



Relationship between Cattell's 16PF and fluid and crystallized intelligence

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ARTICLE INFO

Article history:

Received 3 December 2010
Received in revised form 3 March 2011
Accepted 9 March 2011
Available online 3 April 2011

Keywords:

16PF
Fluid intelligence
Crystallized intelligence

ABSTRACT

The aim of the study was to explore the relationship between the five global factors and 16 dimensions of Cattell's personality model and fluid and crystallized intelligence. A total of 105 third graders (45.7% males) of three high schools participated in the research. Fluid intelligence was measured by Raven's Advanced Progressive Matrices and crystallized intelligence was measured by the Mill Hill Vocabulary Scale. Personality traits were measured by the Sixteen Personality Factor Questionnaire. Anxiety is correlated neither with fluid nor with crystallized intelligence. Extraversion and Self-Control are negatively correlated with fluid intelligence whereas Tough-Mindedness is positively correlated with it. Independence is positively correlated with crystallized intelligence and Tough-Mindedness is negatively correlated with it. Regression analysis reveals that all broad personality factors, except anxiety, are significant predictors of fluid intelligence. When combined together, these factors account for 25% of the variance of fluid intelligence scores. The regression model with crystallized intelligence as a criterion variable is not statistically significant. The study results are consistent with the Chamorro-Premuzic and Furnham's (2005) two-level conceptual framework. Although using a different taxonomy of personality, the results are in accordance with the model's presuppositions.

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1. Introduction

In the 1990s, interest in research on the relationship between intelligence and personality was revived, especially after more detailed analyses of the correlation as interpreted by Saklofske and Zeidner (1995) and Sternberg and Ruzgis (1994), Ackerman and Heggstad's meta-analysis of the interconnectedness of personality constructs and intelligence (1997) and particularly after leading authors in individual differences psychology reached a consensus in regards to the organisation of intellectual abilities and personality structures. Chamorro-Premuzic and Furnham (2004), Chamorro-Premuzic and Furnham (2005) proposed a framework for interpreting the relationship between intelligence and personality traits. Their two-level conceptual framework is based on the Big-Five personality model and concepts of fluid and crystallized intelligence. This study is aimed at testing the basic assumptions of the Chamorro-Premuzic and Furnham conceptual framework with Cattell's model of 16 personality factors as a foundation for the operationalisation of personality traits.

The majority of theoreticians believe that intelligence is hierarchically organised with a general factor on top which can account for the individual differences in the subordinated factors (Carroll 1993; Gustafsson, 1988). One of the most influential theories of intelligence is Cattell's theory of fluid and crystallized intelligence.

Fluid intelligence refers to the processing of information and the ability to reason with the aim to understand relationships and abstract propositions (Stankov, 2000), whereas crystallized intelligence refers to the acquisition, storing, organisation and conceptualisation of pieces of information (Chamorro-Premuzic & Furnham, 2005). In the field of personality psychology, the Big-Five personality framework dominates the trait approach to personality. According to the Big Five model, personality traits can be organised within five broad and basic dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience. These fundamental dimensions are personality dispositions that allow us to understand the consistency of an individual's thinking, feeling and behavior, relatively independent of the situation, context and time (Chamorro-Premuzic & Furnham, 2005).

In studies of the relationship between intelligence and personality traits the most frequent results are low to moderate coefficients of correlation between intelligence and the Big Five dimensions. The correlation between Openness to Experience and intelligence is moderate and positive (Ackerman & Heggstad, 1997; Austin et al., 2002; Chamorro-Premuzic, Moutafi, and Furnham, 2005). Furthermore, studies point to a low and negative correlation between Conscientiousness and intelligence (Ackerman & Heggstad, 1997; Austin et al., 2002; Moutafi, Furnham, & Crump, 2003) whereas the correlation between Neuroticism and intelligence is usually negative (Ackerman & Heggstad, 1997; Austin et al., 2002). The results of research on the correlation

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between Extraversion and intelligence are inconsistent; in some studies the authors report a positive correlation (e.g. Ackerman & Heggstad, 1997), while other researchers report a zero correlation (e.g. Austin et al., 2002), and even a negative correlation (Austin et al., 2002). Of the Big Five personality traits, Agreeableness is the least correlated with intelligence. Ackerman and Heggstad (1997) determined positive, low and statistically insignificant coefficients of correlation between Agreeableness and intelligence. However, a meta-analytical study by Austin et al. (2002) found low, negative, statistically significant correlations.

Chamorro-Premuzic and Furnham (2004), Chamorro-Premuzic and Furnham (2005) proposed a two-level conceptual framework for understanding the results found in investigations of the relationship between the five broad personality traits and fluid and crystallized intelligence. The first level of the model refers to the ability as test performance output (measured directly) and to the effects of Neuroticism and Extraversion on the results of intelligence testing. The negative effects (anxiety, worry, tension, depression, anger) interfere with the cognitive processes needed for an efficient solution of a problem (Chamorro-Premuzic & Furnham, 2005). On the other hand, the correlation between Extraversion and intelligence depends on the nature of the intelligence test (Chamorro-Premuzic & Furnham, 2005). Extraverted persons were more successful in time-limited tests, while the introverts were more successful in those tasks that were not time-limited and needed introspection. Eysenck and Eysenck (1985) explained such a correlation between Extraversion and intelligence by a theory of arousal. According to this theory introverts have a lower reactive inhibition due to which they display a tendency to avoid arousal stimuli, unlike extraverts who show a tendency towards the arousal stimulus. The second level of the model refers to the abilities as a capacity (i.e., they cannot be measured directly) and to the conceptualisation of the correlation between Conscientiousness and fluid intelligence on one side and Openness and crystallized intelligence on the other side. Considering the long-term effects of Conscientiousness and Openness on the development of intellectual abilities, Chamorro-Premuzic and Furnham (2005) refer to these two traits as the “investment traits”. In two studies (Moutafi, Furnham, & Paltiel, 2005; Moutafi et al., 2003) a negative correlation between Conscientiousness and intelligence was determined. In order to explain such results the authors proposed a compensation hypothesis, according to which comparatively lower capability in competitive surroundings is compensated with higher levels of Conscientiousness. Besides, it is possible that intelligent individuals do not become more conscientious over time because they rely on abilities that are sufficient for the execution of every-day cognitive tasks. The positive correlation between Openness and crystallized intelligence is expected, considering the fact that Openness is associated with intellectual curiosity, lively imagination and flexibility in behavior (McCrae & Costa, 1997) which could lead to the higher intellectual involvement and knowledge acquisition.

Chamorro-Premuzic, Furnham, and Petrides (2006) tested the basic premise of the two-level model using Eysenck’s personality model. They explored the correlations between Eysenck’s personality dimensions operationalised by Eysenck’s Personality Profiler (EPP; Eysenck, Barrett, Wilson, & Jackson, 1992) as Emotional Stability, Introversion, Caution (low Psychoticism) and Dissimulation and verbal and numeric abilities. The results show that Emotional Stability and Extraversion are positively associated with verbal abilities, while there was no correlation found between the two personality dimensions and numeric ability. Moreover, they found a negative correlation between Caution and numeric abilities. Overall, the results found were consistent with the two-level model.

In regards to the conceptual and componential similarities between the Big Five and Cattell’s five global dimensions it seems

interesting to evaluate certain premises of the two-level model using Cattell’s model of 16 personality factors. Based on the two-level conceptual framework (Chamorro-Premuzic & Furnham, 2005), and in consideration of the fluid and crystallized intelligence functions, it could be assumed that Anxiety and Extraversion should be in negative correlation with the results on the fluid and crystallized intelligence tests. In consideration of the fact that fluid intelligence refers to the processing of information and ability to reason and that it is linked with the capacity and efficacy of working memory, solving fluid memory test tasks requires greater cognitive endeavor than solving crystallized intelligence test tasks. Thus, we expect a greater negative correlation between Anxiety and fluid intelligence than between Anxiety and crystallized intelligence. Since fluid intelligence tests are not time constrained, and thus more suited to introverts, we expect a negative correlation between Extraversion and fluid intelligence. Furthermore, Self-Control should be in negative correlation with the fluid intelligence test scores, whereas Independence will be in positive correlation with the crystallized intelligence test scores. Self-Control is conceptually similar to the dimension of Conscientiousness, whereas Independence is similar to the dimension of Openness in the Big Five model. We can predict Tough-Mindedness to be in positive correlation with the fluid intelligence test results. This general factor Cattell named “Corteria”, which is shortened from “cortical alertness” and described those individuals who achieve high results in this factor as alert and prone to dealing with problems in a cognitive manner (Cattell, Eber, & Tatsuoka, 1970).

2. Method

2.1. Participants

The study was conducted on a group of 105 students of the third grade of three high schools in Sarajevo, Bosnia and Herzegovina. Of the total number of participants 45.7% were males. Average age of the participants was $M = 17.26$ ($SD = 0.94$).

2.2. Measures

Raven’s Advanced Progressive Matrices (Raven, Raven, & Court, 1998) measure fluid intelligence. They represent a non-verbal test for the evaluation of the ability to understand complex situations, find meaning in events and of rational perception and thinking. According to Carpenter, Just, and Shell (1990) Raven’s Progressive Matrices measure analytical intelligence, that is the ability to reason and produce a solution for problems involving new pieces of information, without extensive use of an explicit store of declarative knowledge. They consist of two parts. Series I contain 12 items used for practice and lowering test anxiety. Series II consists of 36 items presented in ascending order of complexity (i.e. from easiest to hardest). Work-time is not limited.

Mill Hill Vocabulary Scale (Raven, Court, & Raven, 1994) is a companion measure to the Standard Progressive Matrices and assesses reproductive ability, that is, being able to master, recall and reproduce verbal information. It consists of 68 items divided into two segments: Series A (gap filling) and Series B (selection of the correct answer from several offered). The Mill Hill Vocabulary Scale allows the assessment of the ability to store and recall information and knowledge that is accumulated over time by the individual from experiences at home, school, or in the environment and therefore is based on the extensive use of declarative knowledge. With regard to definition of crystallized intelligence (Stan-kov, 2000) crystallized abilities are typically measured by a vocabulary test.

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