

An organizational framework  
for the psychological individual differences:  
Integrating the affective, cognitive, and conative domains

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## Chapter 1

# The Paradigmatic Science of Individual Differences

“ You should not establish a home with an arrogant man. ...  
The eyes of the slanderer always move around as shiftily as a spindle. You should never remain in his presence. ...  
You should not boast in beer halls like a deceitful man: then your words will be trusted. ...  
The artistic mouth recites words; the harsh mouth brings litigation documents; the sweet mouth gathers sweet herbs. ...  
The imprudent decrees fates; the shameless one piles up things in another’s lap: ‘I am such that I deserve admiration.’ ...  
The negligent one ruins his family. ...  
A loving heart maintains a family; a hateful heart destroys a family. ”

*The Instructions of Šuruppag (c. 2600 BCE)*

1 More than a few lines from the oldest surviving text describe the effects of individual differences in  
2 human behavior, and the insights of Sumerian King Šuruppag are, by no means, an isolated example.  
3 Individual differences are also addressed in influential works by several ancient Chinese authors,  
4 including the *Book of Documents* (Legge, 1879, a.k.a. the *Classic of History* or *Shujing*, c. 5th to 11th  
5 centuries BCE), the *Analects* of Confucius (Confucius, 1994, c. 435 BCE), and Liu Shao’s *Classified*  
6 *Characters and Political Abilities* (Shao, 2007, a.k.a. *Ren Wu*, c. 200 CE). This last example is a twelve  
7 chapter volume which explicitly posits a detailed theory of individual differences in temperament and  
8 cognitive ability as well as descriptions of suitable methods for observational data collection and  
9 application of the theory for political and social benefit (Shao, 2007).

10 More familiar to Western scholars are examples contributed by several ancient Greeks. These include  
11 Galen’s theory of temperament (based upon the Four Humors described by Hippocrates (Galen, 1916;  
12 Hippocrates and Galen, 1846), c. 460 BCE), Aristotle’s *Nicomachean Ethics* (Aristotle, 2000, c. 350 BCE),  
13 Cicero’s *Tusculan Disputations* (Eysenck, 1983a, c. 45 BCE), and the *Characters* of Theophrastus  
14 (Boegehold, 1959; De Raad and Ceulemans, 2001; Theophrastus, 1927, c. 319 BCE). Retrospectives on  
15 individual differences often begin with Theophrastus’ *Characters* – probably because it provides an  
16 ancient example of the typological approach to describing trait constellations – though these

conveniently overlook the considerable evidence that Theophrastus' claims regarding the generalizability of his characters were made as a thinly-veiled attempt to shield him from the consequences of overtly satirical descriptions of his political contemporaries (Boegehold, 1959; Theophrastus, 1927).

In any case, it seems reasonable to infer on the basis of these ancient references that individual differences in behavior have been a topic of cross-cultural relevance since the beginning of recorded history. Much more recently, evolutionary theory has suggested that the role for intraspecific individual differences may be even more primal. Some of Darwin's own observations in the first edition of *The Origin of Species* (1859) are particularly relevant (see the subsection titled "Individual Differences" in Chapter II – Variation under nature, and all of Chapter IV – Natural Selection; or the Survival of the Fittest). Darwin initially avoided the suggestion that his theory might also be extended to the human species though the study of individual differences among humans was promptly pursued by others (Fechner, 1860; Galton, 1869) and later by Darwin himself (Darwin, 1871, 1886). "Variation is, after all, the grist for the mill of evolution" (Nettle, 2006) in that random variability is the means by which natural and sexual selection mechanistically proceed, perhaps even among humans in the modern era (Courtiol et al., 2012, 2013).

## 1.1 The absence of a paradigm

“ What human personality is, everybody knows; but nobody can tell. ”  
*William H. Burnham (1929) in Allport and Vernon (1930)*

Two observations are worth emphasizing about the relationship between evolutionary theory and the ancient written references to individual differences. The first of these is recognition of the possibility that, if evolutionary theory is valid across species, references to the importance of individual differences in human texts may be – both literally and figuratively – an artifact of the capacity for verbal and written communication. In other words, the importance of individual differences is not necessarily (and likely, *is not*) dependent on the presence of language structures. This also implies that the degree of introspective recognition (conscious or unconscious) and/or mutual recognition of individual differences likely varies across and possibly within species.

More explicitly, discussion about the importance of individual differences in several of the earliest texts implies that they were important before writing skills were well-developed (the alternative – that the development of writing occurred simultaneous with recognition of the importance of individual differences – seems implausible). This implication has philosophical consequences for the so-called “Lexical Hypothesis,” an idea that was first proposed by Sir Francis Galton (Galton, 1884) and has since served as a foundational assumption in individual differences research. The Lexical Hypothesis essentially states that “those individual differences that are of the most significance in the daily transactions of persons with each other will eventually become encoded into their language” (Goldberg, 1981). Further elaboration of this topic is given in Chapter 2, but it is worth noting here that at least some important underlying differences pre-dated the existence of words to describe them (and the existence of words themselves), and that this is consistent with the Lexical Hypothesis.

The second observation relates to the large chronological discrepancy between the earliest written

references to individual differences and the first incidence of their mention in a *scientific* context. Despite being encoded in written language for millennia, individual differences were rarely the focus of systematic study and classification. This circumstance is markedly different from many other aspects of human experience, most notably those which are now characterized as part of the natural sciences. This combination – the widely acknowledged importance of individual differences among humans and the absence of systematic study of their structure or even definition – has led to a diverse array of partially overlapping, anecdotally-derived lay “theories” (Shamdasani, 2003). While the generations after Darwin and his contemporaries (most prominently, Galton) embraced the suggestion that individual differences and their various subsets should be the target(s) of scientific study, the lack of consensus about the best means of proceeding was impressive and persistent.

Throughout the 20th century, scholars of individual differences from varying theoretical orientations have concurred about this dilemma, describing the situation as: “a chaos [that] does not give unity or definiteness of direction to our study” (Allport, 1921); “little other than a chaos of arbitrary dogmas... with complete lack of agreement” (Jung, 1925 from Shamdasani, 2003); “a deadlock: we cannot advance to agreed conclusions for lack of common terminology; and we cannot achieve such a terminology because of the extreme diversity of views among authorities” (McDougall, 1932); “a chaotic center in personality research” (Cattell, 1940); “no progress seems to have been made” (Roback, 1952); “most so-called ‘theories’... are scientifically unimpressive and technologically worthless” (Meehl, 1978); “one element of the model [of a mature science] has no counterpart in the field of personality: the unanimity of qualified persons in agreeing on a paradigm” (Loevinger, 1987); “there is no agreement on definitions, models, methods, results or indeed anything whatever; all is confusion...” (Eysenck, 1991); and “personality psychology has yet to articulate clearly a comprehensive framework for understanding the whole person” (McAdams and Pals, 2006).

These claims fit quite well with the definition of “pre-paradigmatic science” provided by Thomas Kuhn (Kuhn, 1962). While the terminology introduced in Kuhn’s seminal work, *The Structure of Scientific Revolutions* (Kuhn, 1962, 1970), is now commonplace, it has also been subject to considerable reconstruction, re-interpretation and even misinterpretation in the vast secondary literature spawned by his original text (Hoyningen-Huene, 1993). Given this and the relevance of his philosophy of science to the issues at hand, a lengthy quotation from the original text is justified:

“In the absence of a paradigm or some candidate for paradigm, all of the facts that could possibly pertain to the development of a given science are likely to seem equally relevant. As a result, early fact-gathering is a far more nearly random activity than the one that subsequent scientific development makes familiar. Furthermore, in the absence of a reason for seeking some particular form of more recondite information, early fact-gathering is usually restricted to the wealth of data that lie ready to hand. The resulting pool of facts contains those accessible to casual observation and experiment together with some of the more esoteric data retrievable from established crafts like medicine, calendar making, and metallurgy. Because the crafts are one readily accessible source of facts that could not have been casually discovered, technology has often played a vital role in the emergence of new sciences. But though this sort of fact-collecting has been essential to the origin of many significant sciences, [several examples demonstrate that] it produces a morass. One somehow hesitates to call the literature that results scientific. ... [T]he typical natural history often omits from it’s immensely circumstantial accounts just those details that later scientists will find sources of important illumination. ... This is the situation that creates the

schools characteristic of the early stages of a science's development. No natural history can be interpreted in the absence of at least some implicit body of intertwined theoretical and methodological belief that permits selection, evaluation, and criticism. If that body of belief is not already implicit in the collection of facts – in which case more than 'mere fact' are at hand – it must be externally supplied, perhaps by a current metaphysic, by another science, or by personal and historical accident. No wonder, then, that in the early stages of the development of any science different men confronting the same range of phenomena, but not usually all the same particular phenomena, describe and interpret them in different ways. What is surprising, and perhaps also unique in its degree to the fields we call science, is that such initial divergences ever largely disappear. For they do disappear to a very considerable extent and then apparently once and for all. Furthermore, their disappearance is usually caused by the triumph of one of the pre-paradigm schools, which, because of its own characteristic beliefs and preconceptions, emphasized only some special part of the too sizable and inchoate pool of information. ... To be accepted as a paradigm, a theory must seem better than its competitors, but it need not, and in fact never does, explain all the facts with which it can be confronted." (Kuhn, 1962, Chapter 2)

This suggests that the study of individual differences has been in the pre-paradigmatic stage for most of recorded history (though, in fairness, this is offset by the fact that individual differences were rarely considered in a scientific context prior to the mid-19th century). Nevertheless, the very prolonged period of "early fact-gathering" is consequential. Thousands of years of casual observation can produce a morass of unusual depths, one which might well require several generations to resolve. This morass may be exacerbated by the fact that those who come to study individual differences typically do so after decades of personal, informal fact-gathering which is unsupported by paradigmatic scaffolding and infused by exposure to pseudo-scientific lay theories (for discussion of examples, see Cattell et al. (1964); Dahlstrom et al. (1996); Mehl et al. (2006); Thagard (1978)). Resolution is possible however. Kuhn suggests that the pre-paradigmatic era fades with the spreading recognition that one school of thought is theoretically superior to the rest. The question for scholars of individual differences is whether such a resolution will ever come to pass, if it has not already occurred.

The prospect of a paradigm in individual differences research has been directly addressed several times over the last 30 years (Eysenck, 1983b; Loevinger, 1987; Wiggins, 2003), with two dissimilar conclusions. Loevinger (Loevinger, 1987) and Wiggins (Wiggins, 2003) concurred that several paradigms exist, with Loevinger going so far as to claim that "there will always be a multiplicity of paradigms" (Loevinger, 1987, p. 6). Both authors coincidentally identify the same number of active paradigms (five), though only two of these are clearly overlapping – the psychodynamic/psychoanalytic paradigm and the multivariate/psychometric paradigm.

For Eysenck, the vital need for a singular paradigm was a frequent refrain (Eysenck, 1983b, 1985, 1991, 1994, 1997; Eysenck and Eysenck, 1985), though the objectivity of this claim was somewhat discredited by the suggestion that his own structural theory (the P-E-N model, discussed in Chapter 2) was the most obvious choice. Despite the partiality of his conclusions, Eysenck's reflections on the issue of paradigm development included several arguments which remain relevant today. Most notable is his suggestion that it is first necessary to evaluate the degree to which the study of individual differences constitutes a *scientific* endeavor before one can consider paradigm development (Eysenck and Eysenck, 1985; Eysenck, 1985).

## 1.2 On the scientific quality of individual differences research

“ [O]ne source of a malign compass deviation in the early days has been the very eagerness to assume a true scientific status. For this led to premature regimentation, and indeed slavishness, in following the rules of the older, established sciences when the need was really for invention of methods and trial-and-error exploration of the scientific quality of a new area.

”

*Raymond B. Cattell (1966)*

The “scientific issue” has been a perennial debate (Jastrow, 1901; Boring, 1923; Anastasi, 1948; Hornstein, 1988, 1992) among those who study individual differences, and it has occasionally been quite heated. A representative example comes from the 1923 meeting of the American Psychological Association when James McKeen Cattell interrupted the meeting to castigate a fellow member for mentioning Freud’s name in the context of scientific discourse (Dallenbach, 1955) (this was far more controversial than it might seem today as psychoanalytic theories of personality organization were increasingly popular among APA members at that time). The essence of the controversy is that some approaches to psychological research claim to be more representative of science than others (by virtue of quantification and generalizability) in contrast to the Kantian view that the quantification of mental events is philosophically impossible (Kant, 1799; Loewinger, 1987). The suggestion that quantification and generalizability are key components of the scientific method (Popper, 1959) causes them to be viewed, by turns, as either a necessity in the study of individual differences (Cattell, 1940) or a mindless and unwarranted conformity (Giorgi, 1975) to the standards of the so-called natural sciences.

The defense against quantification and the search for generalizability rests largely on the belief that hermeneutic and existentialist concerns are fundamental to psychologically-oriented individual differences. The extreme view is that the precisely unique qualities of the individual are key determinants of behavior and that the identification of communality across individuals requires an invalidating lessening of precision. As such, idiographic approaches are not only appropriate but mandated in the study of topics such as identity or unconscious features of the psyche. Research on such topics often enjoys wide appeal by virtue of an emphasis on individuality. This emphasis is not inherently problematic – in fact, examination of individual experiences can offer great utility for both the individuals under examination as well as those who endeavor to understand development. But, strict idiographic study is scientifically problematic because it subordinates the search for a generalizable structure of differences across individuals. When used in isolation, idiographic approaches seldom offer opportunities for theory testing in the Popperian sense (Popper, 1959), mainly because it is not currently possible to identify, measure, and control every one of the environmental and biological variables underlying individual outcomes.

The esoteric nature of this debate is undeniable; it hinges upon the degree of commonality in differences. Yet Eysenck (1985) implies that inaction (or perhaps even boredom) caused by this esoteric bind is actually the primary obstacle to graduation from the pre-paradigmatic state. The study of individual differences, according to his logic, is dissimilar from paradigmatic sciences in that there is a surplus of “theories” which are either (a) unlikely to ever enter into the realm of science on the grounds that they are incapable of being used to make testable predictions; or (b) so narrow and methodologically restrictive that they make verifiable predictions of little-to-no relevance. The latter approach sacrifices utility for the sake of rigorous scientific methods (though it should be noted that

Eysenck's opposition to strict empiricism was somewhat inconsistent over the last 10 years of his career). If a paradigm in individual differences research were to gain acceptance according to Kuhn's suggestion – by merely outdoing its competitors – it would have to fulfill the basic qualifications of science while remaining broad enough to address issues of demonstrable relevance.

Eysenck is not unique in calling for a middle path. To the contrary, it seems that individual difference scholars ironically relish the typological as an explicative tool. Allport pitted the Realist against the Nominalist (Allport and Odbert, 1936) and Actuarial approaches (Allport, 1940); Meehl (1954) the Statistical versus the Clinical. Raymond Cattell split the field into three camps: those who embraced the multivariate approach, the overly-rigorous “bivariate brass instrument” methodologists, and a loose collection of “numerous quasi-scientific schools which led to that scholastic Tower of Babel” (Cattell, 1966, p. 8). (All of these scholars were admittedly biased towards the differential approach advocated herein.) Cronbach (1957; 1975) was perhaps more objective in his description of the “Tight Little Island” of experimentalists and the united principalities of the correlationalists’ “Holy Roman Empire.”

The generalized form of these observations is that individual differences research can be organized along a spectrum according to its “scientific-ness.” This spectrum is mainly methodological though does also reflect underlying theory in that the most scientific methods tend to address mechanisms of behavior that are common to the human species while the least scientific approaches tend to deal with idiographic aspects of individual experience. As Kluckhohn and Murray (1948) observed, “every man is, in certain respects, like all other men, like some other men, and like no other man” and these degrees of similarity are reflected in the varied types of research on individual differences in behavior.

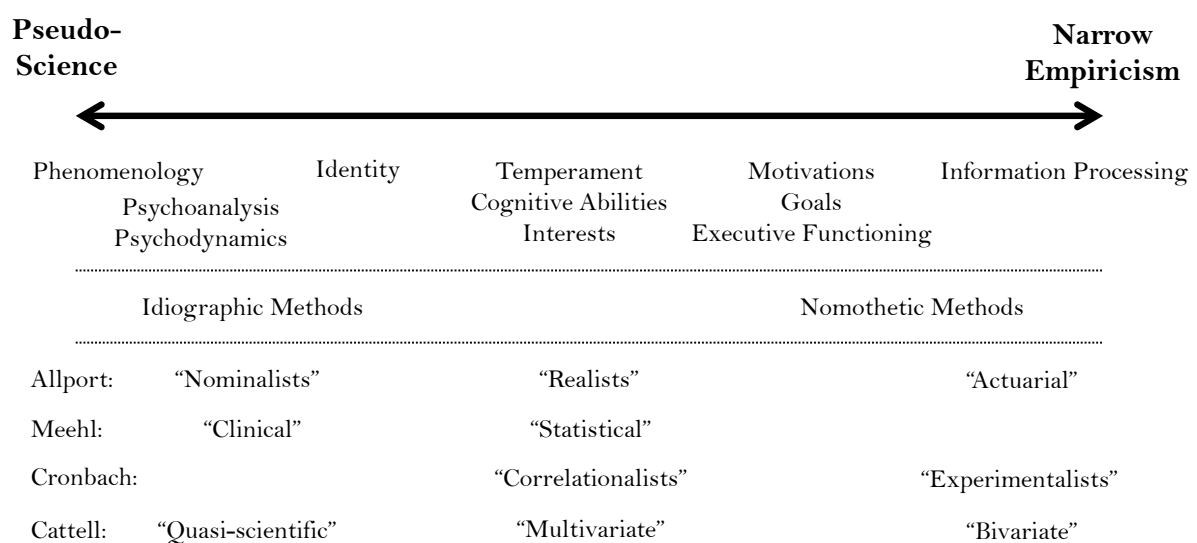


Figure 1.1: The scientific dimension in research on psychological individual differences

Note: This is not intended to exhaustively depict all the major domains of individual differences research nor does it attempt to account for fields of psychological research that seek to describe interpersonal interaction.

Figure 1.1 attempts to capture the essence of this dimension. The ends of this spectrum represent the problematic types described by Eysenck (those which make untestable predictions on the left and those which fail to make predictions of relevance on the right). The labels prescribed by others (Allport, Meehl, Cronbach, and Cattell) are included on the spectrum as well, though it should be acknowledged



that their exact placement would likely lead to some debate among the scholars working in these areas.

The rationale for explicit description of this dimension, despite its imprecision, is to demonstrate the range of “scientific-ness” for research on psychological individual differences. Today, nearly all of the researchers working at various locations on this dimension would describe themselves as “personality psychologists,” except perhaps for those “cognitive psychologists” exploring the more generalizable mechanisms of information processing and executive functioning. Those working on the left end of the spectrum might also be referred to as “personologists,” though this is uncommon. Research in the middle of this spectrum has traditionally been known as “differential psychology.” The placement of these labels on the spectrum is demonstrated in Figure 1.2.

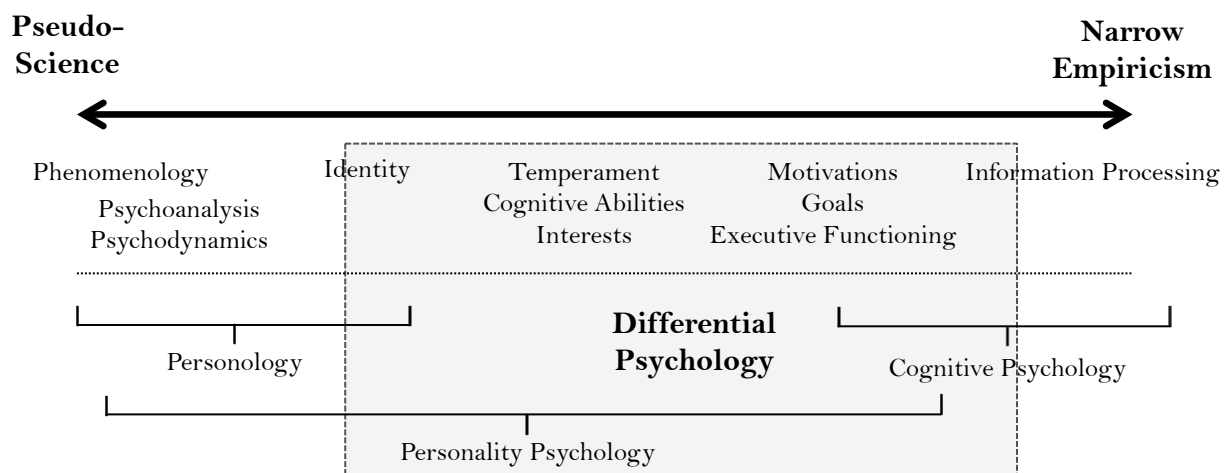


Figure 1.2: Situating Differential Psychology on the scientific dimension

### 1.3 The need to distinguish personality from differential psychology

“ Although it is true that it is the goal of science to discover rules which permit the association and foretelling of facts, this is not its only aim. It also seeks to reduce the connections discovered to the smallest possible number of mutually independent conceptual elements.

”

*Albert Einstein (1941)*

In practice, the “differential psychology” label is used only rarely and even then it is viewed as essentially synonymous with “personality.” The tendency for these terms to be used interchangeably is problematic for two reasons. The first of these is apparent in Figure 1.2; both personality and differential psychology include domains of research which are exclusive of one another. In other words, there are aspects of differential psychology which are not traditionally viewed as part of personality psychology (e.g., neuroanatomical differences) and vice-versa (e.g., case studies of phenomenological experience).

A more nuanced, and perhaps impactful, issue with imbrication of these terms relates to imprecision of the term “personality” more generally. After decades of disagreement about the subtle differences



between terms such as character, temperament, and personality (Allport, 1921; Fernald, 1920; Gilliland, 1928; Jastrow, 1915; Klages, 1929; May and Hartshorne, 1927; McDougall, 1929, 1932; Tolman, 1932; Roback, 1927), the burgeoning field united behind Allport's (1930) view that this area of research should be defined by broad use of the term "personality" to overlay all possible integrative and omnibus interpretations.

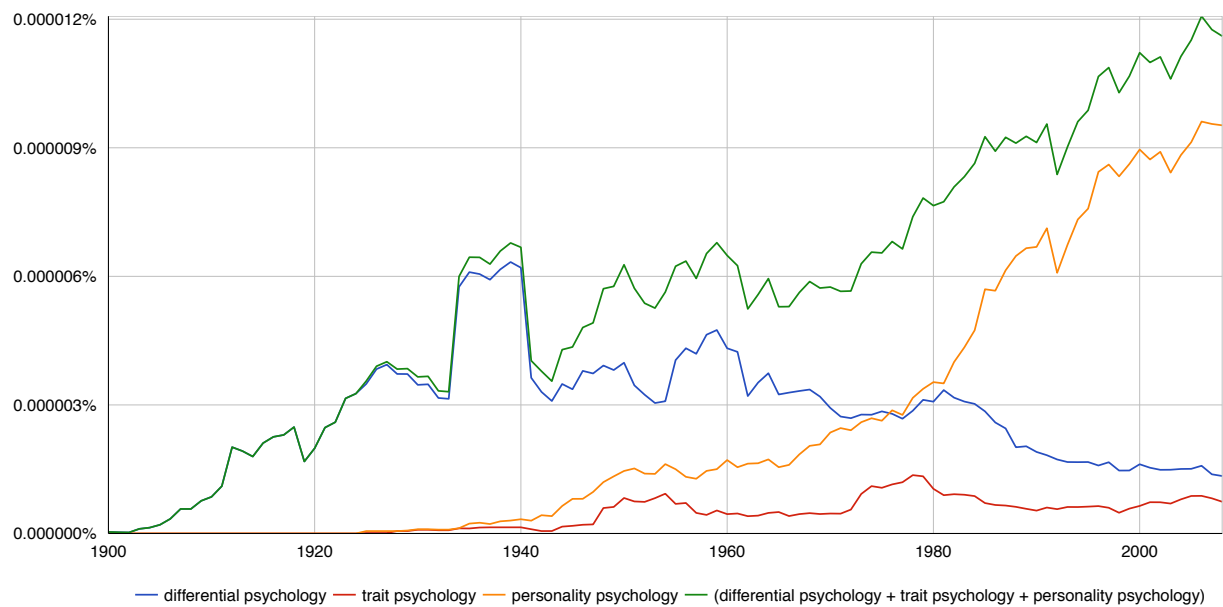
This practical approach is far preferable to the previous ambiguity. However, there is also utility in the application of more specific terminology. "Temperament" for example is generally regarded as the affective component of personality (Allport and Vernon, 1930; Hofstee, 1991; Shiner and DeYoung, 2013) in humans (and other species (Gosling and John, 1999; Gosling, 2001; Weinstein et al., 2008), though this necessitates further expansion of *personality* to include non-person animals). Similarly, "traits" are subsumed under the personality label, though they are more specific than temperament. That is, some personality traits might be described as temperamental traits while others would not.

How should "differential psychology" be distinguished from "personality psychology"? Differential psychology seeks to describe and understand individual differences in order to make predictions about behavior. Personality psychologists who disavow the differential psychology approach seek to merely describe patterns of individuality (Lamiell, 1981, 2003), without specification of the extent to which various features of a given signature may be idiosyncratic. As mentioned earlier, these are overlapping but they are *not the same*. The inherently scientific pursuit of (generalizable) predictiveness implies an intention to identify and organize individual differences in terms of their relationships with various outcomes.

To be clear, use of the label "personality psychology" is not inherently flawed, but rather overly vague. This may be the source of its appeal. Figure 1.3 shows the frequency of usage for "personality psychology" and various other two-word phrases (bigrams) in a sample of books written in English with publication dates between 1900 and 2008 and subsequently digitized by Google (approximately 30 million volumes). While the occurrence of these phrases is an admittedly weak indicator of the nature of the research being conducted, the relative frequency of their usage over time is suggestive of long-term trends.

Perhaps the most important trend is the steady increase in usage of the phrase "personality psychology" between 1940 and 1980. Over the same period, usage of "differential psychology" and "trait psychology" was essentially unchanged. After 1980, "personality psychology" continues to increase in frequency while "differential psychology" and "trait psychology" usage decreases. One interpretation of these trends would be that some of the differential psychology research conducted since 1980 has been more generically labeled as personality research, though it's also possible that the volume and/or significance of differential psychology research has decreased.

The possibility that a substantial portion of personality research might be more narrowly labeled as differential psychology is supported by two related phenomenon over the last few decades. Hofstee (2007) distinguishes these as the "epistemic" and "ethical" components of the argument against the study of individual differences. The ethical argument often invokes Galton's well-known support of eugenics and makes vague implications that those working in other areas which were influenced by Galton probably maintain the same perspective as British aristocrats at the end of the 19th century. This is no more true for differential psychology than it is for genetics. In the event that the disastrously destructive events of the first half of the 20th century did not provide sufficient rationale for disagreeing with Galton's views about anthropological typologies, it is widely recognized, even among the general public



[Click on the image to interact with the figure](#)

Figure 1.3: Frequency of usage for labels describing individual differences research

Note: Frequencies based on usage in the corpus of books digitized by Google and written in English (American and British) with publication dates between 1900 and 2008

(Condit, 1999; Condit et al., 2001), that strict genetic determinism lacks scientific support. Consider, for example, the differences in height among genetically homogenous populations in North and South Korea (Schwekendiek, 2009; Johnson, 2010b); even for the small number of individual differences where variability is highly influenced by genetics, environmental influences can still contribute substantially. Individual differences in behavior are no exception: they are non-deterministic, multi-factorial by-products of a tremendous number of environmental and genetic variables (Weiss and Lambert, 2011).

The epistemic argument calls into question the value of making predictions (as previously addressed) in a world of limitless individuality and situational specificity (Lamiell, 1981). With regards to nomenclature, it may be that “personality psychology” is preferred over “differential psychology” if the former suggests a greater allowance for contextualism by virtue of simply being more vague. In other words, it may be the case that *descriptive* personality psychology research is held to looser standards than *predictive* differential psychology research when it comes to accounting for situational factors.

As trivial as these arguments may seem to many scholars, they continue to perpetuate the very constraints lamented by Cattell (1966), Cronbach (1957), and Eysenck (1985). These arguments may serve as legitimate rationale for use of the more generic “personality” label when naming program areas within academic psychology departments or when describing the broad aims and objectives of a research journal, but they should be eschewed by those conducting quantifiable and generalizable research when more specific terminology is an option<sup>1</sup>. While there exist at least two academic societies

<sup>1</sup>Further digression might be made to consider the ways in which the terms “trait psychology” and “evolutionary psychology” relate to personality and differential psychology. In brief, “trait psychology” or “trait theory” is very similar to differential psychology in that traits are typically conceptualized as synonymous with individual differences. Use of the term has been

(ISSID, 2014; SMEP, 2014) and a sizable contingency of scholars, especially outside the United States, who routinely frame their work as differential psychology research when appropriate (Bouchard et al., 1990; Buss, 1991; Chamorro-Premuzic et al., 2011; DeYoung, 2010a; Johnson, 2007; Kanai and Rees, 2011; Krueger and Johnson, 2008; Nettle, 2006; Plomin and Rende, 1991), the number of researchers who identify as differential psychologists could be much larger still if priority were given to the use of more specific nomenclature.

Differential psychology is the domain of research which occupies the middle road between the strictly unique and universal qualities of a species. By virtue of its focus on the psychological differences, the majority of research in this field focuses on behavioral variance in the human species. The primary challenges to the development and testing of scientific models in differential psychology relate to the identification and quantitative measurement of variables that represent a balance between generalizability and variance across populations. To borrow the language of Einstein (1941), the aim of differential psychology is the “discovery” of those differences “which permit the association and foretelling of facts” and “reduce the connections discovered to the smallest possible number of mutually independent conceptual elements.” This aim will be achieved through the comparative testing of models.

After lengthy digression, it is now proposed that individual differences research is a scientific endeavor in Eysenckian terms to the extent that the concepts under study are quantifiable and that explanatory models of these concepts are generalizable and testable. A great deal of research which meets these conditions has been (and is being) conducted under the heading of “personality psychology,” though it is proposed here that it would be usefully distinguished from research which does not meet these conditions by the more specific label “differential psychology.” Some might take exception to this proposal but it is endorsed here in order to address the question posed earlier regarding the existence of a scientific paradigm in the study of individual differences; it is a non sequitur to evaluate this question for a domain in which the practitioners fail to agree about the qualities of “scientific” output. The question now considered is whether a paradigm exists in *differential psychology*.

## 1.4 Contributions from the major disciplines

“ [T]here are three absolutely irreducible faculties of the mind, namely, knowledge, feeling, and desire. ”

*Immanuel Kant (1790)*

In order to emerge as the dominant paradigm in differential psychology, a theory would need to (mostly) account for the range of the facts which are known regarding individual differences and hold up to extensive testing against predictions of human behavior while simultaneously demonstrating

confused somewhat by recent study of universal human traits (Buss, 1984; Kappeler et al., 2010; McCrae and Costa, 1997; Pinker, 2002), which are those common among humans but unique to varying degrees relative to other species. Differential psychology is slightly preferred because it emphasizes the key feature of *difference* (within species). Evolutionary psychology is a logical subset of differential psychology on the grounds that variation is a prerequisite for evolution but not all differences (including, possibly, some which are predictive of behavior) can be demonstrated to have an evolutionary effect. There is also some controversy about the relevance of evolutionary pressures for modern humans given the so-called adaptive-lag hypothesis (Courtiol et al., 2012; Laland and Brown, 2006; Smith et al., 2001). In any case, both of these terms overlap considerably with differential psychology; it seems that differential psychology is more specific than trait psychology and more broad than evolutionary psychology.

309 parsimony. Expressed through a range of affects, cognitions and desires, these differences are  
310 themselves the manifestations of various genetic and environmental influences which shape individuals  
311 over time. This genetic and environmental interplay suggests a dynamic relationship in which the  
312 “biological” differences shape and, to some extent, are shaped by the features of our environment,  
313 including our interpersonal relations. The universe of individuals differences extends therefore to  
314 include the ways in which individuals differ from one another physiologically and circumstantially as  
315 well as the ways in which they differentially relate to their environments, including other individuals.  
316 Developing a model to account for all of these nuances would be a formidable task.

317 A pragmatic beginning would be to integrate the distinct disciplines of individual differences research  
318 which have evolved since the late 1800s. At the highest level of abstraction, these disciplines map  
319 loosely onto the affective, cognitive and conative modes of behavioral expression. The classification of  
320 psychology according to these three categories has a long history, originating perhaps with the ancient  
321 Greeks (Brett, 1921) but more likely with Immanuel Kant’s *Critique of Judgment* (Hilgard, 1980; Kant,  
322 1790). This classification scheme was referenced commonly by psychologists in the late 19th and early  
323 20th centuries (Hilgard, 1980; McDougall, 1923) before trailing off in popularity with the rise of  
324 behaviorism. Despite the drop in explicit references, each of these categories seems to have developed a  
325 distinct and well-established research tradition. In fact, in contrast to the dated claims of Eysenck and  
326 Eysenck (1985) and Loevinger (1987), “dominant” paradigms have emerged over the last few decades in  
327 each of these disciplines: the affective domain has produced the Big Five/Five-Factor Model (Costa and  
328 McCrae, 1992; Digman, 1990; Goldberg, 1990); the conative domain has developed the RIASEC model of  
329 interests (Holland, 1959, 1997); and consensus has begun to coalesce for two similar models of cognition  
330 – the Cattell-Horn-Carroll (Carroll, 1993; McGrew, 2009) and Verbal-Perceptual-Rotation (Johnson and  
331 Bouchard, 2005) models.

332 The affective domain, which seems to be the topic that many researchers have in mind when using the  
333 term “personality,” has traditionally been referred to as “temperament” (Clark and Watson, 2008;  
334 Heineman, 1995). Use of the term personality is once again problematic in this context for the same  
335 reason described earlier with regards to individual differences writ large – it is unfortunately vague. It  
336 implies the possibility that “non-affective” individual differences are excluded from personality. For this  
337 reason, the term temperament is used here (and recommended for use elsewhere in the context of  
338 individual differences research) to describe the range of emotional (affective) traits on which individuals  
339 differ.

340 It is also necessary to acknowledge the confusion introduced by developmental researchers (Thomas  
341 and Chess, 1977) seeking to distinguish adult “personality” from stable affective patterns in  
342 pre-adolescent children, especially infants and toddlers (Heineman, 1995; Shiner and DeYoung, 2013).  
343 This point precipitates consideration of several fundamental issues, including the degree to which  
344 temperamental differences are dispositional, hereditary (as opposed to environmental), “biological,” and  
345 stable. These issues will not be reviewed extensively here except to state that temperamental differences  
346 are operationally viewed as relatively stable traits which have been found to be associated with various  
347 individual differences in neurobiological processes on both the molecular genetic (Krueger and Johnson,  
348 2008; Krueger et al., 2008) and more broadly neuroanatomical levels (Canli et al., 2001; Canli, 2008).  
349 Further evidence supports the implication suggested by these biological associations – temperamental  
350 differences are innate and, depending on the trait, variability described by genetic and non-shared  
351 environmental factors is roughly the same (Clark and Watson, 2008). These data suggest that robust  
352 models of temperament should account for empirical claims that various differences are more or less

evident across the lifespan. Indeed, it has been posited that the Big Five traits (and perhaps one additional trait to account for “Activity Level”) are well-suited for explaining temperament in infants and children (Shiner and DeYoung, 2013). In any case, the rationale for using the term “temperament” to describe affective differences in infants and children but not adults is not clear.

The cognitive and conative disciplines have traditionally been distinguished from temperament though, strictly speaking, both of these are influenced by affective variance. Research on individual differences in cognition has been a cornerstone of psychological research for well over 100 years (Lubinski, 2004), and also the most frequent source of controversy (Gould, 2006; Herrnstein and Murray, 1994). In fact, with few exceptions (Ackerman, 1997; Duckworth and Seligman, 2005; Lubinski and Humphreys, 1997), social and personality psychologists in the United States had largely abandoned cognitive ability research until a recent resurgence of interest (fortunately, this was not generally the case among personality psychologists elsewhere, particularly in Europe). Today, it is increasingly recognized that individual differences in cognitive ability are predictive of an impressive array of outcomes, including educational attainment, employment status, criminal behavior, marital status, staying healthy, recovery from ill-health and life-expectancy (Gottfredson, 1997; Lubinski and Humphreys, 1997; Deary et al., 2004; Herrnstein and Murray, 1994; Schmidt and Hunter, 2004).

Research on conative individual differences (i.e., differences in desires, motivations, volition and striving) is most frequently conducted through the assessment of interests, especially vocational interests. The dominant interests framework, known as the RIASEC model of vocational interests (Holland, 1959, 1997), organizes both interests and jobs according to six categories (and related scales) – Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. The framework itself allows for hierarchical organization of specific occupations which can be grouped according to shared “basic interest” categories and these in turn can be grouped at a higher level of six general interest factors (Armstrong et al., 2004). In other words, the basic interests may be seen as equivalent to the facet level of the Big Five in the affective domain. It has also been suggested that the six factor structure can be further simplified to two dimensions which are known as “data/ideas” and “people/things” (Armstrong et al., 2008b; Prediger, 1982).

It should be noted that the assessment of vocational interests as a proxy for conation is practical but inadequate. It does not typically include the assessment of preferences, values, avocational interests or pastimes. More generally, the assessment of conative differences is hampered by the fact that specific activities are often idiosyncratically rooted in previous experience and are generally pursued sequentially, with varying degrees of intensity, in accordance with circumstantial factors. In other words, the use of interests to capture conative differences is problematic because (1) interest in a behavior or activity is often dependent on knowledge about that activity and (2) interest does not reflect the intensity with which an activity is pursued, the enjoyment derived from it, or the circumstantial factors which may impede or demand the pursuit of any given activity (e.g., socioeconomic status, cultural influences, etc.). Related to these issues is the fact that the various aspects of conation are seemingly quite distinct: the assessment of *interests* provides a means of describing one’s preferences; *motivation* is generally framed as a measure of intensity (Carver and White, 1994; Gray and McNaughton, 2000); *goals* and *values* are often framed as trait-like heuristics that individuals use to navigate through the stream of choices in life (Higgins et al., 2001; Molden and Higgins, 2005; Peterson and Seligman, 2004).

The stability of these aspects of conation has also received relatively little treatment. The Dynamics of Action model (Atkinson and Birch, 1970) has been proposed for describing state-like variations,



including daily and even momentary fluctuations, which directly influence temporal changes in activity and action tendencies. More recently, this model has been re-parameterized in terms of cues, tendencies and actions (Revelle, 1986; Revelle et al., 2010a) and its efficacy has been simulated for social interactions (Fua et al., 2009, 2010) in an attempt to evaluate even broader models of approach and avoidance motivation, such as Reinforcement Sensitivity Theory (Corr and McNaughton, 2008; Gray and McNaughton, 2000) and control theory (Carver and Scheier, 1982).

## 1.5 The groundwork for an integrative paradigm

“ [I]t is generally admitted that all mental activity has these three aspects, cognitive, conative, and affective; and when we apply one of these adjectives to any phase of mental process, we mean merely that the aspect named is the most prominent of the three at that moment. Each cycle of activity has this triple aspect; though each tends to pass through these phases in which cognition, conation, and affection are in turn most prominent; as when the naturalist, catching sight of a specimen, recognizes it, captures it, and gloats over its capture. ”

*William McDougall (1923)*

### 1.5.1 Prior work towards integration

Unfortunately, the emergence of cognitive, conative, and affective paradigms has occurred without much regard for the degree to which these frameworks overlap or may be incompatible; these issues are exacerbated by inconsistent framing of related constructs across the various domains. Still, the general lack of cross-domain research of individual differences is by no means universal. There have been several influential efforts to evaluate the relationships across the previously mentioned domains, though the majority of these works have been isolated studies with small samples and have only evaluated two of the domains at a time.

Influential studies involving temperament and interests have typically involved joint administration of the NEO-PI-R® (Costa and McCrae, 1992) and measures grounded in the RIASEC framework (the Vocational Preference Inventory and the Self-Directed Search®) (Barrick et al., 2003; Costa et al., 1984; Feist, 2012; Gottfredson et al., 1993; McKay and Tokar, 2012), though one recent study did explore the relations between lower-order facets and the RIASEC scales (Armstrong and Anthoney, 2009). The basic findings of this research, to the extent that it is consistent, suggests that significant correlations between the Big Five and RIASEC scales tend to be low and that it is therefore not appropriate to substitute the two measures for one another (Costa et al., 1984; Gottfredson et al., 1993). More recent results suggest that appreciably higher correlations can be found when using more narrow personality measures (Armstrong and Anthoney, 2009). Noteworthy correlations include positive relationships between the Social and Enterprising interests with Extraversion, and positive relationships between the Investigative and Artistic preferences with Openness.

Studies exploring the temperament/cognition relationship have been more varied. In the context of meta-analytic findings regarding the predictive validity of personality generally, Roberts and colleagues (Roberts et al., 2007) evaluated the relative influences of both Big Five traits and IQ (as well as socio-economic status) for educational and occupational attainment and identified significant

correlations among several aspects. These and additional studies (Kuncel et al., 2010) specifically suggest that cognitive ability is slightly more predictive than pro-social personality traits for educational and occupational outcomes while personality traits (particularly Conscientiousness) are more predictive for outcomes related to health and longevity. In a theoretical review, DeYoung (2012) argues for the explicit inclusion of intelligence in personality models and suggests that many of the Big Five traits assess “abilities” broadly defined (e.g., Conscientiousness as an expression of the ability to delay gratification). He concludes that intelligence is most reasonably situated as an aspect of Openness and calls for more integrative empirical research.

Research on the overlap between cognitive abilities and interests has tended to evaluate specific educational and occupational outcomes. Several research groups have, for example, recently begun to evaluate abilities and interests related to science, technology, engineering and math (“STEM”) outcomes. Data collected from the Study for Mathematically Precocious Youth (Lubinski and Benbow, 2006; Robertson et al., 2010; Wai et al., 2009) has been particularly informative in this regard as has the Spatial Intelligence and Learning Center (Hegarty et al., 2010; Uttal et al., 2013). Spatial ability assessment remains less mature than that of verbal and math ability however, despite growing recognition of the special importance of spatial skills (Lubinski, 2010). Better spatial measures and large scale assessments are needed to inform the ways that spatial interests and abilities interact developmentally, especially across genders (Newcombe and Shipley, 2012; Newcombe et al., 2013). These needs have also been acknowledged more generally for broader studies of interests and cognitive abilities as well (Johnson and Bouchard, 2009).

Attempts to integrate more than two domains of individual differences have been even more limited. Seminal meta-analytic work in this regard has been conducted by Ackerman and colleagues (Ackerman and Heggestad, 1997; Ackerman, 1997; Ackerman and Beier, 2003). Their efforts suggest two prominent lines of findings. First, there are significant commonalities across the domains of interests, cognitive abilities and temperament, as variously described historically. This was particularly true with regards to relationships between temperament and cognitive abilities (positive correlations between Extraversion and Openness with abilities; negative correlations between Neuroticism and abilities). Second, it is possible to identify trait complexes which likely result from various developmental trajectories – indeed, four such trait complexes have been detailed (Ackerman and Heggestad, 1997; Ackerman and Beier, 2003). These complexes are presumably rooted in complementary temperamental and ability dispositions that contribute to interest in specific tasks over time. It should be noted that one of the proposed rationales for the use of trait complexes is the difficulty of assessment and analysis across the three domains when using traditional data collection methods. Attempts to replicate and extend Ackerman’s work are greatly needed, particularly with larger samples.

A second, more theoretical contribution has been proposed by Roberts (Roberts, 2006). This “neo-socioanalytic” model identifies three domains – Traits, Values and Abilities – which are similar in content to the domains described above (temperament, cognitive abilities and interests) with the exception that they explicitly encompass the domain of identity, as assessed with narratives (McAdams, 2001). This model also contains several additional features which extend beyond the more narrow boundaries of differential psychology set forth in Section 1.3; examples include reputational features of personality and person-organization fit. Nevertheless, the organizational framework of individual differences domains (referred to as “units of analysis” in the neo-socioanalytic model) is noteworthy for its similarity to the one used here.

As a conclusion to this review of prior efforts towards integration, it is proposed that the historical lack



of communication between disciplines has created an opportunity for substantial advancement of knowledge. Such an advancement would reflect a more nuanced understanding of the manner in which constructs relate to one another across domains and the manner in which criterion variables are differentially (or similarly) predicted by such constructs. The obstacle to integration however has not been a lack of consensus over theory so much as the methodological difficulty of cross-domain assessments which are simultaneously broad and specific.

### 1.5.2 Challenges to empirically-informed integration and recent innovations

The primary source of difficulty when evaluating across domains is data collection. Clinical psychologists and neuropsychologists overcome this challenge by assessing their patients with extensive commercial batteries of tests, often including personality measures like the Minnesota Multiphasic Personality Inventory®-2 (Butcher et al., 2003) or the NEO-PI-R® (Costa and McCrae, 1992), cognitive measures such as the Wechsler Adult Intelligence Scale® (Wechsler, 2008), vocational measures like the Strong Interest Inventory® (Harmon et al., 1994), and perhaps a sampling of additional measures evaluating psychopathology, aptitudes or psychophysiological functioning. While this approach can be very effective for cross-domain assessment of a single individual, it is not well-suited for large-scale differential psychology research because it is both expensive and time-consuming. All of the tests described above are commercial measures and each requires an average of 90 to 190 minutes for administration, scoring, and interpretation by a licensed practitioner (Camara et al., 2000).

Prior research in the affective, cognitive, and conative domains has required dramatically different methods. Perhaps the most important methodological distinction stems from the use of samples which are convenient to university-based researchers – college students and, to a lesser extent, community samples. While this allows for assessment across far more individuals than the clinical approach, it still usually suffers from issues of representativeness and insufficient size for detecting small but stable relationships between constructs and evaluating the fit of models with many parameters (Kenny, 2012). These concerns are exacerbated when attempting to detect more complex relationships between multiple, lengthy measures because participants of this type are rarely willing to participate in studies lasting more than a couple of hours. In essence, the qualities of the clinical method (extensive testing of a few participants costing considerable time and money) and the traditional research method (more participants at little cost but relatively few measures) are both lacking when it comes to effective cross-domain assessment.

It seems that, beneath the over-arching difficulty of data collection across multiple domains in differential psychology, there exist three underlying challenges. The first of these relates to the need for samples which are large and relatively “representative” of the broader population (or at least the population of interest). Second, the use of large samples precipitates the need for measures which can be administered for little or no cost. The last challenge relates to the need to administer a large number of variables across the sample in order to evaluate the structure across domains. Fortunately, innovative solutions for addressing each of these challenges have been developed over the last two decades, as briefly described in the following sections.

### 1.5.2.1. Telemetric assessment

The number and variety of techniques for collecting data from large samples has increased dramatically since the beginning of the “internet-era,” largely because it has become increasingly easy to reach participants outside of the research laboratory (Wilt et al., 2011). Web-based methods have demonstrated improved sample characteristics in terms of both size and breadth with little loss of validity (Fraley, 2004; Gosling et al., 2004; Skitka and Sargis, 2006). Many large-scale, research-driven internet surveys now exist and several of these have collected samples of unprecedented size – hundreds of thousands of participants or more (Condon and Revelle, 2014; Gosling et al., 2004; Kosinski et al., 2013; Peterson et al., 2005; Revelle et al., 2010b; Sandy et al., 2013; Soto et al., 2010; Wang et al., 2012). With few exceptions (Condon and Revelle, 2014; Kosinski et al., 2013; Revelle et al., 2010b), the data collected from these samples has been limited to short questionnaires which assess constructs from only a singular domain. Most of these also make use of traditional website frameworks, though it has become increasingly common to collect data from mobile devices (Wilt et al., 2011). These include both older technologies such as personal data assistants and SMS-enabled phones as well as more modern devices such as smartphones and tablet computers.

While the number of research groups collecting very large samples has been relatively limited, many more have benefitted from the use of more modest telemetric techniques. These include third-party tools such as survey software providers (e.g., SurveyMonkey and Qualtrics) and recruitment services (Amazon’s Mechanical Turk) as well as the ability to electronically access data collected in very large panel studies (e.g., the Programme for International Student Assessment (Anderson et al., 2007; OECD, 2012) and the General Social Survey (Smith et al., 2011)).

### 1.5.2.2. The development (and aggregation) of public-domain measures

Concomitant with the need to collect data from large samples, it has been increasingly necessary to utilize measures which are not burdened by the costs which are typically associated with using copyright-restricted scales. In conjunction with his proposal for more rapid advancement in personality, Goldberg (Goldberg, 1999) introduced a large pool of personality items for use in the public domain and which were designed to accommodate assessment needs across a broad range of constructs. Historical dependence on copyright-protected measures, as Goldberg has argued (Goldberg, 1999; Grucza and Goldberg, 2007), reduces progress because the owners of these proprietary measures have little incentive to consistently revise or validate them extensively against other measures. Over time, the number of commercial measures has proliferated while few of the most established have been improved to account for findings from novel research. These problems can be avoided through the use of public-domain measures in that the items will be developed, administered and improved by the research community at large.

The International Personality Item Pool (“IPIP”) now contains more than 2,500 items and has come to be used widely within personality research (Goldberg, 2014). These items, when supplemented by an additional 1600 items from various sources (mainly from shorter scales of more narrow focus), form a database of more than 4000 temperament items in total. This database does not include scales designed to assess the cognitive and conative domains (at least, not to the extent that these are distinct from the affective). Public-domain scales of Interests have only recently been developed; they include the Oregon Vocational (Pozzebon et al., 2010) and Avocational Interest Scales (Goldberg, 2010) and O\*NET Interest

Profiler (Armstrong et al., 2008a; Rounds et al., 2010) which together number approximately 500 items.

Public-domain items for cognitive ability have not previously been available, in part because this type of assessment is considerably different from items which ask participants about their typical behavior or attitudes. Cognitive ability measures, by contrast, attempt to assess the level at which an individual “maximally” performs (Condon and Revelle, 2014). In these cases, items are not only copyrighted for their commercial value but also for the sake of test security. As such, efforts to develop and validate public-domain items have recently been pursued by the present author and colleagues (Condon and Revelle, 2014; Revelle et al., 2010b; ICAR, 2014). The challenge to item development lies in the fact that the items are to remain in the public-domain while still maintaining adequate validity. This is accomplished with modern item-generation techniques (Arendasy et al., 2006; Dennis et al., 2002) that make use of algorithms which dictate the parameters of new items with predictable difficulty and in many alternate forms. These techniques allow for the creation of item types where the universe of possible items is very large. This, in turn, reduces the threat to validity that arises from item disclosure. These techniques can even be used to enhance test validity under administration paradigms that expose participants to sample items prior to testing and use alternate forms during assessment as this methodology reduces the effects of differential test familiarity across participants.

The first validation (Revelle et al., 2010b) of these efforts was based on the administration of a preliminary set of 56 items to more than 65,000 participants. These procedures (as well as description and validation of more recently created item types) have since been refined (Condon and Revelle, 2014) and many more item types are now under development as part of an internationally-funded collaboration to develop the “International Cognitive Ability Resource” (ICAR, 2014). At the current time, the resource includes 60 items which are intended to assess four different constructs within cognitive ability: (1) Matrix Reasoning; (2) Verbal Reasoning; (3) Letter and Number Series; and (4) Three-Dimensional Rotation. Validation results (Condon and Revelle, 2014) suggest that correlations between these items and other measures of cognitive ability are promising; correlations range from 0.4 to 0.5 with self-reported achievement test scores and 0.8 with a brief commercial IQ measure, the Shipley-2 (Shipley et al., 2010), after correcting for restriction of range.

In addition to the ICAR items, the IPIP items assessing temperament, and the vocational and avocational interest items, several scales have recently been developed for assessing mental and physical health outcomes. These include the Patient Reported Outcomes Measurement Information System (PROMIS), organized around the domain-mapping framework of the World Health Organization for physical, mental and social health (Cella et al., 2007), and the Personality Inventory for DSM-5 (the PID-5), which has been designed to assess the first empirically based model of maladaptive personality traits (Krueger and Markon, 2014). When considered together, this growing pool of resources provide a pool of freely available items of unprecedented breadth for individual differences assessment.

#### 1.5.2.3. Synthetic Aperture Personality Assessment (“SAPA”) sampling procedures

While telemetric assessment techniques have meaningfully improved the ability to collect larger and more diverse samples, they have not generally been applied to collect data across wider sets of individual differences variables. In other words, they have been used to increase sample sizes ( $n$ ) but not to increase the number of variables administered ( $i$ ). This is because they do not inherently provide a means of assessing participants on a large pool of items without over-burdening individual participants.

Synthetic aperture personality assessment represents a variation on the standard method of web-based assessment and is perhaps best explained by analogy to the technique on which it is based in radio and optical astronomy. An historically problematic issue in these fields stemmed from the fact that the resolution of a telescope is limited by its diameter. This resolution can be functionally increased by combining input from multiple, linked sites into one coherent image. Effectively, a very large telescope is created by synthesizing the input from many smaller ones. A prototypical example of this in radio astronomy is the Very Large Array in Socorro, New Mexico where 27 relatively small (25 meter) radio telescopes are spread out in a Y-shaped configuration to simulate the resolution of a 36 km telescope. In optical astronomy, similar techniques are used in interferometry at the Keck Observatory in Hawaii.

Analogous techniques are available for data collection over the internet. Rather than combining signals from the same source using different telescopes as is done in astronomy, the structure of personality can be studied by combining the responses of many people across more items than any one person is willing to answer. Instead of observing celestial objects beyond the visible range, psychologists can observe the relations between personality constructs which would not otherwise be visible given practical assessment constraints. This can be done by sweeping the assessment “telescope” across a wide range of constructs or by focusing for short periods of time on high-priority topics.

This procedure is not without precedent. Lord (1955) has previously described theoretical procedures for the sampling of items (rather than participants) in the context of testing and similar sampling techniques have long been used by the Educational Testing Service in order to develop new achievement test items. The latter is done by administration of small, random subsets of items to subsamples of test-takers. At ETS, these items are typically under evaluation for discriminant and concurrent validity among the items in their proprietary set, though this is suggestive of an additional methodological innovation in its own right. That is, the advent of broadly used, public-domain scales of individual differences.

### 1.5.3 Combining these innovations via SAPA-Project.org

A web-based application at [SAPA-Project.org](http://SAPA-Project.org) has been developed to make use of synthetic aperture measurement techniques with public-domain measures of individual differences administered over the internet. In practice, the true value of these methodological innovations can only be appreciated when applied to contexts involving many participants. Thanks in large part to web traffic for related websites (mainly [personality-project.org](http://personality-project.org) and especially [personality-project.org/r](http://personality-project.org/r)), the [SAPA-project.org](http://SAPA-project.org) website has averaged approximately 140 unique participants each day since May 20, 2013. In exchange for customized feedback about their personality, participants anonymously provide data on more than 25 demographic variables and respond to an average of 155 items assessing temperament, cognitive ability, and interests. In keeping with SAPA procedures, the items are chosen as semi-random subsets of the much larger group of items under concomitant administration (about 800 items total). Very large, synthetic correlation matrices are formed on the basis of these “Massively Missing Completely at Random” responses from many participants over time (approximately 8.8 million data points per year at the current rate).

It is not accurate to say that this sample is necessarily representative of any population other than those individuals who want to take internet-based personality surveys, but it is more demographically diverse than the samples typically available to university researchers. For example, the 97,000 person sample collected between August 18, 2010 and May 20, 2013 includes participants from 199 countries, 34 of

which are represented by more than 100 participants. Approximately 66% of the sample is female (consistent with broader web-traffic trends) and 78% is from the United States. Among Americans, 32.6% represent ethnic minorities. Median and mean ages are 22 and 26 years old respectively ( $sd = 10.6$ ). Additional categories of data collection include educational and occupational outcomes, parental education and employment information, marital status, height, weight, health data (smoking, exercising, sleep patterns), and self-reported achievement test scores. As may be evident based on the methodological techniques described, these procedures have been refined after several years of online data collection. In total, data have been collected from more than 300,000 participants to date.

## 1.6 Application of the SAPA-Project to develop a testable integrative model

“ [W]e like to think of breakthrough ideas as sudden accelerations on the timeline, where a genius jumps ahead fifty years and invents something that normal minds, trapped in the present moment, couldn't possibly have come up with. But the truth is that technological (and scientific) advances rarely break out of the adjacent possible; the history of cultural progress is, almost without exception, a story of one door leading to another door, exploring the palace one room at a time.

”

Steven Johnson (2010a)

If the primary challenge to the development of a testable and integrated model of individual differences is methodology, paradigm adoption in differential psychology may be a matter of evolving consensus on the heels of incremental technological improvements rather than theoretical “revolution” (to use Kuhn’s terminology). The SAPA Project represents technological improvement in data collection in that it is well-suited to evaluation of the structure of the multidimensional space that is described by the many public-domain items that have been (or are currently being) developed across the affective, cognitive and conative domains. This structure can then be used to inform the development of an empirically integrated framework.

The first several steps in this process involve the identification or reification of structural models in each domain which offer the right balance of theoretical breadth and parsimony across a range of predicted outcomes. For the affective domain, as described in Chapter 2, this work draws heavily on prior research rooted in the psycholexical tradition. In the case of cognition, the identification of structural models is somewhat biased by the (limited) availability of public-domain items, though preliminary evidence that appears consistent with modern models is reviewed in Chapter 3. In the conative domain, research which integrates data collected using competing vocational interest scales is described in Chapter 4.

The last chapter addresses the final step of integration. Given the desire to develop predictive models (which can later be tested by other researchers), integration will be focused on the construction of scales that predict a wide range of specific “real-world” behaviors. The construction of these scales will rely upon psychometric techniques (cluster analysis, factor analysis and two-parameter item-response theory) that will facilitate the use of efficient administration protocols (e.g., computer-adaptive testing) for these scales. The rationale for this approach – the creation of a collection of brief predictive measures which are based on the integration of frameworks from the affective, cognitive, and conative

<sup>665</sup> domains – is rooted in the belief that differential psychology is ready to begin an era of  
<sup>666</sup> empirically-testable paradigms that is no longer bound by compartmentalized, domain-specific research.

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