g., Block (1971), Elder (1998), Kelly (1955), and Schaie (2005). As is true of many longitudinal studies, these were not for the faint of heart, nor for the non-sophisticated methodologist. The Oakland Growth Study and subsequent Berkeley Guidance and Berkeley Growth study have been the source of data for developmentally oriented differential psychologists for more than 70 years (Block, 1971; Elder, 1998). The Schaie (2005) studies, for example involved multiple cohorts sampled every 5-7 years for what is now more than 50 years. The early findings from these studies has matched the later results: ability, interests, and temperament are very stable over decades. Although there is some change, and character is not locked in cement, it is much more stable than had been thought (Roberts & DelVecchio, 2000).

Late 20th Century

Unfortunately, in the mid 1960's, after the proven successes of differential psychologist predicting important criteria, there was a turn away from the study of individual differences, particularly in the United States. Personality trait theory came under attack as a study of small, non-replicable effects with no agreement about the proper structural representation of personality. The research emphasis in American psychology switched to situational explanations of behavior. Studies of ability were attacked as being elitist, racist, or exclusionary. Personality researchers no longer routinely included ability measures in their studies and were not trained in the measurement of ability. Studies of occupational interests and job performance were seen as applied problems not of interest to the pages of the top journals. Exceptions to this generalization were of course the superb integrative text by H. J. Eysenck & Eysenck (1985) and a text on individual differences by Willerman (1979). The research emphasis became one of 'personality x situation interactions' which had, of course, been well studied by Atkinson (1957); Cattell (1957) and H. J. Eysenck (1967) for many years.

Consensual descriptive taxonomies of personality

Eventually, after what some of us in the United States refer to as the 'dark ages' (1968-1990), personality and differential psychology became an active area of research again. This was partly because the European emphasis upon biological bases of personality (e.g., H. J. Eysenck (1967); Strelau & Eysenck (1987)) answered the situational attack, partly because the growing evidence for genetic bases of most individual differences (Bouchard, 1994; Plomin et al., 1994) and partly because of growing consensus about the descriptive dimensions of personality. For in the intervening years, there had been consistent evidence that a limited number of personality traits could be consistently identified in peer ratings and self reports (Fiske, 1949; Norman, 1963, 1969; Tupes & Christal, 1961) and that most self report inventories included some but not necessarily all of these so-called 'Big 5' dimensions. (Digman, 1990; Goldberg, 1990). Two of these dimensions (*extraversion* and *neuroticism*) clearly matched the biologically based taxonomies

of H. J. Eysenck (1967), two (*agreeableness* and *conscientiousness*) seemed to represent a splitting of what H. J. Eysenck (1990) had labeled *psychoticism* or *tough mindedness*, and an additional dimension of intellectual interests and *openness* to new experiences blended ability with approach motivation. Following a number of influential meta analyses showing that personality and ability variables did indeed have predictive validity in occupational settings (Barrick & Mount, 1991; Mount et al., 2005) and that characteristics of bad leadership that were a threat to organizational effectiveness could be identified by self report (Hogan, 1994; Hogan et al., 1990), individual differences research became respectable again.

Subsequent work discussing blends of the Big 5 (Hofstee et al., 1992a; J. A. Johnson & Ostendorf, 1993) continued the atheoretic tradition of the descriptive taxonomies, but did show how three biological dimensions (the 'Giant 3') could be related to five descriptive dimensions. The development of a standard instrument (the Neuroticism-Extraversion-Openness Personality Inventory, Revised or NEO-PI, Costa & McCrae (1985)) to measure the 'Big 5' trait dimensions certainly helped as did the forceful reviews by Costa & McCrae (1992a), (McCrae & Costa, 1997) and McCrae & Costa (1999).

Consensual structure of intelligence

On the abilities front, the review by Carroll (1993) of more than 70 years of intelligence testing integrated most of the prior studies such as the $g_f - g_c$ model of Horn & Cattell (1966) or a hierarchical model of g with second order factors of verbal and educational ($v:ed$ versus spatial, practical and numerical ($k:m$ (Vernon, 1965) into a the three stratum model of g Deary et al. (2010) which, in some versions $g - g_f - g_c$ is known as the Carroll-Horn-Cattell (GHC) model (McGrew, 2009). An alternative three level model (VPR) pitted the $v:ed$ and $k:m$ model against the $g_f - g_c$ and suggests the importance of Verbal, Perceptual/memory and Rotational abilities W. Johnson & Bouchard Jr. (2005) as second level strata in a three level model. (Presentations with few tests tend to discuss three level models, where the lowest level is a test, but as the number of tests increases the lowest level becomes the factor representing these tests). An important concept in relating cognitive variables to criteria

is the correct level of analysis (Wittmann, 1991) which helps provide an agreed upon structure to the studies of ability.

2000-2010

Revival of interest

The last few years have seen a revival of interest in individual differences. Not only this handbook, but also the texts by Cooper (1997), Chamorro-Premuzic (2007), and M. W. Eysenck (1994), well as handbooks on methods (Robins et al., 2007), individual differences in social (Leary & Hoyle, 2009) or cognitive (Gruzka et al., 2010) correlates and edited volumes on biological bases (Canli, 2006) and Reinforcement Sensivity theory (Corr, 2008). The journal *Personality and Individual Differences* has seen its page count expand dramatically as the output of differential psychologists continues to grow. In organizational psychology, meta analyses showing the importance of cognitive (Kuncel et al., 2001, 2007) and non-cognitive predictors (Barrick & Mount, 1991; Mount et al., 2005) for real world outcomes that include occupational attainment, marital stability and early mortality (Roberts et al., 2007).

Individual Differences theories applied to psychopathology

Clinical psychology has always been concerned with individual differences, and was the motivation behind developing such tests as the MMPI (Hathaway & McKinley, 1943) and later, the Schedule for Non Adapative and Adaptive Personalilty (SNAP, Clark, 1993) but until recently that has been surprisingly little interchange between the personality and abilities communities with those who study psychopathology. It would seem that the emphasis on Neuroticism and trait anxiety of many trait theorists would have had direct applications in theories of psychopathology, but the emphasis upon diagnostic categories rather than continuous traits has led to a lack of interaction. Exceptions to this general rule include work relating personality traits to Axis I disorders (Trull & Sher, 1994; Krueger et al., 1996), the work on positive and negative affectivity in models of depression and anxiety (Clark et al., 1994; Watson et al., 2005) as well as applications of the Five Factor Model to predict person-

ality disorders (Bagby et al., 2005; Costa & Widiger, 2002; Widiger & Costa, 1994). The taxonomic work of Krueger (2002); Krueger & Markon (2006), Markon et al. (2005) and Tackett et al. (2008) integrating the dimensions of normal personality with a dimensional rather than categorical organization of psychopathology (Watson, 2005) should lead to better theory development in both of these aspects of differential psychology.

Biological models

Reinforcement Sensitivity Theory. The rat inspired Reinforcement Sensitivity Theory (Gray, 1981, 1982; Gray & McNaughton, 2000) was developed primarily as a theory of anxiety but has had an enormous impact upon biologically inspired personality theorists in general (Corr, 2002, 2008). As Smillie et al. (in press) discuss, RST was developed from the bottom up (from the physiology of the rat up to the behavior of the human) rather than the conventional top down description and theorizing of most personality research. To some, RST is a projective test (Revelle, 2008) in that how it is interpreted depends a great deal upon the investigator. This is perhaps why there is an ongoing debate about the range of the RST (Smillie et al., 2006; Smillie, 2008, in press, and the discussions following). It seems clear that for at least the next decade it will be an active research endeavor.

Other biological models. Contemporary biological models have benefitted from technological advances in assessing neurophysiology. MRI studies have investigated structural correlates of individual differences (Omura et al., 2005; Rauch et al., 2005) from the perspective of learning theory. Depue (1995) his colleagues (Depue & Collins, 1999) claim that individual differences in the strength of a neurobehavioral system tied to dopaminergic functioning is the causal basis for extraversion. Although research on this theory is still in its nascent stages, EEG studies generally supporting the dopaminergic hypothesis (Wacker et al., 2006). Perhaps the most important methodological advance has been the use of fMRI to study how patterns of brain activation relate to individual differences. In particular, Herrington et al. (2006) reviewed evidence suggesting that left hemisphere lateralization is associated with approach temperament. There is mixed evidence that approach tem-

perament, consisting of extraversion, positive affect, and behavioral approach (Elliot & Thrash, 2002), predicts high performance on a variety of neuropsychological tasks that require cognitive functions that are specialized to the left prefrontal lobe. fMRI has also been used to study how individual differences correlate with specific brain regions (Canli, 2004; Canli et al., 2001). New technologies offer exciting opportunities for uncovering the biological bases of individual differences; however, there is also an increased likelihood that data generated by novel approaches may be analyzed inappropriately (Vul et al., 2009). As research in this domain moves forward, it will be important to balance enthusiasm with careful analysis and interpretation.

An important biologically based variable that affects social behavior, affect, and cognition is the diurnal arousal rhythm of animals as diverse as humans, hamsters, and fruit flies. Not only do people vary in their arousal over they day, but the time of peak arousal varies systematically between individuals. Diurnal rhythms and individual differences in phase have been used for testing theories of personality. The interactive effect on cognitive performance of impulsivity, caffeine, and time of day (Revelle et al., 1980) was used to argue against the arousal theory of extraversion (H. J. Eysenck, 1967). Individual differences in diurnal rhythms as assessed by core body temperature were correlated with various measures morningness-eveningness as well as voluntary sleep and awakening times (Baehr et al., 2000). The minimum body temperature of self described morning types was roughly two hours ahead of that for self described evening types, although the behavioral response to social cues led to a smaller difference in voluntary sleeping and rising times between the two groups. The combination of body temperature rhythm and sleep and waking times suggests why evening people are more alert than morning types before going to sleep, and why the evening types are so sluggish after awakening. Individual differences in diurnal rhythms are particularly important for sleep researchers (Tailard et al., 2003), especially those interested in sleep problems associated with adolescents versus adults (Crowley et al., 2007). The combination of social cues with an endogenous clock rhythm has important implications in other species as well: for instance, in the fruit fly where mating habits of different species depend upon their arousal cycle (Rosato

& Kyriacou, 2008).

Genetics

Perhaps one of the clearest findings in differential psychology in the past 30 years is that almost all differences are under moderate to strong genetic control (Bouchard, 1994, 2004; Bouchard & Loehlin, 2001; McGue & Bouchard, 1998; Pedersen et al., 1988; Spinath & Johnson, *in press*, this volume). Equally strong, and much more surprising, is that when doing an ACE analysis (analyzing for additive, common environmental, and unique environmental effects), there is generally little to no evidence for shared family environments. These effects are not just for the standard measures of ability or the 'Big 5' dimensions of personality. They are true for various psychopathologies, for interests, for sexual orientation, and even for religiosity. Indeed, it is now noteworthy when any differential trait does *not* show a substantial genetic component.

That something is heritable does not imply a simple genetic architecture. Heritability is just a ratio of variance that can be associated with genetic causes to the total observed variance. Genetic effects can interact with (Caspi et al., 2002) and/or correlate with environmental variation in complex manners (W. Johnson, *in press*). One of the major disappointments of the switch from quantitative behavioral genetics to the molecular genetics and the search for particular genes is how few genes have been shown to have replicable effects, and even of those, how small the effects are. The simple One Gene-One Disease (OGOD) hypothesis (Plomin et al., 1994) derived from medical genetics, or its somewhat more complicated alternative of One Gene-One System Hypothesis (OGOSH) does not seem to be supported. Even for clearly genetic traits such as height (with a heritability greater than .8), it is hard to find any single gene that is strongly associated with height. Basic concepts to remember when reading the behavior genetic literature are that

1. Additive heritability is a hodgepodge ratio of genetic variance to total variance.
2. The less the environmental variance, the greater the heritability.
3. Heritability within groups does not imply between genetics causes of between group differences.

Between group versus within group differences. A recurring problem in inference about genetics is

whether genetic variability within groups has anything to do with genetic differences between groups. Consider the example of height (W. Johnson, *in press*). It is well established that the heritability of height is roughly .8 within cultures. That is, that about 80% of the variability in height is associated with genes. But it is equally well established that height changes in response to nutrition. Two groups that are genetically equivalent (North and South Koreans) differ by about 6 inches in height. How can this be? The answer is that heritability estimates, based upon within group environmental variance, do not consider environmental variability between groups nor do they say anything about how the trait will respond to environmental changes that do not vary within the group.

Related to this is the so-called "Spearman Hypothesis" that if factor loadings on a variable are correlated with heritability and also correlated with between group differences, then the between group differences must be genetic. A simple thought experiment shows why this is not true. Consider variables measuring overall height. Of these, some will be better measures of height than others, perhaps because of reliability issues, perhaps because the others are less valid. In this case, the factor loadings on the general factor of height will be correlated with their heritability values. In addition those measure that are the better measure of height will show the biggest between group difference on height. Indeed, the factor loadings, heritabilities and between group differences will be highly correlated, even though the between group difference is due to nutrition.

Sex differences

Are men and women different? Yes. But how and why continues to be an important question for differential psychologists. Schmitt et al. (2008) examined sex differences on a short form of the Big 5 (BFI Benet-Martínez & John, 1998) across 55 different countries. The mean z score sex differences showed that women are more neurotic ($\bar{z} = .40$), agreeable ($\bar{z} = .15$), conscientious ($\bar{z} = .12$), extraverted ($\bar{z} = .10$) and less open ($\bar{z} = -.05$). Schmitt et al. (2008) found that sex differences vary across cultures as a function of equality. That is, higher levels of health, access to education and well being were related to greater sex differences. These results differ somewhat from an international (but

English speaking) web based self selected sample of more than 50,000 participants who took a Big 5 inventory and reported their SAT Verbal and SAT Quantitative scores (Revelle et al., 2010), women were more agreeable ($d = .56$), less emotionally stable ($d = -.54$), less open ($d = -.30$), more conscientious ($d = .24$) and more extraverted ($d = .14$). Men and women reported practically identical SAT Verbal scores, but lower SAT Quantitative scores ($d = -.29$). Gender differences have been reported for the facets of the NEO, and to be greater in Europe and America than other cultures (Costa et al., 2001).

Although the stereotype is that women talk more than men, an observational study which sampled talking behavior for 30 seconds every 12.5 minutes for several days did not find a reliable difference in talking behavior between men and women (Mehl et al., 2007).

Even among amazingly talented women and men, there are reliable sex differences in interests and values (Ferriman et al., 2009). More importantly, these differences grow through their career. Men were more career focused and willing to take greater risks in order to receive greater recognition. Women, on the other hand, emphasized community, family and friendships. It seemed as if the men were emphasizing goals that differentiated them from others (inter-individual), while the women were emphasizing family and friends.

Although men and women do not differ in overall ability, the importance of mean differences in the lower order factors of ability tests are masked when looking at overall g scores. Women out perform men on verbal and perceptual speed tasks but do less well on visuospatial problems (W. Johnson & Bouchard Jr., 2007). These sex differences, although strong, partly depend upon method of analysis (Steinmayr et al., 2010). Sex differences in the variance of ability although small, occur early in life (Arden & Plomin, 2006) and have important implications for the frequency of men and women with extreme scores.

Integrating abilities, values, and interests

Individuals differ not only in their abilities and temperaments. They also differ in their values (Feather, 1995; Rohan, 2000) and interests (Holland, 1959, 1996). Unfortunately, although there are exceptions (Ackerman, 1997; Ackerman & Hegg-

stad, 1997; Ferriman et al., 2009; Lubinski & Benbow, 2000), there have been few attempts to integrate the research in interests with research in ability or temperament. Promising attempts are being done as part of the longitudinal study of mathematically precocious youth (Lubinski & Benbow, 2000, 2006). Ackerman & Heggstad (1997) have proposed 'trait complexes' of mixes of abilities and interests and suggest that

abilities, interests, and personality develop in tandem, such that ability level and personality dispositions determine the probability of success in a particular task domain, and interests determine the motivation to attempt the task. Thus, subsequent to successful attempts at task performance, interest in the task domain may increase. Conversely, unsuccessful attempts at task performance may result in a decrement in interest for that domain. (Ackerman & Heggstad, 1997, p 239)

The theory of Work Adjustment (Lofquist & Dawis, 1969) as modified by Lubinski & Benbow (2000) is an excellent example of how to blend individual differences in abilities, interests, and values into a long term theory of job satisfaction. Applications of this model to the long term career choices of especially talented men and women (Ferriman et al., 2009) show the power of the model. This work, although very important, has not yet been integrated into a general theory of individual differences.

Applications

It is important to recognize that differential psychology is not just an academic exercise in measurement and theory building. The use of ability, psychomotor and personality inventories in predicting real world criteria is an important application of our work. Reminiscent of the personality characteristics discussed in *The Republic*, Musson et al. (2004) when predicting aviator or astronaut success found that

Superior performance has consistently been linked to a personality profile characterized by a combination of high

levels of instrumentality and expressivity along with lower levels of interpersonal aggressiveness. This personality profile has sometimes been referred to as the “Right Stuff,” suggesting that this is the ideal description for an effective astronaut or pilot. Inferior performance has been linked to personality profiles typified by a hostile and competitive interpersonal orientation (the “Wrong Stuff,” suggesting that these individuals may not have the best characteristics for teamwork in complex settings) or to low achievement motivation combined with passive-aggressive characteristics (the “No Stuff” cluster, referring to individuals who score uniformly low on key traits). (Musson et al., 2004, p. 342)

For predicting success in graduate school, a combination of ability and conscientiousness predicts success across programs (Kuncel et al., 2001). Long term follow up studies of especially talented 12 year olds have shown the power of ability as well as interests in predicting careers in the STEM (Science, Technology, Engineering, and Mathematics) fields (Ferriman et al., 2009; Lubinski & Benbow, 2000, 2006). It is not just raw talent that is important in terms of who succeeds in a STEM career, but the relative mix of verbal, spatial, and quantitative abilities, as well as interests in family and friends (Ferriman et al., 2009).

Personality, Ability and Values across nations

People as well as nations differ in wealth, education, mental health, nutrition and values (Bardi & Schwartz, 2003; Schwartz & Bilsky, 1987). Attempts at integrating between nation and within nation individual differences are fraught with methodological complications (Hunt & Wittmann, 2008) but also suggest interesting hypotheses about the effects of culture upon behavior (Chiao & Blizinsky, 2009). There is some work attempting to integrate values with abilities and temperament, both within and between nations (Stankov, 2009).

Current Status and Future directions

It is clear that differential psychology has a storied and illustrious past. It is also apparent from the number and diversity of areas reviewed that differential psychology currently has a firm foothold in the field of psychology and has made broad contributions to science more generally. As with any science, however, the task of theorists and researchers is not to relive the glory years or dwell on misguided ventures (i.e., the “Dark Ages”). Rather, the task is to continue to make progress and push the boundaries of knowledge by attempting to answer difficult and important questions. Differential psychology is facing such questions on all fronts and across many levels of analysis. Questions at the forefront of contemporary differential psychology range from how basic genetic and neurobiological characteristics contribute to individual differences (Canli, 2006) to questions about how high-level social and cultural systems interact to influence individual differences (Van de Vijver & Leung, 2008).

Differential psychology, at its heart, seeks to understand variation in how people feel, act, and think and want (Allport, 1937; Emmons, 1989; J. A. Johnson, 1997; Winter et al., 1998). As such, researchers studying differential psychology tend to consider questions in one of four domains of effective functioning: affect, behavior, cognition, and motivation (desire) – the “ABCDs of Personality” (Revelle, 2008). Briefly, affect comprises feelings, emotions, and moods; behavior comprises motor actions such as walking and talking as well as physiological processes such as heart rate; cognition comprises thoughts and beliefs as well as how one makes meaning from the world and out of one’s life; desires comprise motivational tendencies, drives, and one’s short and long-term goals. Researchers typically focus on one ABCD domain of functioning to the neglect of considering connections across levels and domains.

In the domain of *affect*, there has been considerable debate about over how many and which dimensions best characterize affective space, with various competing models garnering empirical support. The circumplex model of affect (Barrett & Russell, 1998; Russell, 1980) arranges affective space around the dimensions of Valence and Arousal. In this model, positive and negative emotions are con-

sidered bipolar opposites. In contrast, other two-dimensional models of affect propose that positive and negative affects reside on two independent unipolar dimensions (Cacioppo & Berntson, 1994; Thayer, 1989; Watson et al., 1988). A three-dimensional model has been proposed that incorporates a Valence dimension with two independent arousal dimensions, Energetic Arousal and Tense Arousal (Schimmack & Grob, 2000; Schimmack & Reisenzein, 2002). Not only do average levels of the aforementioned affective dimensions differ between people (Watson, 2000), but recent research has also shown that the structure of affective space itself may be considered an individual difference variable (Feldman, 1995; Rafaeli et al., 2007).

A longstanding goal of individual differences research is to predict *behavior* (Allport, 1937; Fleeson, 2001; Pervin, 1994). Indeed, predicting ongoing behavior in naturally occurring environments is extolled as a gold standard in individual differences research (Craik, 2000). With some notable exceptions including H. J. Eysenck & Himmelweit (1947)'s work on the factor structure of behavioral observations, this goal has too seldom been realized. It has historically been relatively difficult and expensive to collect large slices of naturally occurring behavior (Eaton & Funder, 2003; Funder, 2001); however, recent advances in methods of data collecting behavior including electronic diaries (Green et al., 2006), portable recorders (Mehl & Pennebaker, 2003), and cell-phone methods of data collection (Collins et al., 2003; Reid et al., 2008) have made it easier to obtain data on behavior as it occurs. Such advances combined with instruments tailored to assess behavior (Funder et al., 2000) have resulted in a growth of studies looking at how Big-Five trait dispositions are reflected in behavior across time (Fleeson & Gallagher, 2009; Mehl et al., 2006; Paunonen, 2003).

The research on intelligence constitutes the most influential and well-established study of any *cognitive* individual difference variable. Real world criteria range from job performance to mortality (Deary et al., 2004, 2010). Researchers have begun studying how personality dispositions relate to cognitive differences, with most of this research focusing on the trait of openness/intellect (Costa & McCrae, 1992b; Hofstee et al., 1992b). Individuals higher in openness generally score higher on measures of cognitive ability (DeYoung et al., 2005;

Revelle et al., 2010), are seen as displaying more creative thinking and have a greater capacity for divergent thinking (McCrae, 1987). Developing in parallel to research on trait dispositions is the social-cognitive approach to personality (Bandura & Press, 1999; Dweck & Leggett, 1988). Researchers in the social-cognitive tradition emphasize variations in cognitive tasks, strategies, and schemas. Some of the most well-know research from this approach has examined differences between people who perceive ability as stable, labeled entity theorists, and those who see ability as malleable, labeled as incremental theorists (Hong et al., 1999). Cognition also includes the life-narrative approach to individual differences (McAdams, 2008), which focuses on variations in how people integrate their remembered past, experienced present, and imagined future into a coherent life story.

Research on individual differences in motivation or *desire* has made some impressive findings in recent years. A hierarchical model of independent approach and avoidance motivation dimensions has been specified (Elliot & Church, 1997), elaborated (Elliot & McGregor, 2001), and correlated with individual differences in academic performance (Cury et al., 2006). Higgins (1998)'s Regulatory Focus Theory (RFT), which posits that people are guided by two distinct motivational systems: promotion focus and prevention focus, has gained solid footing in the literature on motivation. Promotion focus is manifested in attempts to bring one's actual self into alignment with one's ideal selves reflecting one's wishes and aspirations. Prevention focus leads one to bring one's actual selves into alignment with one's ought selves or the standards reflecting duties and obligations. Research on broad life goals, which had long been neglected, has recently picked up in the context of relating goals to Big 5 variables (Roberts & Robins, 2000; Roberts et al., 2004). In addition to nomothetic approaches to motivations and goals, idiographic assessments of what people strive for in their lives (Emmons, 1986) as well as their personal projects (Little et al., 1992) have also gained popularity.

The fact that domains of functioning are studied in isolation from each other level is not a criticism of those researchers for indeed each level and domain deserves careful attention. However, failure to pursue integration may leave gaps or holes (Rozin, 2007) in theories of individual differences.

Therefore, the state of research on individual differences is in need of frameworks in which integration across levels may be achieved. The question of integration boils down to a question of organization. That is, how can theories of individual differences be organized such that the domains of functioning (ABCDs) may be connected in meaningful ways to each other?

We believe that such an integration may be forged by adopting an information processing perspective. Specifically, individual differences in the coherent patterning of affect, behavior, cognition, and desire may be understood at three levels of information processing - *reactive, routine, and reflective* (Ortony et al., 2005). It is important to note that the *reactive, routine, and reflective* levels are not separated by sharp boundaries but lie on a continuum of complexity ranging from more basic and immediate processes (reactive) to well-learned and rehearsed processes (routine) to complex and abstract processes (reflective).

The *reactive* level of information processing comprises rapid and efficient responses to stimuli. Responses at this level consist of a unified combination of affective and behavioral and motivational processes. For example, after touching a stove burner, the motivation to avoid pain, (Desire), fear (Affect), and removal of one's hand (Behavior) likely occur simultaneously and do not require elaborated cognition. The *routine* level comprises well-learned, everyday activities. At this level, affect, behavior, and motivation may be distinguished from each other due to the emergence of low-level cognitive processes. At the routine level of processing, an individual noticing his or her hand approaching a hot stove would be able to cognitively discriminate between the present state of not being in pain and fear (Affect) an unwanted future state of pain (Desire). The individual may thus act (Behavior) to increase the likelihood that pain does not ensue. The *reflective* level describes higher-level cognitive functioning such as self-awareness and metaprocessing. At this level affect becomes enriched with cognitive content such that conscious plans may guide behavior toward or away from well-elaborated and nuanced goals. One may safeguard the stove so that young children are unlikely to come into contact with the burners.

The above examples lead to the realization that the ABCDs constantly interact in dynamic ways

across multiple levels of information processing. As such, those dynamic interactions should be a focal point of differential psychology theories and failure to consider such dynamics may limit the generation of comprehensive theories of individual differences. By adopting an information-processing approach, the study of differential psychology becomes the study of the coherent patterning of ABCDs across time and space (Wilt & Revelle, 2009). The task of differential psychology thus becomes the task of explaining why people have different ABCD patterns across the different levels of information processing and determining how those differences relate to important outcomes.

The ABCD approach has the potential to serve as an overarching conceptual framework for individual differences research. It is important for future research not only to integrate across levels of analysis and domains of functioning but also to resolve some of the specific and pressing issues facing differential psychology today. As would be expected of such a broad and fast-expanding field, questions facing differential psychology involve tackling the influence of variables from genes to virtual environments, and many questions revolve around the use of new technologies.

Although it is too early to render judgment on the usefulness of genome wide association studies (GWAS), the high cost and limited benefits of current GWAS of disease (Kraft & Hunter, 2009) raise the question of whether individual differences research would benefit from employing such methods. Some great discoveries have been made (Amos, 2007), but the infrequency with which these findings occur suggests that the traditional GWAS method of exploring common gene variants is in need of some rethinking before it is adopted by differential psychology. Remaining in the realm of biology, serious thought should also be given to the use and interpretation of fMRI data given the recent debate about whether current findings using fMRI inflate relationships between brain and personality processes (Vul et al., 2009).

Developmental research on individual differences must go beyond studying genes and neurophysiological processes in isolation to focus on interactions between biological and environmental variables using longitudinal studies. When such interactions are found they generate a tremendous amount of excitement (Caspi et al., 2003); however,

interactions are difficult to replicate (Os & Rutten, 2009), calling into question their validity. Further attention may be warranted due to the importance of interactions in establishing boundary conditions for theories of the etiology of disorders as well as for identifying particular populations that might be at most risk for developing disorders.

Longitudinal studies have been instrumental in showing how differences in the Big-Five traits relate to myriad important outcomes such as mental health, mental disorders, job success, marriage satisfaction, and even mortality (Ozer & Benet-Martinez, 2006; Roberts et al., 2007). Indeed, trait psychology has been one of the most successful enterprises of personality for predicting and understanding healthy psychological functioning. Future research should focus on the mechanisms through which traits achieve their effects. Finding mechanistic relationships may be instrumental in developing effective interventions. Research predicting practical outcomes from traits should be balanced with basic research aimed at uncovering the etiology of individual difference dimensions. Non-intuitive but exciting ways to study basic individual differences in humans that do not rely even human beings may be explored by studying animal personality (Vazire & Gosling, 2003; Vazire et al., 2007). There has been a long history of studying biological mechanisms thought to relate to personality using animal models in drug or lesion studies (Gray, 1982; Gray & McNaughton, 2000) as well as selective breeding studies (Broadhurst, 1975). But now, observational studies of non-human animals may allow individual differences researchers opportunities to examine questions that are difficult or impossible to explore in humans.

The already vast database on individual differences is sure to continue grow at an increasingly fast rate given the ease of public domain personality assessment, specifically using resources such as the IPIP (Goldberg, 1999; Goldberg et al., 2006). The possibility for such data to be stored in large databases available for public use heeds the call to make differential psychology accessible to everyone. Additionally, the ability to make inferences about individual differences based on the content of personal websites (Gosling et al., 2004) should only augment the richness of individual differences data that are readily available.

Conclusion

In what ways do people differ from each other? Why do people differ from each other? To study individual differences is to ask these fundamental questions. Although the scope and importance of these questions is almost impossible to overestimate, the field of differential psychology must not be content to tackle description and theory-building alone. In order for the field to realize its potential, it must also be concerned with using individual differences to predict important outcomes. What characteristics make someone a successful graduate student, military officer, or business executive? Generating knowledge about how and why people differ and applying that knowledge to potentially improve society are the daunting tasks charged to our field, but we are well-prepared. Differential psychologists are making advances in understanding characteristic patterns of affect, behavior, cognition, and motivation; these patterns may be conceptualized as individual differences in abilities, interests, and temperament. There may be relatively weak correlations across AIT domains, but it is important that differential psychologist not get discouraged over these results. Indeed, loose associations among these constructs are *encouraging* because that means that variables from each domain may serve as important predictors in their own right. Thus, abilities, interests, and temperaments may have additive and interactive relationships to practically important outcomes. The focus of the field may thus benefit from shifting its focus from correlational structure to prediction. By doing so, we may achieve another high point similar to that we realized in the mid-20th century. Indeed, the future of differential psychology is more promising than it has been for decades.

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