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The Five-Factor Model:
Psychometric, biological and
practical perspectives

by PETER HARTMANN

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The Five-Factor Model (FFM) of personality is a trait approach to the conceptualization of personality. The five dimensions of FFM can be measured validly, although some potential confounders still need to be resolved. Furthermore, these psychometric findings have links to biology, like moderate heritability and physiological correlates, which suggests a biological basis for the FFM. Finally, knowledge of a specific subject's standing on the five dimensions can predict real life behaviour, thereby providing important information in relation to diagnosis, intervention and future outcomes.

Although the FFM is only one among several approaches to personality it provides a platform for combining other approaches to personality, with the ultimate goal of providing a unified, research based framework for describing, explaining and doing research in personality.

Correspondance: Peter Hartmann, Axel Heidesgade 12, 2300 Copenhagen S, Denmark. Tel.: +45 3060 0823. E-mail: peter.weber.hartmann@gmail.com

INTRODUCTION

A clear and univocal definition of "personality" containing all the essential aspects is complicated by the many approaches to personality. What aspects of personality are primary and should be considered most relevant for describing and explaining the human personality? Two possible definitions of personality are: 1) *The unique, relative enduring internal and external aspects of a person's character that influence behaviour in different situations* (Schultz & Schultz, 1994, p. 195) and 2) *Those thoughts and feelings, desires, intentions, and action tendencies that contribute to important aspects of individuality* (Brody & Ehrlichmann, 1998, p. 3). Even though these two definitions limit the scope of personality research, they are over-inclusive. Theoretically, over-inclusive theories can provide synthesis by creating super-models of personality, but in order to test these super-models empirically they need to be broken down to more manageable and clear-cut operational hypotheses.

One central problem in all personality research is to obtain empirical testable hypotheses that later can act as models for understanding personality. One model which has proven robust against scrutinized empirical testing, while at the same

time providing a super-model for understanding personality is “the trait approach” or more specific “The Five-Factor Model” (FFM). The FFM encompasses both the “experimental” and the “differential” method for investigating personality. The experimental method seeks to describe and explain the general laws of personality applying to all people, while the differential method tries to describe and explain the individual differences among specific individuals (Jensen, 1998, p. 9f). The experimental and the differential methods are complementary. What is considered error variance for the experimental methods, is the essence of the differential, and what is considered “normal”/“average” for the differential method is the backbone of the experimental. The FFM can therefore provide a general explanation of human personality, while at the same time explaining individual differences. The literature supporting the psychometric foundation, biological basis, and the practical implications of this approach is pervasive and it is therefore believed that the FFM can act as framework for further research in other domains of the personality realm, and in that sense provides a starting point for an encompassing general theory of personality.

The purpose of the present article is to make the reader familiar with the FFM, more specifically to review the psychometric foundation, to look at the biological basis in order to link the psyche with the soma, and finally to turn the attention towards the practical implications of the FFM. All this is done with the explicit motive of “selling” this theory as a reference point for future research and model-building within personality psychology.

PSYCHOMETRIC BACKGROUND FOR THE TRAIT APPROACH

An important aspect of every theory is the definition and measurement of the concepts. This section focuses hereon in order to make intangible psychological concepts operational and measurable. Thereby moving from abstract theory to concrete hypothesis.

A definition of personality trait

Within the trait approach, the personality trait (PT) is considered the primary level of analysis, which means that while other levels can be of relevancy, the PT is the main focus of interest. The following definition of PT is inspired by McCrae & Costa (1990, p. 23ff) as well as Saucier & Goldberg (1996, p. 244ff), and seeks to combine two views of the PT:

A personality trait: A latent attribute constituted of emotions, thoughts and behaviour.

This definition is best understood by elaborating backwards on it, starting out with 1) constituted of emotions, thoughts and behaviour, followed by 2) attribute and 3) latent.

- 1) *Constituted of emotions, thoughts and behaviour* means that PT is only concerned with that particular aspect of the human that relates to emotions, thoughts and behaviour. Focus is therefore on the mental life, as well as on how and why people feel, think and act as they do. Furthermore, PT is about preferences and dispositions for certain emotions, thoughts and behaviour, and not abilities like classical IQ (Jensen, 1998, p. 49ff).
- 2) *Attribute* is a quality or characteristic of a person (or an object), but does not state anything explicit about the causal nature of this (Saucier & Goldberg, 1996, p. 244ff). The word "attribute" is therefore explicitly chosen in order to try reconciling two diverging views of the PT, namely the causal disposition view and the categorical summary's view (Wiggins, 1997, p. 102ff). The casual disposition view conceptualizes PT as internal and genotypic characteristics residing in the person. The PT therefore determines the person's tendency for specific *emotions, thoughts and behaviour*. In this view, the PT is therefore the primary cause of the *emotions, thoughts and behaviour*. E.g. a person that yells and acts out does so because he has an "aggressive" PT, which causes him to show these tendencies for behaviour. Opposed to this view, the categorical summary's view deems PT to be nothing more than descriptive categories, and therefore not the actual cause of the specific *emotions, thoughts and behaviour*. PT does therefore not reside in the person but is only descriptive categories or abstract verbalizations of a person's *emotions, thoughts and behaviour*. E.g. a person that yells and acts out is described as aggressive, because this word sums up his typical tendencies.
- 3) *Latent* means hidden or not directly observable, and is common for both views on PT. Because PT is latent and not directly observable, it is necessary to infer PT from observable behaviour and thereby estimate the PT indirectly. The direct observation of manifest and concrete attitudes, habits, acts and feelings is the platform from where PT is inferred. PT therefore resides on a higher level of analysis than manifest and concrete attitudes, habits, acts and feelings. However, in order to estimate the more general tendencies for *emotions, thoughts and behaviour*, one needs to observe these lower level manifest and concrete attitudes, habits, acts and feelings. Whereas the manifest and concrete attitudes, habits, acts and feelings often change over time and situation, a PT is relatively stable across time and situation ($r=0.5-0.7$;

(Costa & McCrae, 1997; Bazana & Stelmack, 2004; Larsen & Winsløv, 2005) because the PT is a generalization of the manifest and concrete attitudes, habits, acts and feelings, namely what they have in common. In the same way as one can generalize from the concrete to the more abstract PT, one can also deduce from the PT to the concrete. The presence of a specific PT of a specific strength implies only a tendency for certain concrete attitudes, habits, acts and feelings but does not actually determine it or predict it with complete certainty.

In conclusion, PTs are attributes which either reside in the person or is a mere description of the person. The PTs are constituted by emotions, thoughts and behaviour, which cannot be observed directly. The PTs or latent attributes are therefore induced from the observation of manifest and concrete attitudes, habits, acts and feelings across time and situations, and are therefore also relatively stable. Vice versa, the presence of a PT can predict the tendency for specific manifest and concrete attitudes, habits, acts and feelings but not with complete certainty.

Identifying personality traits

The identification of all relevant PTs is of obvious importance in order to fully describe and explain the personality as seen from the FFM. Two different methods have been proposed in order to do so, namely the lexical and the non-lexical methods (McCrae & John, 1992, p. 181ff).

The lexical method views language as an invaluable source of information. It is argued that those individual differences, which are of most importance and socially relevancy will, in time, be incorporated into the language. Furthermore, the greater the significance of this individual difference, the greater is the likelihood of having this expressed in one single word (John, Angleitner, & Ostendorf, 1988, p. 174). Ergo, by investigating the natural language it is possible to identify all relevant PTs, which further has the advantage of making the description of the human personality accessible to all since no specific terminology is needed besides the ordinary language.

This method was originally proposed by Sir Galton. He collected more than 1,000 words describing the personality. It was later elaborated on by Klages (in 1926), Baumgarten (in 1933), Allport (in 1937), Cattell (in 1943), Norman (in 1963) and Goldberg (in 1982) (All in John, Angleitner, & Ostendorf, 1988, p. 174ff). All of them collecting and analysing the English language and grouping each word according to its meaning.

The lexical method is primarily descriptive and is therefore often closely tied up to the categorical summary's view of PT for obvious reasons, since proponents of this view focus on pure description as presented in ordinary language (Saucier & Goldberg, 1996, p. 24ff). However, the method for discovering all (relevant) PTs is, in principle, independent of the specific view on the PT as being causal or only descriptive, although some of the dominating theories link the "lexical/categorical summaris view" (Ibid) and the "non-lexical/casual disposition view" (McCrae & Costa, 2003).

The lexical method is not without its possible confounders as pointed out by John et al. (1988, p. 175). 1) It is questionable how objective and descriptive a PT derived from the language is, since ordinary language is used rather expressive and evaluative, and does therefore not meet a strict scientific standard. 2) The language varies between and within countries; it is therefore questionable whether a PT can be compared across countries and even within the same country due to different dialects and sub-cultures. 3) The language is also very specific for each subject and seldom clearly defined within subjects and never between subjects. 4) As a further criticism not addressed by John et al. (1988), one can add the fact that language and the use of language change over time, which raises the question whether the nature of PTs therefore also changes.

The non-lexical method has roots back to Jung (in 1923) and Murray (in 1938) (McCrae & John, 1992, p. 185) and later Eysenck & Eysenck (1991), Zuckermann (Joireman & Kuhlman, 2004), and Costa & McCrae (1992b). The method assumes that all (relevant) PTs can be identified either by imagination or by re-extraction of supposedly relevant PTs from existing theories. The downside of this method is the possibility that some PTs are redundant or only philosophically relevant. Although this method potentially recovers all (relevant) PTs throughout the recorded history of personality theory, it is by no means certain that all (relevant) PTs are discovered, since there could exist a PT that has not yet been recorded in any known theories.

In conclusion, it is impossible to guarantee that all (relevant) PTs have been discovered. Both methods have their advantages and disadvantages. Luckily, since the 1980'ies the two methods have collaborated, thereby creating an innovative and excellent platform for research in PTs, resulting in new and better ways to describe and explain PTs (McCrae & John, 1992, p. 186).

The mission of identifying all (relevant) PTs, and thereby trying to embrace all important aspects of personality can be considered a "differential strategy". A different strategy is the "integrative strategy" where the purpose is to reduce and simplify the complexity, by extracting the essence from the obtained information, namely all known PTs. The purpose hereof is to put forth a simple but more informtive model, which despite its lesser accuracy still contains the most impor-

tant aspects. Within the trait approach a reduction or distillation of the infinite number of PTs has resulted in a simple model that incorporates the majority of the diversity and complexity found for PTs.

A method for distilling PTs

One way of reducing the complexity is by applying the statistical method called "factor analysis" to data consisting of respondents rating their own PTs (or being rated). The principal idea of factor analysis is to distil the complexity among correlated variables, and thereby reducing the amount of information from "v" variables to "f" factors, where "v > f". The factors obtained from factor analysis are latent abstractions of the variables included in the analysis (which can be both latent and manifest variables). The factors emerging from the analysis are always dependent on the variables included in the analysis, meaning that 1) the extracted factors are always "coloured" / "flavoured" by the included variables and therefore never perfectly objective, 2) only factors with variance represented in the included variables will emerge, and therefore factors might remain hidden due to lack of representation in the specific data (Carroll, 1993, p. 597; Jensen, 1998, p. 57ff; Hartmann, 2005, for further elaboration on factor analysis). There are two other important aspects of factor analysis, namely 1) the number of extracted factors and 2) "factor indeterminacy".

- 1) There are several ways to estimate how many factors should be extracted from the analysis. However, none of these are perfectly valid. The main problem is the trade-off between reducing the complexity (e.g. few factors) and embracing the complexity (e.g. more factors). An analysis might suggest few factors, but perhaps it gives more semantic/psychological sense to include more factors. The issue of "number of factors" is therefore not only a statistical but also a semantic/psychological consideration with the common goal of achieving simple models with a lot of information.
- 2) Factors derived from factor analysis are indeterminate, which means that their position in hyperspace and their specific content are arbitrary (within the boundaries of the included variables). This means that there are an infinite number of factor solutions for a given number of extracted factors. The determination of the position of the factors and thereby their specific content is to a large extent a semantic/psychological question, rather than a statistical one.

The distilling of PTs

Fiske applied the method of factor analysis to the study of PTs in 1949 (Digman, 1990, p. 419) and found that the infinite number of PTs could be reduced to five factors or “super-traits”. This finding was consolidated soon hereafter by Tupes and Christal in 1961 (Tupes & Christal, 1992, p. 232ff & 244) and Norman (1963) followed by others. The empirical basis for the existence of five super-traits across age, sex, nationality (e.g. Digman, 1990; Costa & McCrae, 1992a; McCrae & John, 1992; Saucier & Goldberg, 1996; McCrae & Costa, 1997; Brody & Ehrlichmann, 1998; McCrae, Costa, Del Pilar, Rolland, & Parker, 1998; McCrae et al., 1999; Joireman & Kuhlman, 2004) has led to the term “Five-Factor Model” of personality (FFM) or “The Big Five”. Although these two terms are often used interchangeably, there is a slight difference. The term FFM is mainly used in the “non-lexical/casual disposition view” (McCrae & Costa, 2003), whereas the term Big Five is more related to the “lexical/categorical summary’s view” (Saucier & Goldberg, 1996, p. 24ff). However, both concepts deem five dimensions to be necessary and sufficient to describe PTs at the most general level. The pervasive research supporting the FFM/Big Five (later just FFM for both) is nicely summed up by the following quote by Digman & Takemoto-Chock (1981, p. 164f) “*Regardless of whether teachers rate children, officers rate one another, college students rate one another, or clinical staff members rate graduate trainees, the result is pretty much the same*”. However, the present support for a FFM does not exclude the possibility that other factors might emerge with time, due to the fact that neither the lexical nor the non-lexical method can guarantee that all (relevant) PTs have been identified. Furthermore, it must be kept in mind that the acceptance of new factors must comply to the following three demands. 1) The level of abstraction has to be the same for all factors (as opposed to just splitting one factor into several sub-factors). 2) Each factor has to be independent and uncorrelated with the other factors (if not they can be further reduced). 3) The factor has to be replicable across population and tests (McCrae & Costa, 1995, p. 457f).

One model vs. several models

Due to the fact that all factor solutions are indeterminate and that only factors having variance represented in the included variables can emerge; the number of different models is infinite and furthermore the specific content of the dimensions in the model is arbitrary. Two such models are presented below, namely the NEO PI-R and the ZKPQ. These models were chosen because of the pervasiveness literature where these tests have been employed.

Costa & McCrae's NEO-Personality Inventory-Revised (NEO PI-R) (Costa & McCrae, 1992b):

Neuroticism (N): Anxious, worrisome, vulnerable, pessimistic, depressive, bad-tempered.

Extraversion (E): Social, friendly, active, thrill/sensation seeking, optimists, assertive, outgoing, gregarious, talkative.

Openness to experience (O): Open to new impressions, tolerant, liberal, flexible, creative, imaginative, in contact with their feelings, novelty seeking.

Agreeableness (A): Altruistic, modest, trusting, empathic, compliant, polite.

Conscientiousness (C): Self-disciplined, ambitious, foresighted, responsible, orderly, conscientious, deliberate.

Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) (Joireman & Kuhlman, 2004):

Activity (ACT): Active, restless, need for challenging and complex tasks, vigorous.

Aggression Hostility (Agg-Host): Ill-tempered, aggressive, relentless, arrogant, hostile, confrontation seeking.

Impulsive Sensation Seeking (ImpSS): Impulsive, thrill/sensation seeking, spontaneous, novelty seeking, non-deliberate.

Neuroticism-Anxiety (N-Anx): Anxious, worrisome, vulnerable, insecure, low self esteem, fearsome.

Sociability (Sy): Social, outgoing, high need to be for other people, gregarious, party-loving, talkative.

Recently, the NEO PI-R has become a synonym for FFM, thereby indicating that FFM can only be measured by the NEO PI-R. This has the advantage that instead of operating with an infinite number of FFMs, one uses a specific model thereby creating a common language or taxonomy for research which in turn makes communication of ideas and findings more effective. In effect, creating a common metric for FFM. However, the disadvantage of using the NEO PI-R as the metric is that while it includes some PTs it is under-representing others, and furthermore, the theoretical foundation for the NEO PI-R is non-lexical/casual dispositional. A consequence hereof is that by using the NEO PI-R as the metric, one gets a selective and somewhat limited view of the FFMs, thereby potentially over-simplifying the complexity of the FFMs and the potential knowledge gained from a pluralistic approach to the FFMs. In conclusion, although a standardization of the FFM into one model like NEO PI-R has some advantages, it is a double-edged sword, and should only be done as long as one remembers that NEO PI-R is only "e pluribus unum" (one out of many).

Measuring PT

PTs are latent variables estimated through personality tests. Besides the obvious and conventional issues of reliability and validity for all tests (Jensen, 1980, p. 259ff, for more on this) the traditional self-rated test of PTs is faced with three other challenges (sometimes also applicable to other tests), that can limit the use of the tests measuring PTs.

These three challenges are related to: Introspection, careful/careless responding, and favourability/social desirability.

Introspection: A prerequisite of self-rated PTs is that the respondent has a well-developed ability to introspect. The respondent needs to be knowledgeable and aware of his own attitudes, habits, acts and feelings. Attempts made to ensure that the respondent's introspection is valid, is to let others rate the respondent either as a substitute or in order to compare the results. However, in order for this to work, the raters need to have intensive and correct knowledge of the rated respondent, which is not always the case. So although rating the respondent can provide extra information, it might in fact provide nothing at all, or even false information.

Careful/careless responding: Self-rated questionnaires are based on full concentration, ability to comprehend the questionnaire and participation of the respondent. If the respondent does not read or comprehend the questions or does not care about filling out the questionnaire, the obtained result might not be valid. Attempts to remedy this potential problem of careless responding are seen in the following three strategies:

- 1) **Rating of the respondent:** Letting others with knowledge of the respondent (see above) rate the respondent. However, this requires that the raters will rate carefully.
- 2) **Direct questions of carefulness:** One can ask the respondents (or the raters) whether they have read and understood the question and been thorough in answering them. However, if answering carelessly, there is no guarantee that these validity questions will be read, understood and answered carefully and correct.
- 3) **Indirect questions of carefulness:** Another strategy is to ask easy and obviously sensible or nonsense questions that have one clear answer, like "I am filling out a personality test right now". These indirect questions will test whether the respondent (or rater) is alert and thorough, however, some people find this kind of questions provocative. The applicability of these kind of questions are therefore a trade-off between catching the careless responders and not provoking the ordinary respondents.

Favourability/Social desirability: Self-rated questionnaires furthermore assume that the respondent answers the items truthfully, and does not try to present himself in a more favourable or social desirable way. As for the problem of careless respondents, the same three strategies as above can be employed, with some of the same limitations:

- 1) Rating of the respondent: Requires that the raters themselves do not rate in favourable or social desirable way. However, friends who have the best knowledge of the respondents, tend to rate their own friend more favourably (Borkenau & Ostendorf, 1989; Funder & Colvin, 1997). Alternatively a naïve rater could rate, but they might not have sufficient knowledge of the respondent. The use of raters is therefore a choice between a naïve objective rater and a knowledgeable subjective rater.
- 2) Direct questions of social desirability: One can ask the respondents (or the raters) whether they have presented themselves in a better way. However, if someone is trying to present himself more favourable, then the “alert faker” (or rater) would obviously answer “no” to this question.
- 3) Indirect questions of social desirability: One can also ask extreme questions that allegedly no human being could truthfully endorse, like “I always tell the truth”. These questions of “unlikely virtues” are in principle excellent. However, one cannot guarantee that the respondent (or rater), does not interpret the question less extremely. Simply because they deem the question to be unrealistic, and thus, something less extreme and more realistic must actually be meant by the question. If this is the case, the questions are not extreme enough to catch the liars. Furthermore, the problem of these “unlikely virtues” questions is that although they are very extreme, some people may in fact answer “yes” to these without lying. This would in turn mean that one would stigmatize the really virtuous people as liars, thereby achieving the exact opposite of what was intended (McCrae & Costa, 1983).

In conclusion, results obtained from any tests measuring PTs can be contaminated with confounders like lack of introspection, careless responding and social desirability. Despite these problems, these kinds of tests are in general valid and show predictive validity, and furthermore the best measuring instrument currently available.

These confounders are naturally unwanted but not invalidating in a research setting. The reason for this is that these confounders, on the population level, are “averaged out” which in turn “just” leads to lower correlations between selected variables. However, in a more practical or applied setting, the individual level is of interest as opposed to the population level. In these cases the previously men-

tioned confounders can invalidate the obtained results. The lack of introspection, careful responding and social desirability may result in less valid test results that in turn will affect the interpretation of the results. This would then in a clinical setting affect the determination of a diagnosis, and the subsequent intervention, or in a recruitment setting affect whether the specific applicant is deemed fit for the job and/or among the best applicants.

It is therefore necessary to remember that although tests of PTs in general are valid on the population level, they are not exact, and furthermore that the measurement error increases when going from the population level to the individual level. One must therefore always take the test result as an indication of the truth and not the truth itself.

Conclusion

Personality traits are latent attributes constituted of emotions, thoughts and behaviour. PTs might be the causal agent of emotions, thoughts and behaviour, but could just be descriptive verbalizations of these. The identification of all (relevant) PTs has been undertaken by two methods, namely lexical studies of the language and the non-lexical studies of past personality theories. Through the statistical method of factor analysis, the infinite number of PTs has been distilled to five factors, trait dimensions, or super-traits, that are necessary and sufficient to describe the personality (from the trait approach) at the highest level of abstraction (or analysis). This empirical finding has led to the term Five Factor Model or Big Five, which is a simple but informative model of personality traits. Tests of PTs are usually based on self-reported attitudes, habits, acts and feelings, which require that the respondent has knowledge of him- or herself and answers the test carefully and honestly.

BIOLOGICAL PERSPECTIVES OF THE TRAIT APPROACH

The last section gave insight into the psychometrics of the FFM. Psychometrics alone does not prove the existence of cause of a specific phenomenon; it only tells us that we can measure a certain concept. One way of tapping into the causal mechanisms behind the psychometric phenomenon is by linking psychometrics with biology. Linking biology and psychometrics is of particular interest because it might suggest a casual link between psyche and soma, and furthermore perhaps potentially find better ways of testing PTs, or perhaps reducing PTs to biology. The two ways of relating psychometrics to biology are at the genetic level and at the neurological/neuroendocrinological level.

The genetic basis for PT

This level of analysis attempts to link genotypes with phenotypes. This can either be done through the investigation of specific genes or through general estimates of heritability. The former is the ultimate goal but this research is only in its infancy, and will only be slightly mentioned in the next section (see below). The latter question of general heritability has been studied intensively using adoption-, twin-, sibling- and combined designs (Plomin & Daniels, 1987; Loehlin, 1992; Plomin, DeFries, McClearn, & Rutter, 1997) and the overall conclusion is that the heritability of the five dimensions as measured by NEO PI-R is around 0.3-0.5, which means that 30-50% of the phenotypic variance can be explained by genotypic variance. However, some (Brody & Ehrlichmann, 1998) believe that correcting these findings for confounders in the estimation of the super-traits would lend support to a heritability as high as 60-70%.

The remaining 30-70% of the phenotypic variance can be explained by the “non-shared environment” (environmental factors not shared by family members), and practically no variance can be explained by the “shared environment” (environmental factors shared by family members). This would indicate that the family environment has no systematic effect on the super-traits of the individual. However, this conclusion is built on the notion of “equal environment assumption” which states that parents treat children identically (Plomin & Daniels, 1987). However, this assumption is not 100% correct (Plomin & Daniels, 1987), and the shared family environment might therefore contribute to the total environmental (non-shared + shared) effect on the super-traits.

In conclusion, by linking genes with psychometrics, it is found that the super-traits have a moderate genetic basis. Although, we know that the environment has a moderate influence as well, there are currently no studies actually linking specific environmental factors within or between families to specific PTs, meaning that we have little idea of how the environment actually shapes the super-traits, only that it does!

Neurological/neuroendocrinological basis for PT

Giving the fact that the super-traits have a genetic basis, it is logical to assume that since genes shape neurological/neuroendocrinological structures and processes, there should be some linkage between psychometric and neurological/neuroendocrinological structures and processes as well.

This neurological/neuroendocrinological level of analysis focuses on neural structures and processes, as well as on hormonal activity in order to link psyche and soma. However, a correlation says nothing about causal direction, only about

co-variation among phenomena. Whether soma causes psyche or vice versa is not proven by a mere correlation.

The problem of investigating the neurobiology of PT, is the fact that there is no isomorphic (1:1) relationship between psyche and soma (Brody & Ehrlichmann, 1998, p. 115) which means that no single biological structure or process can fully explain a PT. It is therefore necessary to investigate several biological structures or processes to uncover the relationship between biology and psychometrics. This is further complicated by the complexity of the nervous system, especially the communication of neurons across the synaptic gap. This communication is dependent on various things, for instance; the amount of synthesized neurotransmitters in the cell, the amount of metabolized neurotransmitters in the cell, the amount of released neurotransmitters in the pre-synaptic neuron, the amount of re-uptake in the pre-synaptic neuron, the activity of any enzymes degenerating/metabolizing neurotransmitters in the synaptic gap, and the amount and sensitivity of receptors on the post-synaptic neuron. Studies linking biology and psychometric seldom include more than one or two of these aspects, and assume that the others are kept constant and that there is no interaction effect. This assumption might not be correct as shown by Reuter et al. (2005). For instance, an observed increase in the amount of neurotransmitters in the synaptic gap might be interpreted as an indication of increased activity of a specific system, but it could also be the system's homeostatic attempt to achieve equilibrium, by increasing the neurotransmitter in order to counteract e.g. an over-active degenerating enzyme, or perhaps few/insensitive post-synaptic receptors. The necessity of having a multi-factorial design including more biological variables in order to uncover any "psyche <-> soma link" becomes apparent. However, this is a cumbersome and pricy business and is unfortunately not often done.

Linking psychometric with biology

The links between soma and psyche are presented in table 1 below. The table is adapted from findings presented elsewhere (Geen, 1997; Brody & Ehrlichmann, 1998, p. 111ff; af Klinteberg, von Knorring, & Orelan, 2004; Brocke, 2004; De Pascalis, 2004; Hennig, 2004; Netter, 2004; Pickering, 2004; Rammsayer, 2004; Siegel, 2004; Reuter, Schmitz, Corr, & Hennig, 2005)

Table 1

Biological "System"	A higher baseline activity of the "system" is related to ...	A more stimulus/manipulation reactive/sensitive "system" is related to ...
	(+) Refers to more or a positive correlation (-) Refers to less or a negative correlation	(+) Refers to more or a positive correlation (-) Refers to less or a negative correlation
Endocrine/hormonal		
Cortisol A stress hormone protecting the body from continuous hyper reactive defence mechanisms	(+) Somewhat more depressiveness, anxiety, and irritable/neurotic aggression	(+) Irritability/neurotic aggression
	(-) Sensation seeking; Antisocial aggression	(-) Antisocial aggression; Depressiveness and anxiety High scores on Neuroticism are also less capable of adapting to changes in the cortisol system
Testosterone Male sex hormone Genetic link: Y chromosome	(+) Dominance; Self esteem; Sensation seeking; Sociability; Goal orientation; Self-rated aggression	(+) Self-rated aggression
	(-) Depressiveness	
Neurophysiological (Different neurotransmitters of which some also have a hormonal form)		
Adrenalin / epinephrine (A monoamine and catecholamine, but also found as hormone)	(+) Introversion; Impulsiveness; Aggression, Type A personality	(+) Aggression, Type A personality High scores on Extroversion also return faster to baseline level
	(-) Extroversion	
Noradrenalin/norepinephrine (A monoamine and catecholamine, but also found as hormone)	(+) Introversion; Sensation seeking; Aggression; Activity, alertness, neuroticism	(+) Aggression High scores on Extroversion also return faster to baseline level The NA synthesises system is more active and reactive while the actual receptors are less sensitive
	(-) Extroversion	(-) Sensation Seeking

Biological "System"	A higher baseline activity of the "system" is related to ...	A more stimulus/manipulation reactive/sensitive "system" is related to ...
Dopamine (A monoamine and catecholamine) Motor activity, motivation, reward Genetic link: DRD2 TaqIA	(+) BAS (Behavioural activation system)	Inconsistencies in whether a more reactive system is related to higher or lower levels of extroversion A relationship with high extroversion is supported by a positive correlation with motivation, sociability, sensation seeking, Parkinson, faster RT (reaction time) and MT (movement time) A relationship with low extroversion is supported by higher sensitivity of RT and MT as a consequence of dopamine manipulation as well as a lower general sensory threshold A possible explanation could be an interaction effect between receptor density, dopamine level, and enzyme activity (COMT/MAO)
	(-) BIS (Behavioural inhibition system)	
Serotonin (A monoamine) Related primarily to the inhibition system		(+) The NA syntheses system is less active/reactive, while the receptors are more sensitive
	(-) Anxiety; Depressiveness; Impulsiveness; Aggression	
Enzymes (Enzymes responsible for metabolizing neurotransmitters)		
MAO (Monoamineoxidase) Enzyme that degenerates/metabolizes monoamines in the cell Genetic link: AP-2	(+) Degenerates/metabolizes adrenalin, noradrenalin and dopamine as well as serotonin	

Biological "System"	A higher baseline activity of the "system" is related to ...	A more stimulus/manipulation reactive/sensitive "system" is related to ...
	(-) Impulsiveness; Aggressiveness; Sensation seeking; Boredom susceptibility; Smoking (could further decrease MAO activity); Type 2 alcoholism (e.g. early onset, consumption unrelated to stressful events)	
COMT (Catechol-O-Methyltransferase) Enzyme that degrades/metabolizes Catecholamines outside the cell. Genetic link: COMT Val158Met	(+) BIS; (Behavioural inhibition system); degrades/metabolizes adrenalin, noradrenalin and dopamine	
	(-) BAS	
Central and peripheral nervous system		
Evoked Response/potential		(+) Introversion
Heart rate (after a stimulus)		(+) Introversion
Skin Response (GSR) (after a stimulus)		(+) Introversion
Augmenters / reducers Augmentation or reduction of stimulus as function of increased stimulus intensity		Extroverts augments the stimuli while the Introverts reduces the stimuli
Movement Time (MT)	(+) Extroversion	(-) Extroversion

Conclusion

The findings presented above suggest a link between biology and psychometrics. Although it is very likely that the casual direction goes from biology to psychometrics, this has not been proven. Environmental effect can influence neurological/neuroendocrinological structures and processes, and even genes by activating or deactivating these, which in turn again leads to changes in the neurological/neuroendocrinological structures and processes. The biological link also supports "the casual disposition view", which states that PTs are casual agents of emotions, thoughts, and behaviour, since it is difficult to imagine how mere descriptive categories could show heritability and physiological correlates.

The present findings show a link between psyche and soma, and thereby anchor rather latent abstract psychological concepts in biological variables thereby indicating that PTs are not only psychological constructs but also biological in nature.

PRACTICAL PERSPECTIVES OF THE TRAIT APPROACH

One relevant feature of a model is to move from theory and psychometrics to the practical realm. Models should make us smarter about how the world is working and enable us to explain and predict real life phenomena, thereby making it possible to anticipate events and perhaps intervene.

The trait approach to personality has made this linkage, and the main findings are presented below. A thorough presentation of the results is beyond the scope of this article and therefore only the most essential is summarised in table 2 below from results reported elsewhere (Barrick & Mount, 1991; Tett, Jackson, & Rothstein, 1991; Costa & McCrae, 1992b; Furnham, 1992; Ones, Mount, Barrick, & Hunter, 1994; Tett, Jackson, Rothstein, & Reddon, 1994; Brody & Ehrlichmann, 1998; Furnham & Heaven, 1999; Judge, Higgins, Thoresen, & Barrick, 1999; Ball, 2004; Donohew, Bardo, & Zimmerman, 2004; Furnham, 2004; Gomá-i-Freixanet, 2004; Johnson & Vernon, 2004; Matthews, 2004; Schmitz, 2004).

Table 2

Area	Super-trait(s)
Integration	+E & -N immigrants are better integrated into society.
Smoking	Type I: Anxious stress related smoking. Type II: Aggressive and impulsive smoking.
Substance abuse	+ ImpSS increases risk of abuse.
Leisure sport preferences	+ImpSS are usually more active in the more dangerous sports.
Preferences for music	+ImpSS prefer more "up-beat" music as opposed to e.g. classical music.
Preferences for art	+ImpSS prefer more abstract and less naturalistic art.
School Grades	+E & +A obtain higher grades in traditional classroom teaching, whereas -E is an advantage at the university level and other forms of more independent studies. +C is general associated with better grades.
Learning style	-E subjects prefer "quiet" learning due to higher distractibility, whereas +E prefers somewhat "background noise".
Vocational interest	Several links, e.g. +O is associated with more creative vocational interest, whereas +A is linked to more nurturing vocations, and +E to sales.
General satisfaction	+E is related to more positive feelings. -N is related to less negative feelings.

Area	Super-trait(s)
Satisfaction with spouse	+O, +C, +A & -N are related to greater satisfaction as well as small relative difference in A, C and O between the spouses.
Creativity	+O is in general more creative.
Health	+C has less mortality; -N has less somatic complaints (although not actually more sick); -N & +E are less stressed and better at coping with stress.
Psychiatric disorders	Several links, e.g. Antisocial personality is associated with -C, -A, -N & +E; depression with +N & -E, Bipolar with +E & +N.
Therapy	+A & +C are more treatment compliant; and +E, +C & -N are likely to benefit more from interventions.
Length of formal education	+O & -N is related to more education.
Job training	+C & +O benefit more from job training.
Job competence	+C & -N are in general better and more efficient employees.
Job status	+C, +E & -N usually have higher job status.
Income	+C & +E often make higher earnings.

It is apparent from table 2 that the applicability of the FFM is pervasive. This is of special interest for some areas. For instance in career counselling, personality assessment can be very useful for helping each individual in getting on to the most optimal vocational path in relation to his personality. In recruitment and HRM, personality assessment can help identifying the potentially better employee and also which employee will benefit most from different learning courses. Also in the clinical realm, personality assessment can help diagnose patients and plan intervention programs. This knowledge obtained through personality assessment can therefore help to shape and change lives for the better, both for the individual and for society in general.

CONCLUSION

The present article describes the FFM of personality, which has gained massive foothold, due to the substantial research supporting five broad dimensions of personality traits. These dimensions are at the highest level of abstraction and considered to be necessary and sufficient to provide a general description of the human personality traits. The five dimensions are in principle arbitrary but the NEO PI-R has in recent years become the conventional metric for FFM, which has its advantages and disadvantages. Research suggests that these five broad dimensions have a moderate heritability and important physiological correlates, thereby linking psychometrics with biology indicating a causal link, although not proving it. Furthermore, the FFM has shown to be applicable in the practical realm, by showing relevant correlates between subjects' scores

on the five dimensions and real life behaviour, like smoking, education, job performance.

This “trinity” of psychometrics, biology and practical applicability shows the usability of the FFM. The model does not claim to encompass all aspects of the personality but illuminates some of the important ones. One could hope that future research within personality would address this “trinity” for other personality theories as well, in order to reach a better and fuller understanding of personality than one perspective alone can give (either psychometric, biology or practical). Furthermore, future research should try linking different approaches to personality with each other in order to reconcile different personality theories and thereby potentially encompass all important aspects of personality. The FFM is here a good reference point, since the “trinity” is already present, proving the usefulness of this conceptualization of personality. It is often argued that the epoch for “grand theories” has passed but the psychometric, biological and practical basis for the FFM, suggests that the FFM can provide a framework for future personality research and for linking other personality theories in order to establish a “grand theory” of personality as attempted by some (McCrae & Costa, 2003).

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