



Openness to Experience, fluid intelligence, and crystallized intelligence in middle-aged and old adults

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ABSTRACT

The present study examined the associations between three aspects of Openness to Experience (Intellectual Interests, Aesthetic Interests, and Unconventionality) and two broad cognitive domains (fluid and crystallized intelligence) in a large middle-aged and old adult sample. Results show that both the measurements of Openness and intelligence were strongly invariant across age groups. Older adults were less intellectually interested and described themselves as more conventional. In both age groups, Aesthetic Interests exerted a small negative effect on fluid and crystallized intelligence while Unconventionality had a positive effect. Moreover, the positive effect of Intellectual Interests was stronger in the older age group. These findings indicate that Openness–intelligence relations depend on the aspect of Openness and on the cognitive domain examined.

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1. Introduction

The present study investigated the relations between two broad domains of psychological research, namely personality and intelligence. Personality traits and intellectual abilities have traditionally been seen as largely distinct domains. More recently, however, there is a renewed scientific interest concerning the relation between personality and intelligence as reflected by a growing number of research studies (Ackerman & Heggestad, 1997; Chamorro-Premuzic & Furnham, 2004). One particular personality trait that has been suggested to lie at the core of a possible personality–intelligence link is Openness to Experience, which reflects a person's willingness to explore, consider, and tolerate new experiences, ideas, and feelings. On the intelligence side, fluid and crystallized intelligence have often been examined in conjunction with personality. Fluid intelligence denotes the ability to acquire new knowledge, whereas crystallized intelligence captures the amount of already acquired knowledge (cf. Horn & Hofer, 1992). It has been found that Openness to Experience typically relates more strongly to crystallized intelligence, with correlations being around .35 (e.g., Goff & Ackerman, 1992), than with fluid intelligence, where correlations are usually around .15 (e.g., Chamorro-Premuzic, Moutafi, & Furnham, 2005).

Research on the Openness–intelligence relation has almost exclusively been conducted in samples of young adults (but see Baker & Bichsel, 2006). From a developmental perspective, however,

one may wonder whether the strength of association between Openness and intelligence remains unaltered across different age groups or whether it changes systematically with age. As we will lay out in the following, based on the investment hypothesis (Cattell, 1963) there are reasons to expect that the link between Openness and intellectual functioning, especially crystallized intelligence, becomes stronger in older adults (cf. Ackerman, 1997; Chamorro-Premuzic & Furnham, 2004; Hofer & Sliwinski, 2001; McCrae, 1987). In order to examine this issue empirically, we first investigated whether the measures of Openness and intelligence, both being conceptualized as latent variables, were invariant across two adult age groups (middle-aged adults and old adults) sampled in the present study. Openness to Experience was differentiated into three item clusters, namely, Aesthetic Interests, Intellectual Interests, and Unconventionality (cf. Chapman, 2007; Saucier, 1998). Second, after having established strong measurement invariance, we examined the covariances among the latent Openness and intelligence variables and tested whether they were of equal size in the two age groups. Finally, we conducted a commonality analysis in order to decompose the unique and common portions of the three Openness item clusters, fluid intelligence, and crystallized intelligence.

1.1. Openness to Experience

Openness to Experience reflects one of the five fundamental dimensions of personality (McCrae, 1993–1994). Broadly, it refers to individual differences in the proneness to be original, complex, creative, and open to new ideas (cf. John & Srivastava, 1999). As such, it includes a motivational component, which is based on a

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general interest in novelty, complexity, and tolerance of ambiguity. In addition, it contains a cognitive component, which refers to the manner in which information is processed and organized. According to Costa and McCrae (1995), Openness to Experience is composed of six facets: Fantasy (a tendency toward a vivid imagination and fantasy life), Aesthetics (a tendency to appreciate art, music, and poetry), Feelings (being receptive to inner emotional states and valuing emotional experience), Actions (an inclination to try new activities, visit new places, and try new foods), Ideas (a tendency to be intellectually curious and open to new ideas and an active pursuit of intellectual interests for their own sake), and Values (a readiness to re-examine traditional social, religious, and political values). Although the conceptualization of Openness and, hence, its label have been the subject of some scientific debate (cf. McCrae & Costa, 1997), in the present study we use the term “Openness to Experience” throughout, because we administered the scale with the same name from the NEO-FFI (Costa & McCrae, 1992b).

A common assumption is that Openness to Experience as a personality trait refers to an enduring pattern of thoughts, feelings, and behaviors. However, there is both cross-sectional and longitudinal evidence for small, but systematic age changes or age-related differences in personality traits at various ages (e.g., Allemand, Zimprich, & Hendriks, 2008; Allemand, Zimprich, & Hertzog, 2007; Allemand, Zimprich, & Martin, 2008; Roberts, Robins, Caspi, & Trzesniewski, 2003; Roberts, Walton, & Viechtbauer, 2006; Terracciano, McCrae, Brant, & Costa, 2005). With respect to Openness to Experience, Roberts et al. (2003) concluded that cross-sectional studies show a slight decrease with age across adulthood (e.g., Costa et al., 1986; McCrae et al., 1999). For example, in a large sample of Internet users aged 21–60 years, Openness to Experience showed a small decline with age (Srivastava, John, Gosling, & Potter, 2003). Srivastava et al.'s findings were similar to those reported in McCrae et al.'s (1999) multi-national studies with a total sample size of over 12,000 adults, where, across cultures, the median correlations of age with Openness to Experience was -0.08 . Recently, in a sample of Medicare patients aged 65–100 years, Weiss et al. (2005) reported a similar negative correlation between age and Openness to Experience ($r = -.07$). Longitudinally, Roberts et al. (2006) demonstrated that, on average, people show increases in Openness to Experience in the college years. During adulthood, Openness to Experience remains largely unchanged, but declines slightly after the age of 60. A similar picture emerged from studies focusing on adulthood and old age. For example, across a 6-year longitudinal time span Small, Hertzog, Hultsch, and Dixon (2003) found a moderate decline in Openness for adults initially aged 55–85 years. Likewise, Schaie, Willis, and Caskie (2004) reported a modest longitudinal increase of Openness to Experience until age 46, a plateau until the late sixties, and a modest decline thereafter. Terracciano et al. (2005) offered a more differentiated picture of the developmental trajectory of Openness to Experience by examining the six facets of Openness (cf. Costa & McCrae, 1995). Following the general trend, the facets Openness to Values, Openness to Feelings, and Openness to Actions showed a small linear decline from age 30 to 90. By contrast, the remaining three facets of Openness, i.e., Openness to Aesthetics, Openness to Ideas, and Openness to Fantasy, exhibited almost no decline, on average. These latter findings indicate that merely considering Openness as a whole might result in an overly simplified picture of age-related changes in Openness.

1.2. Openness to Experience and intelligence

A possible relation between Openness to Experience and intelligence has been investigated in a number of studies during the last years. Typically, it was found that Openness to Experience shows

substantive correlations with measures of intelligence (e.g., Chamorro-Premuzic et al., 2005; Goff & Ackerman, 1992; Moutafi, Furnham, & Crump, 2003). Specifically, in adult samples, Openness to Experience has been shown to relate to general intelligence with correlations ranging from about $r = .15$ (Moutafi et al., 2003) to $r = .42$ (Holland, Dollinger, Holland, & MacDonald, 1995). In a meta-analysis based on 135 studies, Ackerman and Heggstad (1997) examined a variety of personality and intelligence measures regarding their intercorrelations. Distinguishing between fluid and crystallized intelligence, the authors found that Openness correlated weakly with fluid intelligence ($r = .08$), while the association with crystallized intelligence was moderate ($r = .30$). Recently, Ashton and colleagues (2000) applied the Multidimensional Aptitude Battery to assess fluid and crystallized intelligence and the Personality Research Form scales to measure Openness in a sample of 508 adolescents and adults. They reported that Openness correlated $r = .18$ with fluid intelligence and $r = .37$ with crystallized intelligence. While a number of studies have found that Openness is a strong predictor of crystallized intelligence but only weakly related to fluid intelligence (e.g., Bates & Shieles, 2003; Costa & McCrae, 1992a), in some studies crystallized and fluid intelligence did not differ in their relation to Openness to Experience (e.g., Austin, Deary, & Gibson, 1997; Holland et al., 1995; McCrae, 1993–1994). Notwithstanding, the typical finding appears to be that, in adult samples, Openness is weakly correlated with fluid intelligence, while correlations with crystallized intelligence are in the medium range (r s being around $.35$) (Ackerman & Goff, 1994; Goff & Ackerman, 1992; Rocklin, 1994).

Studies that distinguished between the facets of Openness to Experience and their relations to intelligence are scarce. Regarding general intelligence, the facet Openness to Ideas repeatedly emerged as a significant predictor (Harris, 2004; Moutafi et al., 2003). Goff and Ackerman (1992) found that Openness for Ideas explained 10% of variance in crystallized intelligence, but only 2% in fluid intelligence. By contrast, Openness for Values and Openness for Aesthetics explained 2% and 3% of variance in crystallized intelligence, respectively (cf. Ackerman & Goff, 1994). Focusing on fluid intelligence, Moutafi, Furnham, and Crump (2006) showed that the two facets Openness to Ideas and Openness to Actions were positively correlated with fluid intelligence (r s = $.20$, $.07$, respectively). In sum, it appears that the facet Openness to Ideas is associated with both fluid and, in particular, crystallized intelligence.

In order to account for the Openness–intelligence associations reported above, Chamorro-Premuzic and Furnham (2004) have recently argued that some personality traits may play a significant role in the process of skill acquisition in that they may influence choices to engage or invest in particular domains of knowledge. Hence, Openness to Experience might lead to engaging in intellectually beneficial activities, which, in turn, may strengthen the development of intellectual abilities, particularly crystallized intelligence. Similar arguments have been offered by Ackerman (1994, 1996), who emphasized the role of non-ability attributes in the development of intelligence. Based on the assumption that fluid intelligence is cumulatively invested into specific domains of knowledge and, ultimately, transforms into crystallized intelligence, the intensity and direction of fluid intelligence investment over a longer period of time may be determined by motivation, interests, and personality traits, e.g., Openness to Experience (Ackerman, 1994, 1996; Ackerman & Heggstad, 1997). This rationale is inspired by Cattell's (1963) investment hypothesis, which posits that fluid intelligence turns into crystallized intelligence by continuously being directed into specific areas of knowledge. As outlined in his triadic theory, Cattell (1987) posited that for channelling fluid intelligence, personality plays an important role, along with specific training and experience. Specifically, the variety of exposure, the time and energy spent, the reinforcement schedules in

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