



Thinking bigger: The Cronbachian paradigm & personality theory integration



Arthur E. Poropat^{a,*}, Philip J. Corr^b

^a School of Applied Psychology, Griffith University, Australia

^b Department of Psychology, City University London, United Kingdom

ARTICLE INFO

Article history:

Available online 23 October 2014

Keywords:

Personality theory
Generalisability theory
Intra-individual models
Inter-individual models
Theoretical paradigms

ABSTRACT

Personality theories largely mirror disparities between fundamental paradigms that guide most psychology: one based upon Galton's emphasis on inter-individual differences and the lexical hypothesis; the other inspired by Wundt is focused upon intra-individual processes, such as temperament and Reinforcement Sensitivity Theory. Previous integrations of personality models using these paradigms failed to account for observed variance, suggesting model incommensurability. We propose that a broader conception—developed from Cronbach and colleagues' generalisability theory—provides an effective integrating framework, and show how Galtonian and Wundtian models may be assimilated within Cronbachian approaches. Additionally, Cronbachian models have novel practical implications. Application of the Cronbachian paradigm to personality will be challenging, but provides an opportunity to achieve genuine coherence in personality research.

Crown Copyright © 2014 Published by Elsevier Inc. All rights reserved.

1. Introduction

The plethora of theories of personality have long shown remarkable variety, from pre-scientific thought (e.g., Galen's humours, Hindu types, astrological signs) to more recent approaches based upon systematic, empirical investigation. Currently, trait models of individual differences predominate, although more idiographic (e.g., Grice, 2004; Molenaar, 2004) and dynamic conceptualisations (Caprara & Cervone, 2000) have well-argued advocates.

A range of attempts have been made to integrate these various models and theories, several of which are reviewed in this paper. However, we will be arguing that these attempts at harmonisation are inherently limited by failure to consider issues associated with the underlying theoretical-epistemological paradigms that guided the development of the various personality models. Specifically, we will argue that underlying paradigmatic conceptual issues have produced models that are not readily commensurable in that they do not refer to the same phenomena, and attempting to measure these phenomena using tools appropriate for alternative paradigms will be indeterminate at best and likely to be actively misleading. Instead, a broader paradigm is essential for understanding the nature of personality and should be central to any attempts at

integrating personality models. That broader paradigm is already available, and enables the synthesis of existing elements of personality theories and models, thereby providing a firmer basis for future theoretical and methodological developments in personality research and application.

The idea that conceptual elements have a major influence on the development of personality models is hardly a novel notion, but this tends to get overlooked in considerations of personality theory. Yet, the potency of paradigms in personality research is easily recognised, as exemplified by the manner in which various personality models were initially developed and subsequently assessed. For example, the dominant model of personality is the 'Big 5' (B5), which is largely defined by descriptive markers (Goldberg, 1992) and was developed by empirically identifying factors within common-language descriptors of persons (Goldberg, 1993; Saucier & Goldberg, 2001). Consequently, the components of the B5 have largely been assessed on the basis of the extent to which they have been confirmed in subsequent factor analyses (Saucier, 2009), or by testing the efficacy of B5-based personality inventories for statistical predictions of criterion variables (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). This approach contrasts with models of personality which were derived from psychological theories based on biological understanding or neuro-psychological functioning, such as reinforcement sensitivity theory (RST) (Gray & McNaughton, 2000). Likewise, personality models based upon theories of human or evolutionary development, often referred to as temperament theories (e.g., Buss & Plomin, 1975;

* Corresponding author at: School of Applied Psychology, Griffith University, Mount Gravatt, Queensland 4122, Australia.

E-mail address: Arthur.Poropat@Griffith.edu.au (A.E. Poropat).

Shiner et al., 2012), typically rely on theoretical bases for identification of key dimensions of personality. Unlike the empirically-based models, questionnaires and scales are not the only, and not necessarily the best, measurements of the underlying constructs associated with these theoretically-based personality models, and validity tests of these models may not involve standard personality inventories at all (e.g., consider Matthews & Gilliland, 1999 and their discussion of the measurement of RST).

1.1. Wundtian and Galtonian personality paradigms

These issues in personality research reflect many of the basic assumptions adopted within psychology since its inception as a scientific discipline. When considering the history of perception research, Popple and Levi (2000) argued that two paradigms have dominated psychological endeavours, reflecting the guiding assumptions advocated by Wundt and Galton, respectively. In the Wundtian paradigm, understanding intra-individual dynamics has been emphasised, with the assumption that this will lead to knowledge of general principles and hence generalisability (Popple & Levi, 2000). Among personality models, RST and Posner and Rothbart's (2007) theorising about temperament on the basis of attentional processes reflect this intra-individual, Wundtian approach. The contrasting Galtonian paradigm starts from a focus upon inter-individual differences, effectively using these as the basis for development and understanding of principles with the intention of subsequent application back to individuals (Popple & Levi, 2000), as clearly reflected by the methodologies that supported the identification of the B5 and comparable models. This difference is seen between Eysenck's (1947, 1967) inter-individual differences approach based on statistical variations between people, which were *then* extended to intra-individual difference via the constructs of arousal and activation; and Gray's (1975, 1982) primary focus on intra-individual differences in reinforcement sensitivity, which were *then* extended to inter-individual differences in personality traits. The difficulty of integrating even these two theoretical approaches, despite their apparent overlaps, attests to the nature of this conceptual problem.

In short, the Wundtian approach to personality is about attempting to *explain* personality, while the Galtonian approach to personality has been more focused on *describing* personality. This distinction underlies much of the debate about models surrounding the B5, which has long been most heavily criticised for its lack of explanatory value (Block, 2001; Revelle, 1987), despite its substantial utility for describing aspects of personality relevant to differences in life outcomes observed between people. Failure to recognise the disparate paradigmatic bases of these approaches is likely to result in confused and misleading efforts when researchers attempt to integrate models across paradigms. These shortcomings are a direct consequence of the failure to consider that both Wundtian and Galtonian models operate at different levels of analysis, thereby running afoul of the well-recognised observation from systems theory that conclusions that are valid at one level of analysis are not necessarily applicable at other levels (for a personality-based demonstration of this, see Molenaar & Campbell, 2009). Failure to recognise these limitations has been recognised as a hindrance to effective integration within cognitive psychology (Popple & Levi, 2000); similar problems should be respected within personality psychology.

Yet, personality research (and psychological research more generally) is further complicated by the fact that both personality as a phenomenon (Andersen & Chen, 2002) and every assessment of personality (Kenny & West, 2008) are inherently social, thereby creating effects linked with both judges of personality and the targets of their assessments. Seriously acknowledging these issues of conflicting levels of analysis and the inherently social nature of

personality expression and assessment militates against the types of integration that have previously been proposed.

1.2. A Cronbachian integrative paradigm

Despite the range and longevity of these problems, there are ideas based on measurement theory that speak directly to the issues outlined above, which have been discussed under the label of generalisability theory. Although many others have been involved, the name that appears to have dominated the initial development of generalisability theory is that of Lee Cronbach (e.g., Cronbach, Gleser, Nanda, & Rajaratnam, 1972; Cronbach, Rajaratnam, & Gleser, 1963) and much of this was conceptually anticipated in earlier work by Cronbach (e.g., Cronbach, 1957); hence, we suggest that a third approach to personality theory – a Cronbachian paradigm in contrast with the Wundtian and Galtonian paradigms. To appreciate this alternative, it is necessary to consider the basics of generalisability theory, which was developed as a means for modelling the range of systematic influences on psychological measurements. These influences include elements linked with specific traits, targets and judges of ratings, contexts, measurement tools, temporal factors, etc. As such, the Cronbachian paradigm goes beyond the consideration of causes of behaviour outlined in interactionist models of personality (see Reynolds et al., 2010 for a recent consideration of this approach), to also consider the interpretation of behaviour, making personality judgement as important as personality expression. Later in this paper we argue that although often used to better comprehend psychometrical features, these ideas also imply a theoretical framework that will enable researchers to conceptually integrate elements of both intra- and inter-individual models. Thus, the Cronbachian paradigm contrasts with the Galtonian paradigm, which requires intra-individual elements to be viewed from an inter-individual basis, or the Wundtian paradigm which demands the reverse. This Cronbachian approach to integration of personality theories therefore has important implications for the ontological status of constructs included within existing personality models.

In the next sections, we outline the consequences of the methodological bases of Galtonian and Wundtian models of personality, before critiquing previous attempts at integration. We then outline the alternative Cronbachian approach for integrating personality models, before providing recommendations for future research.

1.3. Galtonian (inter-individual) personality models

One of the most successful hunches in psychology has been the lexical hypothesis, which is based on the idea that there should be a relationship between individual differences and natural languages. Preliminary thoughts that led to the lexical hypothesis were presented by Galton (1884) himself, developed greatly by Allport and Odbert (1936), before later researchers, notably Tupes and Christal (1958), Norman (1963) and Goldberg (1981), used it as the basis for identifying the B5. At heart, the lexical hypothesis is the proposition that natural languages develop in such a way that they enable identification of important psychological features by providing more descriptors for these, because social and evolutionary advantages will accrue to individuals who can use words that accurately identify important individual differences: this allows individuals greater facility for description and, importantly, prediction of behaviour. A series of exploratory factor analyses of English adjectives in the middle of the twentieth century converged on what came to be known as the B5, which is probably the most-cited and most-used model of personality.

Consistent with the lexical hypothesis, the components of the B5 have been clearly demonstrated to be important, having reliable associations with a range of socially-valuable outcomes including

mortality, divorce, occupational level (Roberts et al., 2007), various forms of work performance (Hurtz & Donovan, 2000; Poropat & Jones, 2009), academic performance (Poropat, 2009; Poropat, 2014a; Poropat, 2014b), and psychiatric diagnosis (Gore & Widiger, 2013). Many of these correlations rival or exceed corresponding associations of intelligence and socio-economic status with these criterion variables. By any account, the lexical hypothesis has been strongly confirmed—natural language personality descriptors do, indeed, relate to important individual differences.

1.4. Wundtian (intra-individual) personality models

The Wundtian approach to understanding persons, and by implication personality, was built upon modelling intra-individual processes and using these as the basis for broader approaches for measuring individual differences. With respect to personality, a range of distinct but complementary theories have been proposed that describe various aspects of the manner in which an individual's genetic and biological influences affect their behaviours. These can be usefully summarised in terms of developmental, biological, and approach-avoidance based models. Most or all of these models also implicitly or explicitly consider the interaction between internal processes and social environments, thus explicitly allowing for interactive effects. Yet, Wundt himself was well aware that in taking such an intra-individual perspective, inter-individual variance tends to get ignored and relegated to 'error' variance, a point relevant to later discussion of the Cronbachian paradigm. In the following sections, we summarise three of the more influential personality models of the past 50 years to describe how an intra-individual perspective informed their development, although it should be noted that a range of other models also fit under the Wundtian umbrella, such as those advocated by Cloninger (1987) and Zuckerman (1992).

1.4.1. Temperament-based personality

An important Wundtian approach to the identification of personality structure has been work aimed at identifying aspects of 'temperament', which has been viewed as the underlying influences that interact with experience to produce observed personality (McAdams & Olson, 2010; Rothbart, 2007). Thus, temperament takes the theoretical role of genotype in Saucier and Goldberg's (2001) terminology. Models of temperament have mostly been developed with a focus on childhood development (e.g., Shiner et al., 2012; Thomas & Chess, 1977; Thomas, Chess, & Birch, 1968). Buss and Plomin (1975), however, extended this focus to include evolutionary development by means of cross-species comparisons, with other models proposed later by Kagan (2008), and Goldsmith and Campos (1982). These various models have produced similarly varied collections of constructs and measures; however, when they were factor-analysed by Presley and Martin (1994), they produced either three or five orthogonal components, depending on the source of temperament ratings.

A different approach was adopted by Posner and Rothbart and their colleagues (Posner & Rothbart, 2007; Rothbart, 2007; Rothbart, Derryberry, & Posner, 1994), who explicitly sought to ground conceptions of temperament upon fundamental work on attentional networks. These authors proposed a theoretical framework in which alerting in response to stimuli, orienting or selective attention to stimuli, and executive attention or management of conflicting stimuli and responses, form basic aspects of an individual's reactivity to the environment. The Children's Behavioral Questionnaire (CBQ) (Rothbart, Ahadi, Hershey, & Fisher, 2008) was designed as a measure of temperament based upon this model, and has three major factors: effortful control, negative affectivity, and extraversion/surgency, which are quite similar to

the three-factor solution reported by Presley and Martin (i.e., Inhibition, Negative Emotionality, and Task Persistence).

1.4.2. Biologically-inspired personality

One of the earliest, and most influential biological approaches to personality was proposed by Eysenck in his arousal-activation (1967) theory. Although the dimensions of Eysenck's personality model were developed using factor analyses of individual differences, Eysenck's 'biosocial' theory explicitly conceives personality traits as end-products of interacting biological and social factors, coordinated by genetically and phenotypically-determined arousal and activation mechanisms in the brain (Eysenck, 1967; Matthews & Gilliland, 1999). Genetics and physiology have central roles in Eysenck's theory, along with the interplay of genes/physiology with the environment. By simple inference, individual differences in brain functioning affect perception and analysis of the environment and thus, to a large extent, both define and determine its influence. That is, given the same (objectively defined) event (the 'situation'), there are different psychological consequences (e.g., emotional experience) depending on pre-existing dispositions (i.e., personality).

So, while genetics provide a blueprint for development of a specific phenotype (e.g., extraversion), it is the interplay with environmental factors that determines which behaviours are observed. This corresponds with the idea that although there must be a blueprint (or 'preparedness') for language acquisition, we all learn specific languages with local dialects. However within Eysenck's approach, personality factors were assumed directly to reflect underlying biological factors (Matthews & Gilliland, 1999). Social considerations such as language and culture do not seem to have been addressed by Eysenck and his collaborators, as evidenced by their willingness to simply translate measures of his personality model to other languages and cultures (Poropat, 2011a) rather than attempting to identify markers from within those languages and cultures. In other words, from an Eysenckian perspective personality may be expressed socially but it is driven internally (Matthews & Gilliland, 1999), making the theory (if not the associated measure) a representative of the Wundtian paradigm.

1.4.3. Functional modelling of personality

RST is the third general approach to personality we consider under the Wundtian paradigm. This approach-avoidance theory of personality is based on the assumption that important classes of motivational stimuli can be grouped into 'rewards' and 'punishments', with animals such as humans viewed as cybernetic systems that have evolved to respond to attractors and repulsors (positive and negative goals) in such a way as to promote survival and reproduction. Without a tendency to approach beneficial stimuli (e.g., food, drink, and sexual mates) and to avoid aversive stimuli (e.g., predators and poisons) individuals and species will not pass on their DNA blueprint – the fundamental criterion within evolution.

As an approach-avoidance personality theory, RST can trace its origins to early behavioural-learning researchers (e.g., Mowrer, 1960), who posited that two motivation-emotion processes correspond to these motivational stimuli: the reward-associated system being linked with approach behaviour and positive emotions, while the punishment-associated system linked with avoidance behaviour and negative emotions. Jeffrey Gray (e.g., 1975) argued that the major traits of personality reflect long-term stabilities in systems that mediate reactions to different classes of reinforcing stimuli, generating emotion and shaping ('motivating') approach and avoidance behaviour. A wealth of later empirical research has confirmed the hypothesis that distinct and separable systems in the brain mediate reward and punishment-related emotion, motivation and learning (Gray & McNaughton, 2000).

The most recent version of RST includes three primary systems that control reactions to punishment, reward and conflict: The fight-flight-freeze system (FFFS), the behavioural approach system (BAS), and the behavioural inhibition system (BIS) (Gray, 1982; Gray & McNaughton, 2000; for summary, see McNaughton & Corr, 2008). The one positive system, the BAS, is responsible for mediating reactions to rewarding stimuli (which includes relief from punishment) and activating exploratory approach behaviour, so is related to hope and anticipatory pleasure. Of the defensive systems, the FFFS mediates reactions to all punishing stimuli (which includes omission/termination of expected reward, and frustration), is related to fear, and prompts active avoidance and escape behaviour. In contrast, BIS is activated by conflicts between goals, especially between FFFS-related and BAS-related ones, which it manages by inhibiting responses. Thus, BIS generates a cautious approach in goal-conflict situations, generating risk assessment behaviour, rumination and increased arousal. Of interest, the BIS can be activated by the conflict of two opposing approach goals, such as when receiving two similarly appealing romantic offers, which nonetheless can have aversive consequences associated with the potential of making the wrong decision and incurring a relative loss. Consequently, the BIS is related to the emotion of anxiety. Given this emphasis on explaining behaviour and personality through neuropsychological processes, the various instantiations of RST clearly fit the Wundtian paradigm of attempting to explain personality from the inside-out.

2. Previous attempts to integrate personality models

The range of both Galtonian and Wundtian personality models outlined here is substantial but hardly exhaustive. Such diversity represents a major challenge for personality psychology specifically, but also has broader implications for psychology and related disciplines. The lack of unifying frameworks for personality seriously handicapped personality research for most of the twentieth century, and was one of the major concerns raised in pivotal critiques of personality (Guion & Gottier, 1965; Mischel, 1968). Consequently, the advent of the B5 gave fresh impetus to personality research because it enabled integration of findings from disparate models and their associated measures, leading to some of the most-cited research in psychology. These include a series of meta-analyses, such as: Barrick and Mount (1991), which was one of the most-cited papers in industrial-organisational psychology for more than a decade; the integrative review of personality and social outcomes by Roberts et al. (2007); and the review of measurement methodology by Connelly and Ones (2010). None of these reviews could have been realised without the capacity provided by the B5 to allow integration of earlier research. So, further integrations of personality models appear to be particularly attractive for both theoretical and practical reasons.

Two general strategies have been adopted in previous attempts to integrate personality models, but these strategies have been unwittingly constrained by the fact that each has come from within the Galtonian and Wundtian paradigms that guided the development of the models themselves. So, some authors sought to logically organize intra-individual constructs according to apparent thematic similarities especially by comparison with empirically-identified inter-individual factors. Other authors attempted to identify intra-individual elements that would account for observed inter-individual differences. In other words, previous attempts at integration have tried to subsume Wundtian models within the Galtonian paradigm, or Galtonian models within a Wundtian paradigm. The following sections review some of the more notable of these attempts at paradigmatic hegemony, before summarising the serious limitations of each of these general approaches.

2.1. Galtonian (inter-individual) personality integration

Consistent with a Galtonian paradigm, many attempts at integrating personality models have revolved around the B5, however it should be noted that most of the comments on these efforts can readily be extended to other lexical personality models. Given the Galtonian emphasis on inter-individual differences, the obvious focus for integration attempts is to compare the psychometric measures that make these inter-individual differences most apparent, either by identifying common themes or by using correlational techniques to determine the extent of redundancy between measures based on different models. Encouragement for this approach arises from the fact that apparent thematic similarities have been identified between B5 factors and measures of either temperament or psychoneurological models of personality. Both Caspi, Roberts, and Shiner (2005), and Shiner and DeYoung (2013) have pointed out the clear conceptual parallels between B5 extraversion, emotional stability, and conscientiousness factors with the CBQ extraversion/surgency, negative affectivity (reversed), and effortful control dimensions respectively. Although their separate review focused on a broader range of temperament models, Mervielde, De Clercq, De Fruyt, and Van Leeuwen (2005) came to comparable conclusions. These reviews are well-argued, but each is open to two major criticisms, both linked to their empirical basis. Firstly, neither of these integrations provided compelling evidence of observed relationships between the measures of the various components. Secondly, both of these integrations relied upon reliable associations between personality measures and independently obtained indicators of the underlying processes presumed to explain those personality measures. As has already been discussed, many measures of Wundtian personality models have less-than-entirely reliable associations with their underlying constructs, a point to which we return in a later section. Any attempt at integrating personality models that fails to address both of these components is consequently no more than a proposal, which is inadequate for scientific purposes until empirically verified.

Unfortunately, when these types of evidence have been examined, the evidence has been less than compelling for the Galtonian integrations. To begin with, De Pauw, Mervielde, and Van Leeuwen (2009) examined the relationship between a B5 measure (The Hierarchical Personality Inventory for Children (HiPIC): Mervielde & De Fruyt, 1999) and CBQ scales among children, along with measures designed to assess the models proposed by Buss and Plomin, and Thomas and Chess. The reported correlations and analyses were only partly consistent with expectations. The principal components analysis appeared to confirm the link between B5 extraversion and CBQ surgency (i.e., both loaded on the same component), and between three of the CBQ negative affectivity subscales a measure of a B5 neuroticism subscale labelled anxiety (likewise loading on a shared component). However, several loadings were inconsistent with expectation, with only one CBQ effortful control subscale loading on the component defined by measures of B5 conscientiousness subscales: the remaining CBQ effortful control subscales formed a separate component. Oddly, measures of B5 openness and one of the neuroticism subscales loaded on the conscientiousness-dominated component. In a later study, De Pauw (2012) reported relationships between temperament and B5 scales that changed with the age of the children who were assessed. In contrast with earlier conclusions, that differences between the B5 and these temperament themes are “more apparent than real” (Mervielde et al., 2005, p. 134) De Pauw (2012) argued that measures of personality and temperament “complement each other as measures of individual differences” (slide 26)—in other words, the personality and temperament measures were not mutually redundant.

Attempts to statistically integrate psychoneurological models have likewise met with mixed outcomes. On the one hand, research on a measure of Cloninger's Tridimensional Personality model, which attempts to describe personality in terms of neurobiological functioning, has been shown to measure conceptual space adequately described by the B5 (Ramanaiah, Rielage, & Cheng, 2002; Stewart, Ebmeier, & Deary, 2004). This would appear to make Cloninger's Tridimensional Personality model redundant with the B5 but only if it is also accepted that the measure of Cloninger's model used in these studies was an accurate reflection of the corresponding theoretical dimensions of that model. Unfortunately, this has not been clearly established. Attempts to statistically integrate measures for RST and the B5 have been less successful because although measures of both models are linked and form meaningful super-factors, examination of the results of Mitchell et al. (2007) shows that most of the variance in either model is unaccounted for by its counterpart, regardless of whether measures of B5 factors or sub-facets of B5 factors are used in the analysis. Likewise, Keiser and Ross (2011) found reliable associations between measures of RST and the B5, but the B5 measures accounted for less than a third of the variance of any of the RST measures, results that are consistent with those reported by Seibert, Miller, Pryor, Reidy, and Zeichner (2010). Taken together, these various results show that although there are conceptual similarities, empirical evidence is inconsistent with measures of the B5 being redundant with measures of either temperament or RST factors, or vice versa.

The results of these Galtonian-style statistical attempts to integrate lexical personality factors with measures of temperament and neuropsychological individual differences have at best been mixed, with much of the variance in the alternative models left unexplained. Consequently, it is unsafe to argue for an integrated model of personality based on apparent conceptual similarities. However, the problems with integration of personality models are actually far greater than limited correlations between measures, with fundamental issues relating to model confirmation and measurement that personality researchers are yet to address.

2.2. Wundtian (functional) integrations

In contrast, Wundtian-inspired searches for unifying biological bases for personality traits leads to various questions apparently unanswerable from a Galtonian perspective, the most important of which are: What biological bases or processes account for personality, and where is one to look for them? This problem is more real than apparent, and its resolution requires a conceptual model of personality processes. One integrative approach that has yielded theoretical fruit is based on the biology of motivational control systems. This functional approach operates on the premise that stable individual differences in behaviour (personality traits) must be due to relatively stable individual differences in the operation of brain systems that produce behaviour from moment-to-moment (personality state). From this perspective, population-level traits reflect the operations of brain systems that have evolved to respond to different classes of functional requirements (Denissen & Penke, 2008). This in turn implies that the search for biological underpinnings of personality should entail the search for: (a) the functions of specific reactions, and systems of reactions; and (b) the neurophysiology of coordinated systems that mediate these reactions.

Functional accounts of personality have gained widespread popularity in recent years, affording important insights into human behaviour. As discussed below, this approach provides a taxonomy of behaviours not in terms of the naming of traits and not even their specific behavioural outputs but, rather, in terms of the functions they serve. For example, different behavioural strategies (e.g., cooperation or coercion) may be identical in function (e.g., social

influence) but their expression is influenced by context (e.g., power relationship). Contrariwise, the same behaviour (e.g., cooperation) may serve different functions (e.g., altruism or submission), again depending on the context. Functions cannot simply be 'read-off' from behaviours; there is need for some form of conceptual nervous system to guide the search for the main systems of the real nervous system.

The so-called Five-Factor Theory (Allik & McCrae, 2002; McCrae & Costa, 1999) is an example of an attempt to do just that, because it tried to identify underlying functions on the basis of observed dimensions of personality. Within Five-Factor Theory, the B5 are 'explained' by 'basic tendencies', which unfortunately are not clearly linked with independently-obtained knowledge of intra-personal processes. This gap is compounded by the fact that the basic tendencies are both unobservable and unobserved, but instead can only be inferred from the factors that they supposedly explain. In other words, the five factors are explained by things that we only know about because of the five factors, making the Five-Factor Theory a meaningless piece of circular reasoning.

A theoretically-deeper and more-inclusive Wundtian-style integration, combining temperament, the B5, and RST, was provided by Van Egeren (2009) in the process of arguing for a cybernetic model of personality. In this model, personal goals, behaviours, outcomes, and situations, interact in feedback loops to provide self-regulatory control, thereby underpinning personality and associated individual differences. In Van Egeren's conceptualisation, the B5 dimensions correspond to temperamental dispositions on the basis of their role in these self-regulatory loops. So, temperamental dispositions to respond to rewards (behavioural outputs linked to goals) correspond to extraversion, while dispositions to respond to threatened frustration of goals (outcomes linked to goals) is reflected in neuroticism (emotional stability, reversed). In doing so, Van Egeren implies links from extraversion to BAS and from neuroticism to FFFS. Conscientiousness relates to a focus upon if-then relationships (behaviours linked to outcomes) and appropriately moderating responses, thereby expressing a disposition to restrain extraverted and neurotic responses through effortful control, implying the application of BIS.

In arguing for these relationships, Van Egeren is consistent with the different arguments presented previously about similarities between the B5 and temperament dimensions. However, he goes further in an attempt to integrate the remaining two B5 factors. Openness is consequently seen as reflecting outcome prediction processes (making links between situations and outcomes), while agreeableness reflects capacity for forming partnerships with others in pursuit of cybernetically-defined outcomes. Sadly, these theoretical associations are at most only partially consistent with the empirical evidence about the relationships between the B5 and RST that were outlined in the previous section.

2.3. Problems with lexical personality factors

One of the major problems underlying previous integrations of personality models is that they have effectively assumed a similar ontological status for lexical personality factors (such as those within the B5 and other models) and the constructs included within personality models based upon temperament, neurobiology, or cognitive function. Yet, without clear and unambiguous independent confirmation from non-lexical evidence, it remains a distinct possibility that lexical personality factors merely represent summaries of behavioural consistency that personality judges and researchers find convenient. This gives lexical personality factors an uncertain ontological and causal status, meaning that they remain theoretically suspect from a Wundtian perspective, a point which was perhaps most forcefully argued by Block (2001) and has yet to be effectively addressed. For example, although there some

evidence linking lexical personality dimensions with brain structures has been reported in the past decade (e.g., DeYoung et al., 2010), to date these relationships are both controversial (Vul, Harris, Winkielman, & Pashler, 2009) and unreliable (cf., Bjorneklett et al., 2013). It would be fair to conclude that relationships exist between lexical personality factors and the brain but that these relationships do not compel acceptance of any particular lexical personality structures (Corr, DeYoung, & McNaughton, 2013).

Just as concerning is the lack of reliability of lexical personality dimensions across populations. Although early research repeatedly found B5 structures in multiple datasets, these were restricted to English or German, or effectively imposed the B5 on other languages by using etic methodologies (Saucier & Goldberg, 2001). More recent research examining emergent personality factors in multiple languages has found evidence supporting either additional factors (Ashton & Lee, 2001; Saucier, 2003), or that only two (Saucier et al., 2014) or three (De Raad et al., 2010) factors are genuinely replicable across languages, while some factors are more cross-culturally replicable than others (De Raad, Barelids, Timmerman, De Roover, & Mlačić, in press). Even within English, varying the culture in which research is conducted appears to affect the factors that are obtained (Ashton & Poropat, 2013; Skuse & Poropat, 2013). This lack of factor reliability, combined with the inherent arbitrariness of factor analytical techniques (Block, 2001) makes it unlikely that a neat correspondence will be found between lexical personality factors and underlying brain structures or cognitive functions.

This conclusion should be neither surprising nor controversial. The lexical hypothesis itself provides an unpromising basis for identifying personality factors that relate to neurocognitive features. This is because lexical factors summarise what observers find to be important, not what *produces* the observations. In other words, lexical factors reflect a person's phenotype, not their genotype (Saucier & Goldberg, 2001), nor their endophenotype (internal processes and factors, along the lines of attentional processes or brain structures). In part, this is a direct result of the fact that language from which lexical factors are derived is always interpersonal rather than introspective—no private language of interior experience can be used interpersonally (Wittgenstein, 1953/2001)—and so no lexical factor has privileged access to genotype or endophenotype (cf., Hogan, 1996; Saucier & Goldberg, 2001). Consequently, although lexical factors have been demonstrated to have strong pragmatic value, especially with respect to inter-individual evaluation and behavioural prediction, there is no straightforward theoretical or logical basis for assuming that lexical factors will have any explanatory theoretical value, except as evidence for the lexical hypothesis itself.

2.4. Problems with measurement of theoretical constructs

This criticism also applies to some models of temperament, which despite their theoretical claims were in fact developed in a manner that was broadly comparably with the lexical personality factors, with observers asked to identify what they believed to be important children's behaviours (Thomas et al., 1968 is a clear example of this). Temperament measures developed in this way appear to be based on inter-individual phenotype in a manner analogous to the lexical personality factors.

A noteworthy exception to this criticism is the work leading to the development of the CBQ (Rothbart, 2007), because it was explicitly based upon fundamental work on attentional networks, and the CBQ has subsequently been associated with measures of attention and attentional control. Unfortunately, these associations are moderate at best and somewhat unreliable. For example, correlations of effortful control with measures of executive attention or

cognitive control range from non-significant (Checa & Rueda, 2011; Martel, Roberts, & Gremillion, 2013) to absolute values between .35 and .47 (Gerardi-Caulton, 2000; Simonds, Kieras, Rueda, & Rothbart, 2007). Whereas this departure from redundancy is not a threat to the theory of temperament that underlies the CBQ, it limits the extent to which the CBQ can be accepted as reflecting its theoretical origins, and also means that even strong correlations between the CBQ and lexically-based personality measures would not establish that the lexically-based dimensions are explained by these underlying aspects of attention.

In a similar fashion, the various questionnaire measures of the BIS and BAS within the framework of RST do not sit neatly with the postulated underlying neuropsychological systems. For example, there is a substantial disconnect between measures of BIS and BAS and independent measures of the underlying neuropsychological processes (Corr & McNaughton, 2012). Frankly, as a theory that has strong claims to biological primary, this remains something of an embarrassment for RST.

So, the links between personality measures and corresponding theoretically-based constructs is typically small-to-moderate. Further, measures of supposedly independent constructs, such as the B5 and temperament, often use similar items despite the fact that they are assumed to reflect phenomena at different levels of analysis. Failures to address such issues makes it difficult to discuss meaningfully the associations between personality dimensions from different models without reifying their differences (e.g., temperament is different to personality, even if measured in the same way) before 'explaining' their links (e.g., temperament is expressed in personality).

The use of questionnaires or rating-scales introduces other issues that need to be addressed within any integrated model of personality. Much of the variance associated with different approaches to personality ratings and similar forms of measurement has substantive validity in terms of capacity to predict criterion variables, both statistically and in some cases longitudinally. These include differences in measures obtained from different judges¹ of personality (Connelly & Ones, 2010; Poropat, 2014a; Poropat, 2014b). Although often treated as 'error', these aspects of personality measurement can produce criterion-linked effects of greater magnitude than those associated with the purported traits being measured (Lance et al., 2010). A further problem is presented by the persistent individual differences in individual variability in the expression of personality that are apparent from repeated-measures intra-individual studies rather than from cross-sectional inter-individual studies (e.g., Flesson & Gallagher, 2009). In other words, measurement-linked forms of variance are important components of personality as a complete phenomenon, requiring them to be included in any model of personality that aims at a comprehensive integration.

In summary, there are a variety of major issues in personality research that previous attempts at integration have not addressed. These include: the large gap between measures of temperament and personality, however defined, and their supposed basis in phenotypic or endophenotypic factors; the substantial variability in lexical factors across languages and cultures; the substantial amount of variance in measures of temperament, B5, and RST, that is not integrated when these are analysed together; and the proportion of variance in personality ratings that is measurement-dependent, but which still appears to be valid. It appears that these issues cannot be effectively addressed without properly considering the role of measurement in personality, not simply as a methodological concern but as a central part of personality theory.

¹ NB: Many writers on psychological measurement prefer the term 'raters' (e.g., Lance, Dawson, Birkelbach, & Hoffman, 2010), but we have instead used 'judges' for the person who provides the rating and 'targets' for the person whose personality is being rated, in order to be consistent with Funder (2001).

3. A Cronbachian approach to personality integration

In contrast with Galtonian and Wundtian approaches, the Cronbachian paradigm explicitly assumes that both psychological phenomena and measurement reflect multiple factors, all of which have to be adequately modelled to present a comprehensive account (Cronbach et al., 1972; Cronbach et al., 1963). This is commonly contrasted with the model of reality represented in classical test theory (CTT) accounts of measurement. Most personality research either explicitly or implicitly assumes a CTT model of measurement in which observed scores (X) reflect some underlying true score (T) and a random error component (E), as summarised in the well-known equation:

$$X = T + E \quad (1)$$

Nonetheless, most personality researchers readily acknowledge the existence of systematic variance linked with the method by which constructs are measured. At times this is expressed in what Lance, Baranik, Lau, and Scharlau (2009) refer to as the *normative accuracy model*, which is a logical development of CTT, incorporating a systematic measurement bias component (SB) as follows:

$$X = T + SB + E \quad (2)$$

In this context, *bias* is taken to imply *invalid*, yet as Lance et al. (2009) demonstrate, much of what passes for bias is directly linked to valid reflections of the measurement target. So, when ratings of personality are obtained from different judges (e.g., self- versus other-raters), these different sources of ratings have often been treated as different methods, and the associated variance as a form of systematic bias: a so-called ‘common method bias’ (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff, MacKenzie, & Podsakoff, 2012). Yet, there is good evidence that differences between raters are not a form of bias or error (Hoffman & Woehr, 2009; Lance et al., 2010) but instead reflect “valid differences in perception” (Borman, 1974, p.107), and that judge and target effects in large part reflect valid variance within the construct space. The size of these judge or target effects can be substantial, accounting for as much as three-quarters of non-random variance in multitrait-multirater studies (Lance et al., 2009). Connelly and Ones (2010) specifically compared self- and other-ratings of personality, and found that the average self-other agreement across B5 dimensions varied substantially depending on the source of ratings, with self-raters agreeing much more strongly with other-raters from within their family (mean $R^2 = .18$ uncorrected; $.72$ corrected) than with other-raters from work (mean $R^2 = .04$ uncorrected; $.42$ corrected) demonstrating the substantial consequences of varying the source of personality ratings. Despite the low self-other agreement at work, Connelly and Ones (2010) found that other-rated personality was as good as or substantially better than self-rated personality for predicting work performance, indicating it provides independent validity. Consequently, the first step towards effectively integrating personality models requires the modelling of personality expression by targets and the process of empirically observing and interacting with these personality expressions by judges.

Generalisability theory, a model of measurement for which Lee Cronbach and his associates (Cronbach et al., 1972; Cronbach et al., 1963) deserve much of the credit, provides a framework for considering how these distinct components of personality can be assessed. Specifically, generalisability theory allows for decomposing measures, such as those typically used in personality research, into a set of factors. An example of a generalisability theory model, in which components of ratings are identified on the basis of who has been the object or the provider of the relevant rating, is outlined in Eq. (3).

$$\text{rating}_{ij} = \text{Target}_i + \text{Judge}_j + \text{Target}_i \times \text{Judge}_j + \text{residual}_{ij} \quad (3)$$

From this perspective, the systematic bias of Eq. (2) is composed of valid variance and not error. So in the model represented in Eq. (3), ratings are a function of not only persistent variance between targets, but also variance between judges and the interaction between these. In this model, targets present a phenotype (i.e., they provide opportunities to be observed) that judges use or fail to use in ways that reflect judges’ own individual differences (Funder, 2001). Consequently, lexical factors based upon factor analyses of personality ratings are complicated by the presence of effects linked with targets, judges, and interactions between targets and judges. Examples of these types of judge and interaction effects were provided by Funder, Kolar, and Blackman (1995), when they demonstrated that judges can validly assess personality, even when their ratings are only modestly correlated (mean $r = .25$) with that of judges who have observed targets in different contexts.

These relationships complicate models of the relationship between behaviour and personality assessment. For example, correlations between ratings of temperament and of personality may be due to any one of the terms in Eq. (3), or any combination thereof. Without actively modelling all of these components, observed correlations are at best indicative and not conclusive. However, intra-individual processes (e.g., perception, evaluation, and action initiation) that lead to observable inter-individual differences always occur within situations in response to stimuli within those situations, and are always linked with outcomes (Van Egeren, 2009), so the Target term in Eq. (3) is decomposable, as summarised in Eq. (4):

$$\begin{aligned} \text{Target}_i = & \text{Process}_m + \text{Situation}_n + \text{Outcome}_o + \text{Process}_m \\ & \times \text{Situation}_n + \text{Process}_m \times \text{Outcome}_o + \text{Situation}_n \\ & \times \text{Outcome}_o + \text{Process}_m \times \text{Situation}_n \times \text{Outcome}_o \\ & + \text{residual}_{mno} \end{aligned} \quad (4)$$

With respect to Eq. (5), the consequences of individual differences in sensitivity to novel events (Rothbart, 2007) or aversive stimuli (RST) will depend on the situation (e.g., presence or absence of events or stimuli) and outcomes (consequences that will accrue to the individual), plus their various interactions. Consequently, any study that found strong associations between endophenotypic processes and target behaviours will at best be serendipitous and unlikely to be generalisable because of the limitations identified within generalisability theory. This is part of the reason why the unreliable correlations between CBQ ratings and attentional processes are not necessarily indicative of flaws in Posner and Rothbart’s (2007) theory, but instead are likely to indicate unmodelled complexities in measurement or methodology.

Just as the Target effects in Eq. (3) can be decomposed, so too can the Judge effects, and in comparable manner because a judge’s rating is in itself a behaviour, determined in part by the judge’s own processes. It has long been accepted that judges’ ratings are affected by the outcome they are pursuing when producing a rating (Vazire, 2010), but they are also affected by the specific target behaviours observed and the situation in which these are observed (Kammrath, Mendoza-Denton, & Mischel, 2005; Reynolds & Karraker, 2009; Saucier, Bel-Bahar, & Fernandez, 2007). Situations are so important for judges that a recent study demonstrated that when judges are not provided with information about situations, they either infer or actively create situations to enable them to construct ratings (Wiemers & Poropat, 2013). So for judges, their ‘situation’ can be decomposed by considering the targets’ observed behaviours and observed situations. These points lead to Eq. (5), which has been simplified for presentation but which can be readily expanded:

$$\begin{aligned}
 \text{Judge}_j = & \text{Process}_p + \text{Observed Behaviour}_q \\
 & + \text{Observed Situation}_r + \text{Outcome}_s \\
 & + \text{2-way interactions} + \text{3-way interactions} \\
 & + \text{4-way interactions} + \text{residual}_{mno} \quad (5)
 \end{aligned}$$

It is clear from Eq. (5) that personality ratings themselves are highly complex, and that there is much to be explored within this aspect of personality. However, it should also be clear that Judge effects are neither random nor error but instead represent valid variance, albeit variance that complicates the identification of Target effects. Instead, Judge effects express the consequences of judges' endophenotypes, along with the rating situations and outcomes they are addressing, making judges a component of ratings every bit as important as targets, and potentially more complex.

The final step in this analysis would be the integration of Eqs. (3)–(5), which for the sake of simplicity has not been presented. It should be noted that although temporal effects, such as those analysed by [Fleeson and Gallagher \(2009\)](#), are not explicitly incorporated within this analysis, they are implicit within the various effects associated with situations and outcomes, which vary substantially with time. Similarly, cultural and linguistic effects are subsumed within components such as situations, outcomes, and interactions between processes and these factors. It should also be noted that this analysis implicitly accounts for the finding that factor analyses of intra-individual (Wundtian) variation produce different factors to more traditional factor analyses of inter-individual (Galtonian) variation ([Molenaar & Campbell, 2009](#)), because they combine different variance components from this Cronbachian perspective. Thus, when personality is viewed from a Cronbachian paradigm, attempts at integrating personality from either a Galtonian or Wundtian perspective become less credible. Instead, adequate integration of personality models will require reliable assessment and analysis of intra- and inter-individual processes and variation, combined with attention to both the expression and perception of personality. At its most simple, we are arguing that theories of personality can be properly integrated only by explicitly modelling both what causes persistent individual differences in behaviour, but also what causes persistent individual differences in perception of behaviour, along with the consequences of the interactions of these various causes for the measurement of personality.

4. Implications

The implications of this review are humbling for personality researchers and for psychology more broadly. Despite the heavy focus on correlations between ratings and exploratory factor analyses in personality research, at this point in time using such research as the basis for integrating personality theories is at best premature and at worst is grossly misleading. This is because relatively simple analyses such as correlations or exploratory factor analyses systematically ignore substantial portions of the variance components and associated causal factors outlined above. Likewise, even though [Eysenck \(1998\)](#) invoked Cronbach when reviewing his personality model, his approach integrated neither the context for nor the perception of personality, both of which we argue are essential for proper effective integration. Even the partialling of variance into target and judge components will not adequately address this problem because knowing the amount of variance associated with targets and judges does not explain what produces that variance. To do that, it will be necessary to further deconstruct these variance components to identify the extent to which they reflect (intra-individual) neurocognitive features and processes, along with (inter-individual) reputational and

perceptual features, as well as situational influences that vary with time and location.

4.1. Future research

The only types of analyses currently available that would enable such a comprehensive integration of personality theories and models require much more comprehensive datasets than those currently used. Such datasets would combine, at a minimum, sets of factors corresponding to targets crossed with judges crossed with situations crossed with intra-individual and neuro-biological processes, and using comparably complex forms of analysis. The complexity of such analyses in turn implies very large datasets in order to provide adequate reliability in modelling. Such datasets are potentially of several orders of magnitude greater than those commonly used in personality research. In other words, researchers have as yet only nibbled at the edges of this problem and it is time to start thinking much, much bigger. The required jump is comparable to the shift that physics made in the past century, from table-top experiments to multi-national collaborations involving very large research teams.

If the analysis presented here is correct, it will not be possible properly to characterise the relationship between the Galtonian empirically- and Wundtian theoretically-derived personality models without data that reflects these various sets of causal factors and their interactions. This does not mean, however, that only analyses of this level of complexity are valuable for exploring personality theories—nibbling at a problem makes more progress than ignoring it. While the type of mega-study referred to would be ideal, a range of more modest investigations should be profitable in the meantime. Specifically, researchers should strive to increasingly integrate further components of the generalizability theory model within their research and theorising, with the aim of progressively approximating a more inclusive and valid representation of personality. Some indicative examples of how such research may be conducted are provided by [Kandler, Riemann, Spinath, and Angleitner \(2010\)](#) and [Riemann and Kandler \(2010\)](#).

Personality researchers should start pursuing different types of research than the currently dominant approach of comparing personality assessments with criterion variables, especially those that are assessed in similar manner to personality and which probably have overlapping content. When there is overlapping content in the personality and criterion variables, this can be interpreted as correlations or even causation even when in fact it represents nothing more than confounding. Correlations between personality and many work performance ratings, especially measures of conscientiousness and citizenship performance, appear to be examples of exactly this type of confounding ([Poropat, 2011b](#)). Instead, there should be more research focused on exploring the factors that guide the expression and perception of behaviour, such as by considering how judges construct personality ratings, how attention and learning processes produce target behaviours, or how judge-target interactions affect both target expressed behaviours and ratings of personality. More attention should also be focused upon how both targets and judges are affected by intra-individual processes and situational factors, and their interactions.

4.2. Predictions

The limitations that previous research and datasets have placed upon personality researchers are substantial and the efforts required to overcome them effectively are daunting. Nonetheless, there is sufficient information to make at least some predictions about what may ultimately be found in the search for comprehensive personality models. To begin, different types of personality models will be differentially useful for specific contexts and

criteria. So, personality models based on Wundtian, intra-individual theories should be best at explaining and predicting intra-individual factors, such as individual development and cognitive processes, or within-individual (but cross-situational) variance and learning trajectories. This means that RST and temperament theories, when validly measured, should provide more effective accounts of within-individual cognitive development and decision-making.

In contrast, the personality models based on Galtonian inter-individual models will be most successful for predicting socially-valued outcomes, such as career success, and work and academic performance. Such results have already been well-established, as referred to earlier, but it is important to note that the reason for this is not because the Galtonian models are superior reflections of endophenotype, but because they reflect similar types of variance and measurement to that of the outcomes they have been shown to statistically predict. Specifically, when compared with Wundtian intra-individually-based measures, Galtonian inter-individually-based measures of personality reputation will be inherently more likely to be correlated within inter-individually-observed differences in outcomes, even if the reason is nothing more than their basis in comparable levels of analysis of individual behaviours and inter-individual differences, or a basis in comparable analytical strategies (e.g., Poropat & Jones, 2009). The reverse argument supports the prediction that validly-measured Wundtian intra-individually-based personality measures should be best at statistically predicting intra-individual outcomes.

However, a Cronbachian account implies that other components of variance within personality measures will also be differentially associated with criterion variables. For example, given the fact that target-linked variance in ratings is inherently associated with the targets themselves, it would follow that that target-linked variance would be most closely associated with target endophenotypic factors, such as intra-individual cognitive and affective processes, neurological structures, and levels of behaviour-relevant neurotransmitters and hormones. However, similar arguments apply to personality judges, so judge-linked variance will be more closely linked with judge endophenotypic processes. And, target-judge interaction-related variance should be more closely linked with situational influences and observational limitations faced by judges, because of the central role of context and observation in the construction of personality assessments (Funder, 2001).

So, a Cronbachian perspective on personality does more than offer a pathway to eventual integration of personality models, albeit one that faces substantial pragmatic challenges. This broader perspective has further, specific implications for more easily accessible research efforts that are similar in scale to current research. Adopting this perspective, however, will create an incentive for personality researchers to more critically consider the basis for the results they present, by stopping to ask whether the presence or relative strength of observed relationships is due to the specific component of variance named, be it intra- or inter-individually based, or something yet more complex.

5. Conclusions

Ultimately, integrated understandings of personality will require attention to the full range of variance in personality, rather than merely assuming straightforward relationships between underlying theoretical constructs and either their expression or assessment. The tendency to exclude much of the variance of personality measurement from consideration in attempts to integrate personality may be a result of assuming greater validity for the distinction between trait and measurement effects than is warranted, or by unwittingly being misled by the unspoken but apparently widely-accepted focus on either individual and contextual

influences upon behaviour. Instead, there will be no comprehensive integrated model of personality until researchers are able to model the measurement, context, phenotype, endophenotype and genotype of personality simultaneously. Adopting this broader, Cronbachian paradigm for personality research will be far more challenging than even the most extensive research undertaken to date, yet provides a genuine opportunity to unravel the apparent complexity of personality as it is currently perceived from with disparate paradigmatic perspectives. The consequences of the analysis presented here are reminiscent of the hoary chestnut of the wise blind men and the elephant, because it is only when we step back to take in the full view of personality, as offered by a Cronbachian approach, will we be able to genuinely integrate this many-featured beast.

References

- Allik, J., & McCrae, R. R. (2002). A five-factor theory perspective. In R. R. McCrae & J. Allik (Eds.), *The five-factor model of personality across cultures* (pp. 303–321). New York: Kluwer Academic/Plenum.
- Allport, G. W., Odbert, H. S., (1936). Trait names: A psycho-lexical study. *Psychological Monographs*, 47(1, Whole No. 211). <http://dx.doi.org/10.1037/h0093360>.
- Andersen, S. M., & Chen, S. (2002). The relational self: An interpersonal social-cognitive theory. *Psychological Review*, 109(4), 619–645. <http://dx.doi.org/10.1037/0033-295X.109.4.619>.
- Ashton, N., & Poropat, A. E. (2013). Does personality look different in different occupational cultures? Paper presented at the Australian Conference on Personality and Individual Differences, Brisbane, Australia.
- Ashton, M. C., & Lee, K. (2001). A theoretical basis for the major dimensions of personality. *European Journal of Personality*, 15, 327–353. <http://dx.doi.org/10.1002/per.417>.
- Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personality Psychology*, 44, 1–26.
- Bjornebekk, A., Fjell, A. M., Walhovd, K. B., Grydeland, H., Torgersen, S., & Westlye, L. T. (2013). Neuronal correlates of the five factor model (FFM) of human personality: Multimodal imaging in a large healthy sample. *Neuroimage*, 65, 194–208. <http://dx.doi.org/10.1016/j.neuroimage.2012.10.009>.
- Block, J. (2001). Millennial contrarianism: The Five-Factor approach to personality description 5 years later. *Journal of Research in Personality*, 35, 98–107.
- Borman, W. C. (1974). The rating of individuals in organizations: An alternative approach. *Organizational Behavior and Human Performance*, 12, 105–124.
- Buss, D. M., & Plomin, R. (1975). *A temperament theory of personality development*. New York: Wiley.
- Caprara, G. V., & Cervone, D. (2000). *Personality: Determinants, dynamics, and potentials*. Cambridge, UK: Cambridge University Press.
- Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annual Review of Psychology*, 56, 453–484. <http://dx.doi.org/10.1146/annurev.psych.55.090902.141913>.
- Checa, P., & Rueda, M. R. (2011). Behavioral and brain measures of executive attention and school competence in late childhood. *Developmental Neuropsychology*, 36(8), 1018–1032. <http://dx.doi.org/10.1080/87565641.2011.591857>.
- Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants: A proposal. *Archives of General Psychiatry*, 44(6), 573–578. <http://dx.doi.org/10.1001/archpsyc.1987.01800180093014>.
- Connelly, B. S., & Ones, D. S. (2010). An other perspective on personality: Meta-analytic integration of observers' accuracy & predictive validity. *Psychological Bulletin*, 136(6), 1092–1122. <http://dx.doi.org/10.1037/a0021212>.
- Corr, P. J., & McNaughton, N. (2012). Neuroscience and approach/avoidance personality traits: A two stage (valuation–motivation) approach. *Neuroscience and Biobehavioral Reviews*, 36(10), 2339–2354. <http://dx.doi.org/10.1016/j.neubiorev.2012.09.013>.
- Cronbach, L. J. (1957). The two disciplines of scientific psychology. *American Psychologist*, 12, 671–684. <http://dx.doi.org/10.1037/h0043943>.
- Cronbach, L. J., Gleser, G. C., Nanda, H., & Rajaratnam, N. (1972). *The dependability of behavioral measurements: Theory of generalizability for scores and profiles*. New York: Wiley.
- Cronbach, L. J., Rajaratnam, N., & Gleser, G. C. (1963). Theory of generalizability: A liberalization of reliability theory. *British Journal of Statistical Psychology*, 16(2), 137–163. <http://dx.doi.org/10.1111/j.2044-8317.1963.tb00206.x>.
- De Pauw, S. S. W. (2012). How are temperament and personality related in children and adolescents from 1.5 to 15 years? Paper presented at the 16th European Conference on Personality, Trieste, Italy.
- De Pauw, S. S. W., Mervielde, I., & Van Leeuwen, K. G. (2009). How are traits related to problem behavior in preschoolers? Similarities and contrasts between temperament and personality. *Journal of Abnormal Child Psychology*, 37(3), 309–325. <http://dx.doi.org/10.1007/s10802-008-9290-0>.
- De Raad, B., Barelids, D. P. H., Ostendorf, F., Mlačić, B., Di Blas, L., Hřebíčková, M., et al. (2010). Only three factors of personality description are fully replicable across

- languages: A comparison of 14 trait taxonomies. *Journal of Personality & Social Psychology*, 98(1), 160–173. <http://dx.doi.org/10.1037/a0017184>.
- De Raad, B., Barelids, D. P. H., Timmerman, M. E., De Roover, K., & Mlačić, B. (in press). Towards a pan-cultural personality structure: Input from 11 psycholinguistic studies. *European Journal of Personality*. <http://dx.doi.org/10.1002/per.1953>.
- Denissen, J. J. A., & Penke, L. (2008). Motivational individual reaction norms underlying the Five-Factor model of personality: First steps towards a theory-based conceptual framework. *Journal of Research in Personality*, 42, 1285–1302. <http://dx.doi.org/10.1016/j.jrp.2008.04.002>.
- DeYoung, C. G., Hirsh, J. B., Shane, M. S., Papademetris, X., Rajeevan, N., & Gray, J. R. (2010). Testing predictions from personality neuroscience: Brain structure and the Big Five. *Psychological Science*, 21(6), 820–828. <http://dx.doi.org/10.1177/0956797610370159>.
- Eysenck, H. J. (1947). *Dimensions of personality*. London: Routledge and Kegan Paul.
- Eysenck, H. J. (1967). *The biological basis of personality*. Springfield Ill: Thomas.
- Eysenck, H. J. (1998). *Dimensions of personality*. New Brunswick, NJ: Transaction.
- Fleeson, W., & Gallagher, P. (2009). The implications of big five standing for the distribution of trait manifestation in behavior: Fifteen experience-sampling studies and a meta-analysis. *Journal of Personality & Social Psychology*, 97(6), 1097–1114. <http://dx.doi.org/10.1037/a0016786>.
- Funder, D. C., Kolar, D. C., & Blackman, M. C. (1995). Agreement among judges of personality: Interpersonal relations, similarity, and acquaintanceship. *Journal of Personality and Social Psychology*, 69(4), 656–672. <http://dx.doi.org/10.1037/0022-3514.69.4.656>.
- Funder, D. C. (2001). Accuracy in personality judgement: Research and theory concerning an obvious question. In B. W. Roberts & R. T. Hogan (Eds.), *Personality psychology in the workplace* (pp. 121–140). Washington DC: American Psychological Association.
- Galton, F. (1884). Measurement of character. *Fortnightly Review*, 36, 179–185.
- Gerardi-Caulton, G. (2000). Sensitivity to spatial conflict and the development of self-regulation in children 24–36 months of age. *Developmental Science*, 3(4), 397–404. <http://dx.doi.org/10.1111/1467-7687.00134>.
- Goldberg, L. R. (1981). Language and individual differences: The search for universals in personality lexicons. In L. Wheeler (Ed.), *Review of personality and social psychology* (vol. 2, pp. 141–165). Beverly Hills, Calif: Sage.
- Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment*, 4(1), 26–42. <http://dx.doi.org/10.1037/1040-3590.4.1.26>.
- Goldberg, L. R. (1993). The structure of phenotypic personality traits. *American Psychologist*, 48, 26–34. <http://dx.doi.org/10.1037/0003-066X.48.12.1303>.
- Goldsmith, H. H., & Campos, J. J. (1982). Toward a theory of infant temperament. In R. N. Emde & R. J. Harmon (Eds.), *The development of attachment and affiliative systems* (pp. 161–193). New York: Plenum Press.
- Gore, W. L., & Widiger, T. A. (2013). The DSM-5 dimensional trait model and five-factor models of general personality. *Journal of Abnormal Psychology*, 122(3), 816–821. <http://dx.doi.org/10.1037/a0032822>.
- Gray, J. A. (1975). *Elements of a two-process theory of learning*. London: Academic Press.
- Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. Oxford: Oxford University Press.
- Gray, J. A., & McNaughton, N. (2000). *The Neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. Oxford: Oxford University Press.
- Grice, J. W. (2004). Bridging the idiographic-nomothetic divide in ratings of self and others on the Big Five. *Journal of Personality*, 72(2), 203–241. <http://dx.doi.org/10.1111/j.1467-6494.2006.00407.x>.
- Guion, R. M., & Gottier, R. F. (1965). Validity of personality measures in personnel selection. *Personnel Psychology*, 18, 135–164.
- Hoffman, B. J., & Woehr, D. J. (2009). Disentangling the meaning of multisource performance rating source and dimension factors. *Personnel Psychology*, 62, 735–765. <http://dx.doi.org/10.1111/j.1744-6570.2009.01156.x>.
- Hogan, R. T. (1996). A socioanalytic perspective on the Five-Factor Model. In J. S. Wiggins (Ed.), *The five-factor model of personality: Theoretical perspectives* (pp. 163–179). New York: Guilford Press.
- Hurtz, G. M., & Donovan, J. J. (2000). Personality and job performance: The Big Five revisited. *Journal of Applied Psychology*, 85(6), 869–879. <http://dx.doi.org/10.1037/0021-9010>.
- Kagan, J. (2008). The biological contributions to temperament and emotions. *European Journal of Developmental Science*, 2(1–2), 38–51. <http://dx.doi.org/10.3233/DEV-2008-21204>.
- Kammrath, L. K., Mendoza-Denton, R., & Mischel, W. (2005). Incorporating if/then personality signatures in person perception: Beyond the person-situation dichotomy. *Journal of Personality and Social Psychology*, 88(4), 605–618.
- Kandler, C., Riemann, R., Spinath, F. M., & Angleitner, A. (2010). Sources of variance in personality facets: A multiple-rater twin study of self-peer, peer-peer, and self-self (dis)agreement. *Journal of Personality*, 78(5), 1565–1594. <http://dx.doi.org/10.1111/j.1467-6494.2010.00661.x>.
- Keiser, H. N., & Ross, S. R. (2011). Carver and Whites' BIS/FFFS/BAS scales and domains and facets of the Five Factor Model of personality. *Personality & Individual Differences*, 51(1), 39–44. <http://dx.doi.org/10.1016/j.paid.2011.03.007>.
- Kenny, D. A., & West, T. V. (2008). Self-perception as interpersonal perception. In J. V. Wood, A. Tesser, & J. G. Holmes (Eds.), *The self and social relationships* (pp. 119–138). New York: Psychology Press.
- Lance, C. E., Baranik, L. E., Lau, A. R., & Scharlau, E. A. (2009). If it ain't trait it must be method. In C. E. Lance & R. J. Vandenberg (Eds.), *Statistical and methodological myths and urban legends: Doctrine, verity and fable in the organizational and social sciences* (pp. 337–360). New York: Routledge.
- Lance, C. E., Dawson, B., Birkelbach, D., & Hoffman, B. J. (2010). Method effects, measurement error, and substantive conclusions. *Organizational Research Methods*, 13(3), 435–455. <http://dx.doi.org/10.1177/1094428109352528>.
- Martel, M. M., Roberts, B., & Gremillion, M. L. (2013). Emerging control and disruptive behavior disorders during early childhood. *Developmental Neuropsychology*, 38(3), 153–166. <http://dx.doi.org/10.1080/87565641.2012.758731>.
- Matthews, G., & Gilliland, K. (1999). The personality theories of H. J. Eysenck and J. A. Gray: A comparative review. *Personality & Individual Differences*, 26(4), 483–626. [http://dx.doi.org/10.1016/S0191-8869\(98\)00158-5](http://dx.doi.org/10.1016/S0191-8869(98)00158-5).
- McAdams, D. P., & Olson, B. D. (2010). Personality development: Continuity and change over the life course. *Annual Review of Psychology*, 61, 517–542. <http://dx.doi.org/10.1146/annurev.psych.093008.100507>.
- McCrae, R. R., & Costa, P. T. Jr., (1999). A five-factor theory of personality. In L. A. Pervin & O. P. John (Eds.), *Handbook of Personality: Theory and Research* (2nd ed., pp. 139–153). New York: Guilford.
- McNaughton, N., & Corr, P. J. (2008). The neuropsychology of fear and anxiety: A foundation for Reinforcement Sensitivity Theory. In P. J. Corr (Ed.), *The Reinforcement Sensitivity Theory of Personality* (pp. 44–94). Cambridge, UK: Cambridge University Press.
- Mervielde, I., De Clercq, B., De Fruyt, F., & Van Leeuwen, K. G. (2005). Temperament, personality, and developmental psychopathology as childhood antecedents of personality disorders. *Journal of Personality Disorders*, 19(2), 171–201. <http://dx.doi.org/10.1521/pedi.19.2.171.62627>.
- Mervielde, I., & De Fruyt, F. (1999). Construction of the Hierarchical Personality Inventory for Children (HiPIC). In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe: Proceedings of the Eighth European Conference on personality psychology* (pp. 107–127). Tilburg, the Netherlands: Tilburg University Press.
- Mischel, W. (1968). *Personality and assessment*. New York: Wiley.
- Mitchell, J. T., Kimbrell, N. A., Hundt, N. E., Cobb, A. R., Nelson Gray, R. O., & Lootens, C. M. (2007). An analysis of reinforcement sensitivity theory and the Five-Factor Model. *European Journal of Personality*, 21, 869–887. <http://dx.doi.org/10.1002/per.644>.
- Molenaar, P. C. M. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time, forever. *Measurement: Interdisciplinary Research and Perspectives*, 2(4), 201–218. http://dx.doi.org/10.1207/s15366359mea0204_1.
- Molenaar, P. C. M., & Campbell, C. G. (2009). The new person-specific paradigm in psychology. *Current Directions in Psychological Science*, 18(2), 112–117. <http://dx.doi.org/10.1111/j.1467-8721.2009.01619.x>.
- Mowrer, O. H. (1960). *Learning theory and the symbolic processes*. New York: Wiley.
- Norman, W. T. (1963). Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *Journal of Abnormal and Social Psychology*, 66, 574–583.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63, 539–569. <http://dx.doi.org/10.1146/annurev-psych-120710-100452>.
- Popple, A., & Levi, D. M. (2000). Wundt versus Galton – two approaches to gathering psychophysical measurements. *Perception*, 29(4), 379–381. <http://dx.doi.org/10.1068/p2904ed>.
- Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and academic performance. *Psychological Bulletin*, 135(2), 322–338. <http://dx.doi.org/10.1037/a0014996>.
- Poropat, A. E. (2011a). The Eysenckian personality factors and their correlations with academic performance. *British Journal of Educational Psychology*, 81(1), 41–58. <http://dx.doi.org/10.1348/000709910X497671>.
- Poropat, A. E. (2011b). *What a difference a rater makes: Rater-method variance and conscientiousness-work performance correlations*. Paper presented at the Industrial-Organisational Psychology Conference, Brisbane, Australia.
- Poropat, A. E. (2014a). A meta-analysis of adult-rated child personality and academic performance in primary education. *British Journal of Educational Psychology*, 84(2), 239–252. <http://dx.doi.org/10.1111/bjep.12019>.
- Poropat, A. E. (2014b). A meta-analysis of other-rated personality and academic performance. *Learning and Individual Differences*, 34(1), 24–32. <http://dx.doi.org/10.1016/j.lindif.2014.05.013>.
- Poropat, A. E., & Jones, L. S. (2009). Development and validation of a unidimensional measure of Citizenship Performance. *Journal of Occupational and Organizational Psychology*, 82(4), 851–869. <http://dx.doi.org/10.1348/096317908X374139>.
- Posner, M. I., & Rothbart, M. K. (2007). Research on attention networks as a model for the integration of psychological science. *Annual Review of Psychology*, 58, 1–23. <http://dx.doi.org/10.1146/annurev.psych.58.110405.085516>.
- Presley, R., & Martin, R. P. (1994). Toward a structure of preschool temperament: Factor structure of the temperament assessment battery for children. *Journal of Personality*, 62(3), 415–448. <http://dx.doi.org/10.1111/j.1467-6494.1994.tb00304.x>.
- Ramanaiah, N. V., Rielage, J. K., & Cheng, Y. Q. (2002). Cloninger's temperament and character inventory and the NEO Five-Factor inventory. *Psychological Reports*, 90(3), 1059–1063. <http://dx.doi.org/10.2466/pr0.90.4.1059-1063>.

- Revelle, W. (1987). Personality and motivation: Sources of inefficiency in cognitive performance. *Journal of Research in Personality*, 21, 436–452. [http://dx.doi.org/10.1016/0092-6566\(87\)90031-6](http://dx.doi.org/10.1016/0092-6566(87)90031-6).
- Reynolds, B., & Karraker, K. (2009). A big five model of disposition and situation interaction: Why a “helpful” person may not always behave helpfully. *New Ideas on Psychology*, 21, 1–13.
- Reynolds, K. J., Turner, J. C., Branscombe, N. R., Mavor, K. I., Bizumic, B., & Subasic, E. (2010). Interactionism in personality and social psychology: An integrated approach to understanding the mind and behaviour. *European Journal of Personality*, 24(5), 458–482. <http://dx.doi.org/10.1002/per.782>.
- Riemann, R., & Kandler, C. (2010). Construct validation using multitrait-multimethod-twin data: The case of a general factor of personality. *European Journal of Personality*, 24(3), 258–277. <http://dx.doi.org/10.1002/per.760>.
- Roberts, B. W., Kuncel, N. R., Shiner, R. L., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Psychological Science*, 2(4), 313–345. <http://dx.doi.org/10.1111/j.1745-6916.2007.00047.x>.
- Rothbart, M. K. (2007). Temperament, development, and personality. *Current Directions in Psychological Science*, 16(4), 207–212. <http://dx.doi.org/10.1111/j.1467-8721.2007.00505.x>.
- Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2008). Investigations of temperament at three to seven years: The children’s behavior questionnaire. *Child Development*, 72, 1394–1408. <http://dx.doi.org/10.1111/1467-8624.00355>.
- Rothbart, M. K., Derryberry, D., & Posner, M. I. (1994). A psychobiological approach to the development of temperament. In J. E. Bates & T. D. Wachs (Eds.), *Temperament: Individual differences at the interface of biology and behavior* (pp. 83–116). Washington, DC: American Psychological Association.
- Saucier, G. (2003). An alternative multi-language structure for personality attributes. *European Journal of Personality*, 17, 179–205. <http://dx.doi.org/10.1002/per.489>.
- Saucier, G. (2009). Recurrent personality dimensions in inclusive lexical studies: Indications for a Big Six structure. *Journal of Personality*, 77(5), 1577–1614. <http://dx.doi.org/10.1111/j.1467-6494.2009.00593.x>.
- Saucier, G., Bel-Bahar, T., & Fernandez, C. (2007). What modifies the expression of personality tendencies? Defining basic domains of situation variables. *Journal of Personality*, 75(3), 479–503. <http://dx.doi.org/10.1111/j.1467-6494.2007.00446.x>.
- Saucier, G., & Goldberg, L. R. (2001). Lexical studies of indigenous personality factors: Premises, products and prospects. *Journal of Personality*, 69(6), 847–879. <http://dx.doi.org/10.1111/1467-6494.696167>.
- Saucier, G., Thalmayer, A. G., Payne, D. L., Carlson, R., Sanogo, L., Ole-Kotikash, L., et al. (2014). A basic bivariate structure of personality attributes evident across nine languages. *Journal of Personality*, 82(1), 1–14. <http://dx.doi.org/10.1111/jopy.12028>.
- Seibert, L. A., Miller, J. D., Pryor, L. R., Reidy, D. E., & Zeichner, A. (2010). Personality and laboratory-based aggression: Comparing the predictive power of the Five-Factor Model, BIS/BAS, and impulsivity across context. *Journal of Research in Personality*, 44(1), 13–21. <http://dx.doi.org/10.1016/j.jrp.2009.09.003>.
- Shiner, R. L., Buss, K. A., McClowry, S. G., Putnam, S. P., Saudino, K. J., & Zentner, M. (2012). What is temperament now? Assessing progress in temperament research on the twenty-fifth anniversary of Goldsmith et al. (1987). *Child Development Perspectives*, 6(4), 436–444. <http://dx.doi.org/10.1111/j.1750-8606.2012.00254>.
- Shiner, R. L., & DeYoung, C. G. (2013). The structure of temperament and personality traits: A developmental perspective. In P. D. Zelazo (Ed.), *The Oxford handbook of developmental psychology: Self and other* (Vol. 2, pp. 113–141). Oxford: Oxford University Press.
- Simonds, J., Kieras, J. E., Rueda, M. R., & Rothbart, M. K. (2007). Effortful control, executive attention, and emotional regulation in 7–10-year-old children. *Cognitive Development*, 22(4), 474–488. <http://dx.doi.org/10.1016/j.cogdev.2007.08.009>.
- Skuse, B., & Poropat, A. E. (2013). *Indigenous Australian personality factors*. Paper presented at the Australian Conference on Personality and Individual Differences, Brisbane, Australia.
- Stewart, M. E., Ebmeier, K. P., & Deary, I. J. (2004). The structure of Cloninger’s Tridimensional Personality Questionnaire in a British sample. *Personality & Individual Differences*, 36, 1403–1418. [http://dx.doi.org/10.1016/S0191-8869\(03\)00237-X](http://dx.doi.org/10.1016/S0191-8869(03)00237-X).
- Thomas, A., & Chess, S. (1977). *Temperament and development*. New York: Brunner-Mazel.
- Thomas, A., Chess, S., & Birch, H. G. (1968). *Temperament and behavior disorders in children*. New York: New York University Press.
- Tupes, E. C., & Christal, R. E. (1958). Stability of personality trait rating factors obtained under diverse conditions. *USAF Wright Air Development Center Technical Note*, 16, 58–61.
- Van Egeren, L. F. (2009). A cybernetic model of global personality traits. *Personality and Social Psychology Review*, 13(2), 92–108. <http://dx.doi.org/10.1177/1088868309334860>.
- Vazire, S. (2010). Who knows what about a person? The self-other knowledge asymmetry (SOKA) model. *Journal of Personality & Social Psychology*, 98(2), 281–300. <http://dx.doi.org/10.1037/a0017908>.
- Vul, E., Harris, C., Winkielman, P., & Pashler, H. (2009). Puzzlingly high correlations in fMRI studies of emotion, personality, and social cognition. *Perspectives on Psychological Science*, 4(3), 274–290. <http://dx.doi.org/10.1111/j.1745-6924.2009.01125.x>.
- Wiemers, M., & Poropat, A. E. (2013). *Detection and use of information in personality perception: A think-aloud methodology*. Paper presented at the Australian Conference on Personality and Individual Differences, Brisbane, Australia.
- Wittgenstein, L. (1953). *Philosophical investigations*. Malden, Mass: Blackwell Publishing.
- Zuckerman, M. (1992). What is a basic factor and which factors are basic – Turtles all the way down. *Personality and Individual Differences*, 13(6), 675–681. [http://dx.doi.org/10.1016/0191-8869\(92\)90238-K](http://dx.doi.org/10.1016/0191-8869(92)90238-K).