

# Part I

## Individual Differences *An Up-to-Date Historical and Methodological Overview*

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# I

## Individual Differences and Differential Psychology *A Brief History and Prospect*

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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 that 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 have seen progress in the integration of these two approaches (Cronbach, 1975; Eysenck, 1997; Revelle & Oehlberg, 2008). Indeed, one of the best known experimental psychologists of the 1960s and 1970s argued that “individual differences ought to be considered central in theory construction, not peripheral” (Underwood, 1975, p. 129). However, Underwood went on to argue (p. 134) that these individual differences are not the normal variables of age, sex, IQ,

or social status, but rather 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.

## Early Differential Psychology and Its Application

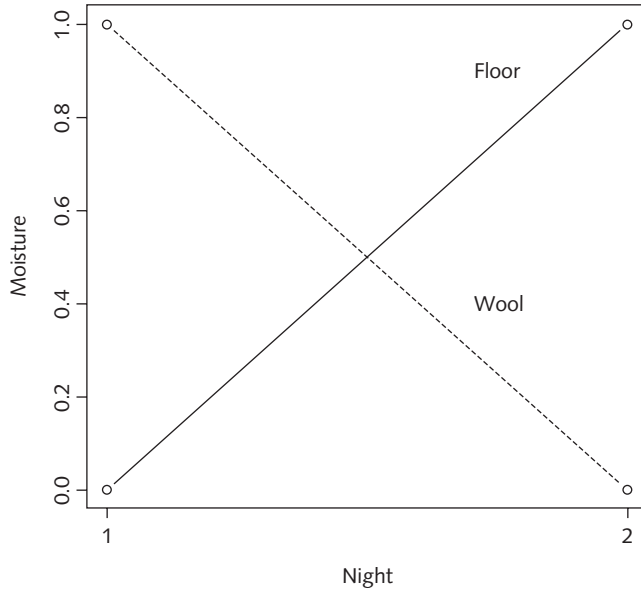
Differential psychology is not new; for an understanding of research methodology and individual differences in ability and affect was described as early as the Hebrew Bible, in the story of Gideon (Judges 6: 37–40, 7: 2–6). Gideon was something of a skeptic, who had impressive methodological sophistication. In perhaps the first published example of a repeated-measures crossover design, he applied several behavioral tests to God before agreeing to go off to fight the Midians, as he was instructed. Gideon put out a wool fleece 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 crossover 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 crossover interaction. (See Figure 1.1, which 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 versed in within-subject designs, a student of affect and behavior, and someone familiar with basic principles of assessment. Other early applications of psychological principles to warfare did not emphasize individual differences as much as the benefits of training troops in a phalanx (Thucydides, as cited by Driskell & Olmstead, 1989).

## 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 (429–347 BC) discussion of the personality and ability characteristics required of the hypothetical figure of the philosopher-king emphasized the multivariate problem of the rare co-occurrence of appropriate traits:



**Figure 1.1** Gideon's double dissociation test. Gideon's testing of God is an early example of a double dissociation test, and probably the first published example of a crossover 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)

... 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, 1892: *The republic*, VI, 503c–e)

Similar work is now done by Robert Hogan and his colleagues as they study the determinants of leadership effectiveness in management settings (Hogan, 1994, 2007; R. Hogan, Raskin, & Fazzini, 1990; Padilla, Hogan, & Kaiser, 2007) as well as by 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—or rather Tyrtamus of Eresos, in Lesbos (372–287 BC), a student of Aristotle who, according to his teacher, acquired the nickname “Theophrastus” (“the one who speaks like a god”) for his oratorical skills.

**Table 1.1** Theophrastus's character types and the traits of the "Big Five" show remarkable similarity. "Big Five" adjectives taken from John, 1990; Theophrastus's *Characters* presented in Jebb's translation of 1870

<i>Extraversion</i>	<i>Agreeableness</i>	<i>Conscientious</i>	<i>Neuroticism</i>	<i>Openness</i>
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
boastful	unpleasant	distrustful	mean	boor
ironical	feckless	slanderer	unseasonable	offensive
petty ambition	tiresome	penurious		gross
arrogant	outcast	avaricious		
garrulous	complaisant	reckless		
gossipy	surly	officious		
oligarch	evil speaker	patron of rascals		

Theophrastus is famous today as a botanical taxonomist. But he is also 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 is a work often used to illustrate and epitomize the lack of coherence of early personality trait description; however, it is possible to organize his "characters" into a table that looks remarkably similar to equivalent tables of the late twentieth century (John, 1990; John & Srivastava, 1999; see Table 1.1).

One thousand and six hundred years after Theophrastus, Chaucer added to the use of character description in his *Canterbury Tales*, which are certainly the first and probably the "best sequence of 'Characters' in English Literature" (Morley, 1891, p. 2). This tradition continued into the seventeenth century: the character writings of that period are a fascinating demonstration of the broad appeal of personality description and categorization (Morley, 1891).

### Causal theories

Theophrastus asked a fundamental question of personality theory, which is still of central concern to us in personality theory 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. (Theophrastus, 1870: *Characters*, p. 77)

**Table 1.2** Greek and Roman causal theory of personality

<i>Physiological basis</i>	<i>Temperament</i>
Yellow bile	Choleric
Phlegm	Phlegmatic
Blood	Sanguine
Black bile	Melancholic

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 of shared family environment as causes of behavior.

Biological personality models have also been with us for more than two millennia, through the work of Plato, Hippocrates, and, later on, Galen, all of which had a strong influence. Plato's placement of the tripartite soul into the head, the heart, and the liver and his organization of it into reason, emotion, and desire remain a 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).

About 500 years later, the great doctor, pharmacologist, and physiologist Galen (AD 129–ca216) unified and systematized the earlier literature of the classical period, particularly the work of Plato and of the medical authors of the Hippocratic Corpus, when he described the causal basis of the four temperaments. His empirical work, based upon comparative neuroanatomy, aimed to provide support for Plato's tripartite organization of soul into 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.

Eighteen centuries later, Wilhelm Wundt (1874, 1904) reorganized the Hippocratic–Galenic four temperaments into the two dimensional model later discussed by Hans Eysenck (1965, 1967) and Jan Strelau (1998).

### Early methodology

In addition to Gideon's introduction of the crossover experiment, Plato introduced two important concepts, which would later find an important role in psychometrics and in the measurement of individual differences. Something similar to the modern concept of *true score* and to that of a distinction between *observed* and *latent* variables may be found in the celebrated "allegory of the cave" at the opening of Book VII of Plato's *Republic* (VII, 514a ff.). For, just as the poor prisoners chained to the cave wall must interpret the world through 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 differences in height,

**Table 1.3** Wundt's two-dimensional organization of the four temperaments

	<i>Changeability</i>	
Excitability	Melancholic Phlegmatic	Choleric Sanguine

it can also reflect differences in distance from the light. For the individual differences specialist, making inferences about true score changes on the basis of observed score differences can be problematic. Consider the increases in observed IQ scores over time, reported by Flynn (1984, 1987, 2000), which are known as 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 in a process equivalent to the change in shadow length in the cave, say, because of a change in position, but not one of height in the real 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 Nineteenth and Early Twentieth Centuries

Any discussion of differential psychology must include the amazing contributions of Sir Francis Galton. Apart from considering the hereditary basis of ability (Galton, 1865, 1892), 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), Galton also developed an index of *correlation* in terms of the product of deviations from the median and of the probable error of the estimate (Galton, 1888; see 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:

... 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 every-day 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 to psychologists the correlation coefficient as well as the concept of reliability and corrections for attenuation:



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, 1904a, p. 96)

In the next issue of the same journal, Spearman then introduced factor analysis and suggested a general factor of ability (1904b). 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 (1908) 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, one based on observer ratings. Eysenck has presented a very thorough review of Heymans's work (Eysenck, 1992), as has Strelau (1998). Van der Werff and Verster (1987) reanalyzed the data using principal components analysis. In the original studies, 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, classifying them according to temperamental dimensions of activity, emotionality, and "primary vs. secondary functioning." This latter dimension may be taken as related to Introversion–Extraversion or to the temporal aspects of behavior and to the speed of switching between activities (see Atkinson & Birch, 1970 and Fua, Revelle, & Ortony, 2010 for a consideration of the temporal component). The original data reanalyzed in this way included 90 questions referring to 2,309 members of 437 families. A five-component and a three-component solution were obtained. The components represented: (1) impulsivity versus thoughtfulness; (2) activity (with two sub-components, one of continuous activity and one of "not easily daunted" activity); and (3) "bad temper" versus "good temper," which encompassed items like trusting and unselfish versus imperious and irritable. Strelau (1998) pays these important studies the respect they deserve.

The early twentieth century also saw the introduction of the IQ test (Binet & Simon, 1905; Goddard, 1908; Terman, 1916); the introduction of the hypothesis of a general factor of ability (Spearman, 1904b); and the introduction of ability (the Army Alpha test) 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, seeing as they did the beginnings of the landmark longitudinal study of 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 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 of memory that bias self-reports of

any kind. His lectures should be of interest to all those interested in narrative approaches to the study of individuals. Stern is best 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 applying the factor analysis of correlational “tables” became much simpler and the subsequent extraction of multiple factors of intellect more reasonable. Debates between theories of general intelligence (“*g*” theories) (Spearman, 1946), multi-factor models (Thurstone, 1933, 1935, 1947), and sampling theories of intelligence (Bartholomew, Deary, & Lawn, 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 for 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 principle was—and is—that, if one shares interests with people of a particular occupation, 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 interest, as the latter were measured by the Strong Interest Inventory (Armstrong, Smith, Donnay, & Rounds, 2004; Donnay, 1997). Interests shared with those in an occupation do not imply that one has an ability for that occupation (one may share interests with opera singers, but, if one is a second monotone—that is, unable to carry a note—one is unlikely to succeed in what opera singers do).

### Mid-Twentieth Century: The High Point of Differential Psychology?

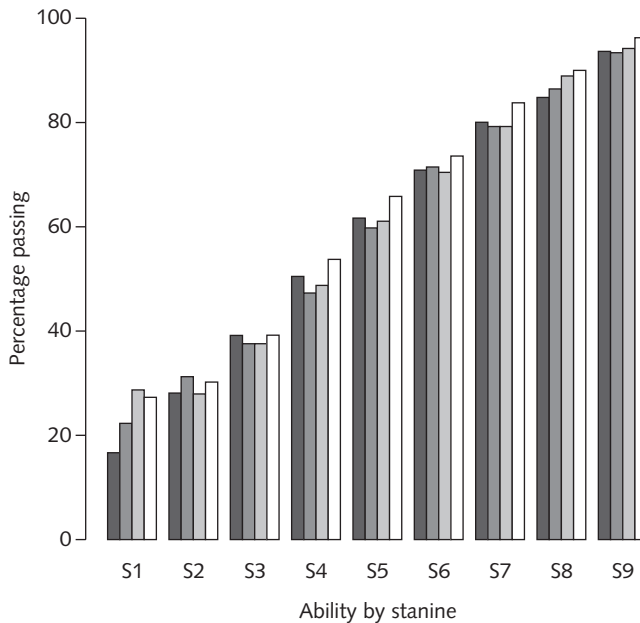
The 1930s saw the creation of the journal *Psychometrika*, the pages of which were soon filled with detailed discussions on reliability theory, factor analysis, and scale construction. Most of the work was on measuring ability, and the primary debates

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 problems of selection and training. About 1,500 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 (Dubois, 1947) is a primer on how to do validity studies. The point biserial validities for cognitive and psychomotor tests for predicting training success, for example for 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 1.2).

Differential psychologists primarily associated with personality and social psychology were also involved in selection, but in selection for more difficult criteria. Differential psychologists assisted with the selection of agents for the Office of Strategic Services (OSS), which later became the Central Intelligence Agency. Whereas



**Figure 1.2** Success rate in Army Air Force elementary pilot classes as a function of the ability scored in stanines. Cohorts 43 H–K. Figure adapted from tables in Dubois, 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

the criteria for air force pilots were 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 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, Hezlett, & Ones, 2001): a mixture of ability and objectively assessed interests and personality variables predicts graduate student success with roughly equal ( $\approx .25-.30$ ) validities, which, when combined, form a multiple correlation,  $R$ , of about .4. More importantly, and in tune 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 temperament, ability, and interests (TAI).

### Theories of individual differences

The late 1940s through to the mid-1960s 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 sub-components, such that operations could be divided into five: cognition, 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 *Gf-Gc* 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, 1946c, 1946b, 1957, 1966b, 1978). To Cattell (1946c), *surface traits* were clusters of observations such as self-reports of anxiety, crying, or depression; they needed to 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 across tests (Q analysis), how tests varied across time (P analysis), and so on. 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 Sixteen Personality Factors Inventory (16PF). As a reflection of his belief in the power of differential psychology and in 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 in individual differences by starting to use behavioral measures (Eysenck & Himmelweit, 1947); then he attempted to explain individual differences by using learning theory (Eysenck, 1952) and subsequently arousal theory (Eysenck, 1967). By blending experimental and correlational data with the best available theory, he inspired others to study the hard question of mechanism. He was never one to avoid controversy, and his popular books (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, 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 effects of situational challenges and individual differences to *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 through the recent studies of Elliot and Church (1997) and Elliot and Thrash (2002), who fit achievement motivation and anxiety into an approach and avoidance temperament system similar to those of Carver and White (1994) and of Gray (1970). Taking the expectancy-value framework even further forward is the work of Eccles and Wigfield (2002), who integrate achievement motivation with theories of goal-setting and interest motivation.

Perhaps unfortunately, the same period was also characterized by an explosion of personality inventories. These were developed by many different research groups. Inventories were constructed by using empirical (Dahlstrom, 1992; Hathaway & McKinley, 1951: MMPI), rational (Gough, 1957: CPI; Heist & Williams, 1957; and Warren & Heist, 1960: OPI), and factorial (Eysenck & Eysenck, 1964, EPI; Cattell & Stice, 1957: 16PF; Comrey, 1995: CPS; Guilford & Zimmerman, 1949: GZTZ;

Hogan & Hogan, 1995: HPI) methodologies—some without any organizing principle other than alphabetical (London & Exner, 1978).

Less noticed at the time but more recently seen as bearing some very rich fruit was a series of longitudinal studies started in the late 1920s, which continued through the 1950s, for example Block (1971), Elder (1998), Kelly (1955), and Schaie (2005). As is true of many longitudinal studies, these were not for the faint of heart or 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 have matched later results: ability, interests, and temperament are very stable over decades. Although there is some change and character is not locked in cement, the latter is much more stable than had been thought (Roberts & DelVecchio, 2000).

## The Late Twentieth Century

Unfortunately, in the mid-1960s, after the proven successes of differential psychologists in 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, undertaken 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, of no interest to the readers of the top journals. Exceptions to this trend were of course the superb integrative text by Eysenck & Eysenck (1985) and a text on individual differences by Willerman (1979). Research emphasis came to be placed on “personality  $\times$  situation interactions,” which had, of course, been well studied by Atkinson (1957), Cattell (1957), and 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 happened partly because the European emphasis upon the biological bases of personality (e.g. Eysenck, 1967; Strelau & Eysenck, 1987) answered the situational attack, partly because there was growing evidence for genetic bases of most individual differences (Bouchard, 1994; Plomin, Owen, & McGuffin, 1994), and partly because there was growing consensus about the descriptive dimensions of personality. For, in the intervening years, a limited number of personality traits were consistently identified in peer ratings and self-reports (Fiske, 1949; Norman, 1963,

1969; Tupes & Christal, 1961), and this steadily accumulated body of evidence indicated that most self-report inventories included some—even if not necessarily all—of these so-called “Big-Five” dimensions (Digman, 1990; Goldberg, 1990). Two of these dimensions, *extraversion* and *neuroticism*, clearly matched the biologically based taxonomies of Eysenck (1967); two, *agreeableness* and *conscientiousness*, seemed to represent a splitting of what he had labeled *psychoticism* or *tough mindedness* (Eysenck, 1990); 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, Barrick, Scullen, & Rounds, 2005) and that characteristics of bad leadership (which were a threat to organizational effectiveness) could be identified by self-report (R. Hogan, 1994; R. Hogan et al., 1990), individual differences research became respectable again.

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

### The 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 *Gf–Gc* model of Horn and Cattell (1966), or a hierarchical model of *g* with second-order factors—verbal and educational (*v:ed*) versus spatial, practical, and numerical (*k:m*) ones (Vernon, 1965)—into a three-stratum model of *g* (Deary, Penke, & Johnson, 2010), which, in some versions (*g–Gf–Gc*), 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 *Gf–Gc* and suggests the importance of verbal, perceptual/memory, and rotational abilities (Johnson & Bouchard, 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

### A 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 Eysenck (1994); handbooks on methods (Robins, Fraley, & Krueger, 2007) and on individual differences in social (Leary & Hoyle, 2009) or cognitive (Gruszka, Matthews, & Szymura, 2010) correlates; and edited volumes on biological bases (Canli, 2006) and on reinforcement sensitivity 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 show the importance of cognitive (Kuncel et al., 2001; Kuncel, Cred, & Thomas, 2007) and non-cognitive (Barrick & Mount, 1991; Mount et al., 2005) predictors for real-world outcomes that include occupational attainment, marital stability, and early mortality (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 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 Minnesota Multiphasic Personality Inventory (MMPI, Hathaway & McKinley, 1943) and, later, the schedule for non-adaptive and adaptive personality (SNAP; Clark, 1993) but until recently there has been surprisingly little interchange between the personality and abilities communities on the one hand and those who study psychopathology on the other. 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 (Krueger, Caspi, Moffitt, Silva, & McGee, 1996; Trull & Sher, 1994), work on positive and negative affectivity in models of depression and anxiety (Clark, Watson, & Mineka, 1994; Watson, Gamez, & Simms, 2005) as well as applications of the five-factor model to predict personality disorders (Bagby, Costa, Widiger, Ryder, & Marshall, 2005; Costa & Widiger, 2002; Widiger & Costa, 1994). The taxonomic work of Krueger (2002), Krueger and Markon (2006), Markon, Krueger, and Watson (2005), and Tackett, Silberschmidt, Krueger, and Sponheim (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 (RST)* 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, Loxton, and Avery discuss in the present volume, 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 the way 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, Pickering, & Jackson, 2006; Smillie, 2008, and the discussions following). It seems clear that, for at least the next decade, this will be an active research endeavor.

*Other biological models* Contemporary biological models have benefited from technological advances in assessing neurophysiology. Magnetic resonance imaging (MRI) studies have investigated structural correlates of individual differences (Omura, Constable, & Canli, 2005; Rauch et al., 2005) from the perspective of learning theory. Depue (1995) and his colleagues (Depue & Collins, 1999) claim that individual differences in the strength of a neurobehavioral system tied to dopaminergic functioning form the causal basis for extraversion. Although research on this theory is still in its nascent stages, electroencephalography (EEG) studies generally supporting the dopaminergic hypothesis (Wacker, Chavanon, & Stemmler, 2006). Perhaps the most important methodological advance has been the use of functional MRI (fMRI) to study how patterns of brain activation relate to individual differences. In particular, Herrington, Koven, Miller, and Heller (2006) reviewed evidence suggesting that left hemisphere lateralization is associated with approach temperament. There is mixed evidence that approach temperament, consisting of extraversion, positive affect, and behavioral approach (Elliot & Thrash, 2002), predicts high performance on a variety of neuropsychological tasks that require cognitive functions 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, Harris, Winkielman, & Pashler, 2009). As researching 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 in animals as diverse as humans, hamsters, and fruit flies. Not only do people vary in their arousal over the 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, Humphreys, Simon, & Gilliland, 1980) was used to argue against the arousal theory of extraversion (Eysenck, 1967). Individual differences in diurnal rhythms as assessed by core body temperature were correlated with various measures of morningness–eveningness, as well as with voluntary sleep and awakening times (Baehr, Revelle, & Eastman, 2000). The minimum body temperature of self-described morning types was roughly two hours ahead of that observed for self-described evening types, although the behavioral response to social cues diminished the 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 ones before going to sleep, and also why they are so sluggish after awakening. Individual differences in diurnal rhythms are particularly important for sleep researchers (Taillard, Philip, Coste, Sagaspe, & Bioulac, 2003), especially those

interested in sleep problems associated with adolescence versus adulthood (Crowley, Acebo, & Carskadon, 2007). The combination of social cues with an endogenous clock rhythm has important implications for other species as well—for instance in the fruit fly, where the 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, Plomin, McClearn, & Friberg, 1988; see also Spinath & Johnson in this volume). Equally clear, and much more surprising, is the fact that, when doing an ACE analysis (that is, when 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 for the Big-Five dimensions of personality. They are true for various psychopathologies, for interests, for sexual orientation, and even for religiosity. Indeed, it is now noteworthy when a 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 which can be associated with the genetic causes of the total observed variance. Genetic effects can interact with (Caspi et al., 2002) and/or correlate with environmental variation in complex manners (W. Johnson, 2010). One of the major disappointments of the switch from quantitative behavioral genetics to molecular genetics and of the search for particular genes is how few genes have been shown to have replicable effects, and, even among those, how small the effects are. The simple “one gene–one disease” (OGOD) hypothesis (Plomin et al., 1994), which is derived from medical genetics, or its somewhat more complicated alternative, the “one gene–one system” hypothesis (OGOSH), do 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 genetic literature on behavior are that:

- 1 additive heritability is a hodge-podge ratio of genetic variance to total variance;
- 2 the less the environmental variance, the greater the heritability;
- 3 heritability within groups does not imply genetic causes of between-groups differences.

*Between-group versus within-group differences* A recurring problem in inferences about genetics is whether genetic variability within groups has anything to do with genetic differences between groups. Consider the example of height (Johnson, 2010). It is well established that the heritability of height is roughly .8 within cultures. That is, about 80 percent 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, which are 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,” which claims that, if factor loadings on a variable are correlated with heritability and also 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 measures that represent the better measure of height will show the biggest between-group differences in height. Indeed 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, Realo, Voracek, and Allik (2008) examined sex differences on a short form of the Big Five (Benet-Martinez & John, 1998) across 55 different countries. The mean  $z$  score of sex differences showed that women are more neurotic ( $\bar{z} = .40$ ), agreeable ( $\bar{z} = .15$ ), conscientious ( $\bar{z} = .12$ ), and extraverted ( $\bar{z} = .10$ ), and also less open ( $\bar{z} = -.05$ ) than men. 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-Five Inventory (BFI) and reported their SAT (Scholastic Assessment/Ability Test) verbal and SAT quantitative scores (Revelle et al., 2010). In that sample, women were more agreeable ( $d = .56$ ), less stable emotionally ( $d = -.54$ ), less open ( $d = -.30$ ), more conscientious ( $d = .24$ ), and more extraverted ( $d = .14$ ). Men and women reported practically identical SAT verbal scores, although women reported lower SAT quantitative scores ( $d = -.29$ ). Gender differences have been reported for the facets of the NEO Personality Inventory, and are greater in Europe and America than in other cultures (Costa, Terracciano, & McCrae, 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, Vazire, Ramirez-Esparza, Slatcher, & Pennebaker, 2007).

Even among amazingly talented women and men, there are reliable sex differences in interests and values (Ferriman, Lubinski, & Benbow, 2009). More importantly, these differences grow through people’s 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 is masked when looking at overall  $g$  scores. Women out-perform men in verbal and perceptual speed tasks, but do less well on visuospatial problems (Johnson & Bouchard, 2007). These sex differences, although strong, partly depend upon the method of analysis (Steinmayr, Beauducel, & Spinath, 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 & Heggstad, 1997; Ferriman et al., 2009; Lubinski & Benbow, 2000), there have been few attempts to integrate research on interests with research on ability or temperament. Promising attempts are being made as part of the longitudinal study of mathematically precocious youth (Lubinski & Benbow, 2000, 2006). Ackerman and Heggstad 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 and Benbow (2000), is an excellent example of how to blend individual differences in abilities, interests, and values into a theory of long-term 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 inventories of ability as well as of psychomotor and personality inventories in predicting real-world criteria is an important application of our work. In a way which is reminiscent of the personality characteristics discussed in Plato’s *Republic*, Musson, Sandal, and Helmreich (2004, p. 342), when predicting aviator or astronaut success, found that

[s]uperior 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” [...] 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).

In the context of 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 that of 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 determining who succeeds in a STEM career, but the mixture of verbal, spatial, and quantitative abilities, together with their interest 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, 2010). 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 years of glory or to dwell on the misguided ventures of 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 those about the way in which basic genetic and neurobiological characteristics contribute to individual differences (Canli, 2006) to those about the way in which 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, think, and want (Allport, 1937; Emmons, 1989; J. A. Johnson, 1997; Winter, John, Stewart, Klohnen, & Duncan, 1998). As such, researchers studying differential psychology tend to consider questions falling into 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 beat; cognition comprises thoughts and beliefs, including how one creates meaning out of 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 just one of these ABCD domains of functioning, neglecting to consider connections across levels and domains.

In the domain of *affect*, there has been considerable debate over how many and what 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 considered 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, Clark, & Tellegen, 1988). A three-dimensional model has also been proposed, which incorporates a valence dimension with two independent arousal dimensions: energetic arousal and tense arousal (Schimmack & Grob, 2000; Schimmack & Reizenzein, 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 differences variable (Feldman, 1995; Rafaeli, Rogers, & Revelle, 2007).

A long-standing 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 Eysenck and Himmelweit’s (1947) work on the factor structure of behavioral observations, this goal has too seldom been realized. Historically, it has 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, Rafaeli, Bolger, Shrout, & Reis, 2006), portable recorders (Mehl & Pennebaker, 2003), and cell-phone methods of data collection (Collins, Kashdan, & Gollnisch, 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, Furr, & Colvin, 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, Gosling, & Pennebaker, 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, Whiteman, Starr, Whalley, & Fox, 2004; Deary et al., 2010). Researchers have begun studying how personality dispositions relate to cognitive differences, most of this research focusing on the trait of openness/intellect (Costa & McCrae, 1992b; Hofstee, Raad, & Goldberg, 1992). Individuals higher in openness generally score higher on measures of cognitive ability (DeYoung, Peterson,

& Higgins, 2005; Revelle, Wilt, & Rosenthal, 2010), are seen as displaying more creative thinking, and have a greater capacity for divergent thinking (McCrae, 1987). Developing in parallel to the 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 schemata. Some of the best known research from this approach has examined differences between people who perceive ability as stable, who are labeled “entity theorists,” and those who see ability as malleable, who are labeled “incremental theorists” (Hong, Chiu, Dweck, Lin, & Wan, 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 motivational dimensions has been specified (Elliot & Church, 1997), elaborated upon (Elliot & McGregor, 2001), and correlated with individual differences in academic performance (Cury, Elliot, Da Fonseca, & Moller, 2006). Higgins’s (1998) 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, which reflect one’s wishes and aspirations. Prevention focus leads one to bring one’s actual selves into alignment with one’s ought selves, that is, with 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-Five variables (Roberts & Robins, 2000; Roberts, O’Donnell, & Robins, 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 in their personal projects (Little, Lecci, & Watkinson, 1992) have also gained popularity.

The fact that domains of functioning are studied in isolation from each other is not a criticism of the researchers involved; for indeed each level and each 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 one of organization. That is, how can theories of individual differences be organized such that the domains of functioning (ABCDs) may be connected to each other in meaningful ways?

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, Norman, & Revelle, 2005). It is important to note that the reactive level, routine level, and reflective level 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), the fear (affect), and the removal of one's hand (behavior) are likely to 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 discriminate cognitively between the present state of not being in pain and fear (affect) and an unwanted future state of pain (desire). The individual may thus act (behavior) so as to increase the likelihood that pain does not ensue. The *reflective* level describes higher-level cognitive functioning such as self-awareness and meta-processing. 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 the 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 bio-



logical and environmental variables by 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), which calls into question their validity. Further attention may be warranted due to the importance of interactions in establishing boundary conditions for theories on 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 theory in 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 on the basis of 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 are not confined to human beings may be explored by studying animal personality (Vazire & Gosling, 2003; Vazire, Gosling, Dickey, & Schapiro, 2007). There has been a long history of studying biological mechanisms thought to relate to personality by using animal models in drug or lesion studies (Gray, 1982; Gray & McNaughton, 2000) as well as in 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 data base on individual differences is sure to continue to grow at an increasingly fast rate, given the ease of public-domain personality assessment which specifically uses resources such as the IPIP (Goldberg, 1999; Goldberg et al., 2006). The possibility for such data to be stored in large data bases available for public use heeds the call to make differential psychology accessible to everyone. Additionally, the ability to make inferences about individual differences on the basis of the content of personal websites (Gosling, Vazire, Srivastava, & John, 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 are 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 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 temperament, abilities and interests. There may be relatively weak correlations across TAI domains, but it is important that differential psychologist not get discouraged over these results. Indeed, loose associations among these constructs are *encouraging*, because their existence means that variables from each domain may serve as important predictors in their own right. Thus temperaments, abilities and interests may have additive and interactive relationships with practically important outcomes. 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 the one we realized in the mid-twentieth century. Indeed the future of differential psychology is more promising than it has been for decades.

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