

***PERSONALITY TRAITS AND INTELLECTUAL COMPETENCE: THE
RELATIONSHIP BETWEEN PERSONALITY TRAITS, ACADEMIC
PERFORMANCE, PSYCHOMETRIC AND SUBJECTIVELY-
ASSESSED INTELLIGENCE***

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NUMBERING

AS ORIGINAL

For My Parents

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Abstract

This thesis concerns the relationship between personality traits and intellectual competence. It contains five chapters and ten independent but related empirical studies.

Chapter one presents a review of the salient literature in the area. It is divided into three sub-sections: personality and psychometric intelligence, personality and academic performance (AP), and personality and subjectively-assessed intelligence (SAI).

Chapter two (studies 1 to 4) examines the relationship between the Big Five personality traits with several psychometric intelligence tests, SAI, and gender. Results indicated that personality traits (notably Neuroticism and Agreeableness) are significantly related to SAI, but not to psychometric intelligence. Since SAI is also significantly related to psychometric intelligence, it is suggested that SAI may mediate the relationship between personality and psychometric intelligence.

Chapter three (studies 5 to 8) examines the relationship between psychometric intelligence and personality (the Big Five and the Gigantic Three) with AP. Results indicate that personality traits (notably Conscientiousness and Psychoticism) are significant predictors of AP, accounting for unique variance in AP even when psychometric intelligence and academic behaviour are considered as predictors.

Chapter four (studies 9 & 10) looks at the relationship between personality and psychometric intelligence with a measure of art judgement as well as several indicators of previous art experience. Results indicate that art judgement is related to both personality and intelligence, and may therefore be considered a mixed construct.

Chapter five presents a brief summary of the results and conclusions.

Note: Study 8 has been published in *Social Behaviour and Personality*, 2002, 30, 807-813. Study 7 has been accepted for publication by the *European Journal of Personality*. Study 6 has been accepted for publication by the *Journal of Research in Personality*. Study 10 has been accepted for publication by *Personality and Individual Differences*. Currently another five studies are under editorial review: studies 1 and 2 by the *Journal of Personality*, study 3 by the *Journal of Personality Assessment*, study 4 and study 9 by the *British Journal of Psychology*.

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Chapter 1: Review of the Salient Literature

1.1 Overview

Despite more than a century of psychological research into intellectual ability, the question of whether and why some people are more intellectually competent than others has remained constantly debated. Nevertheless, intelligence has undoubtedly become one of psychology's most popularised concepts and the use of IQ tests has, albeit with constant criticisms, become a well-established and widely used method for the prediction of human performance across a variety of occupations and settings (Brody, 2000; Jensen, 1980; Zeidner & Matthews, 2000). Although the predictive validity of these tests has clearly justified their use, it has also undermined the importance of non-cognitive individual differences underlying intellectual competence, leading to the idea that intellectual performance is a direct and simple function of intellectual ability (see Ackerman, 1994; Snow, 1992).

However recent research by Ackerman and his colleagues (e.g., Ackerman, 1996, 2001; Ackerman & Beier, 2003; Ackerman & Heggestad, 1997; Goff & Ackerman, 1992) has suggested that non-cognitive traits such as personality do play an important role in the development of adult intellectual competence and of performance on intelligence tests. Furthermore, recent studies suggest that IQ test performance may be influenced not only by a person's ability but also by his/her personality traits (Ackerman & Heggestad, 1997; Austin, Deary, Whiteman, Fowkes, Pedersen, Rabitt, Bent & McInness, 2002; Rindermann & Neubauer, 2001; Zeidner & Matthews, 2000).

There are important recent reviews that look at the relationship between personality and ability test performance (notably Zeidner & Matthews, 2000). It is

however argued that, in order to understand the importance of personality traits with regard to intellectual competence, it is necessary to examine not only ability tests but also other indicators of intellectual competence, such as academic performance and subjectively-assessed intelligence. Hence this review, is divided into three sections, according to whether it will examine the literature on the relationship between personality traits and psychometric intelligence (1.2), academic performance (1.3), or subjectively-assessed intelligence (1.4).

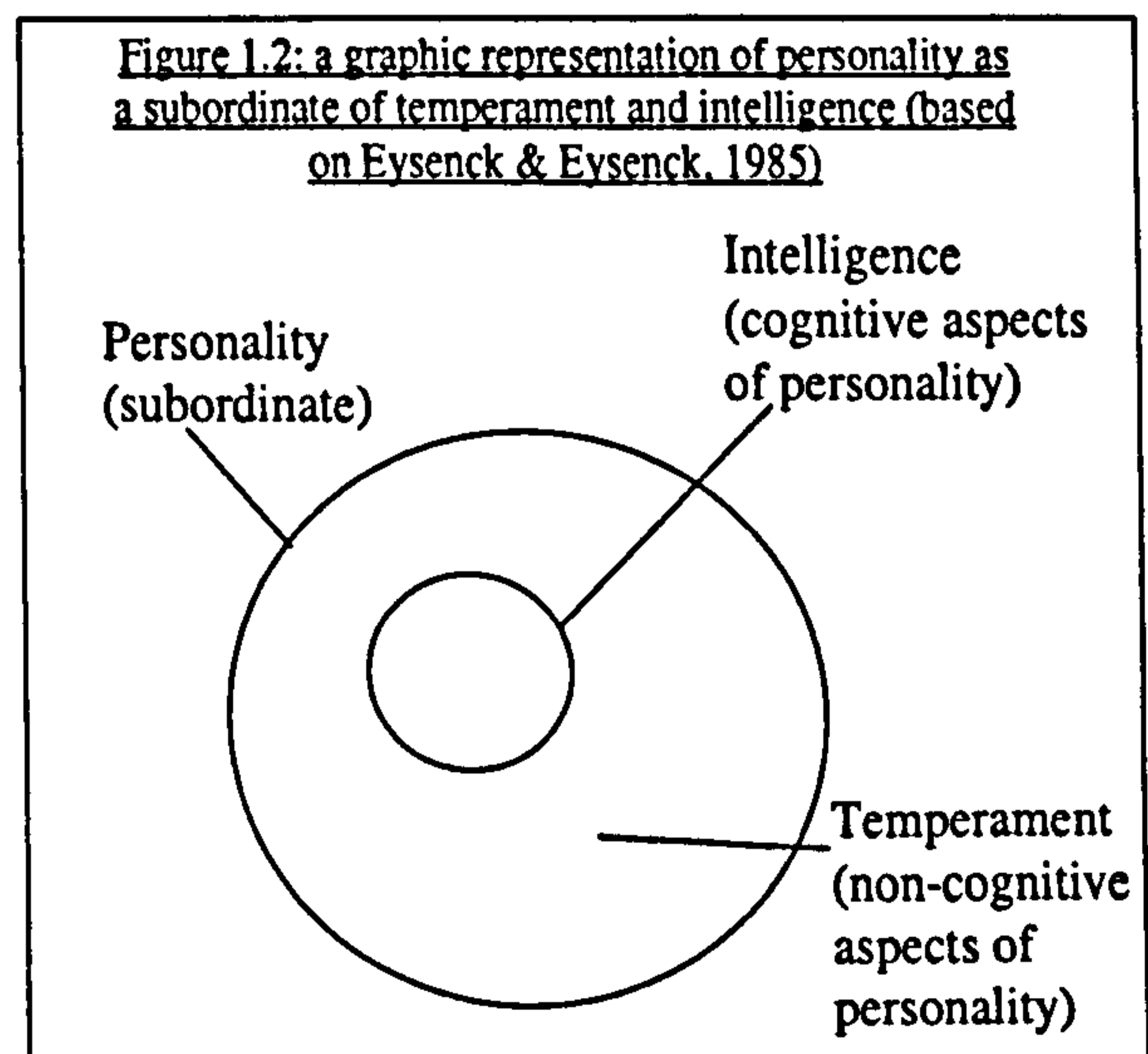
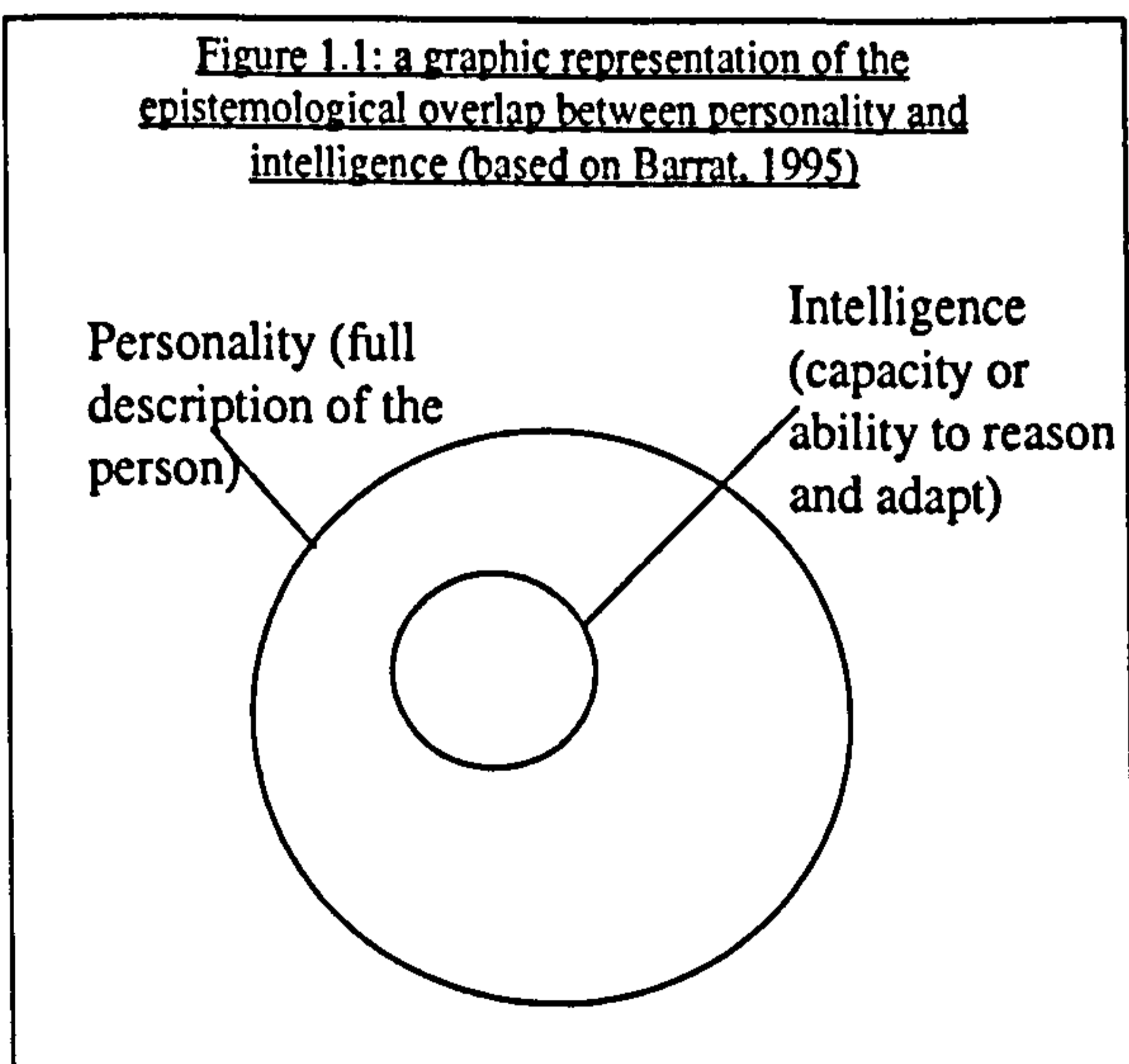
1.2 Personality traits and psychometric intelligence

Although in the history of research into personality and intelligence most researchers have treated the two constructs as relatively independent (Eysenck, 1994a; Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000), both areas have developed primarily in the context of individual differences research. Personality theory aimed at providing a parsimonious description of individuals and the mechanisms and processes which account for different behavioural patterns between and within individuals, while intelligence research aimed at specifying, describing, explaining and measuring the cognitive capacity to adapt to environmental demands (Barratt, 1995).

It has been noted that the link between personality and intelligence is present in the very conceptual structure of both constructs, in the sense of an implicit epistemological overlap: personality and intelligence both concern stable individual features among which people differ (Barratt, 1995; Stankov, Boyle & Cattell, 1995). More specifically, the concept of intelligence appears to comprise traits that are also part of personality, but not vice versa (although it will be seen that traits such as Openness to

Experience and Typical Intellectual Engagement may be exceptions to this rule). Since personality supposedly comprises (all) stable individual differences between individuals (a full description of the person) and intelligence involves (only) individual differences in cognitive capacity/ability, it seems evident, at least conceptually (and certainly from a lay perspective), that intelligence is part of personality. That is, the capacity or ability to reason and adapt is an important feature in the description of a person (see Figure 1.1).

Alternatively, Eysenck and Eysenck (1985) distinguished between temperament and intelligence, to refer to the non-cognitive and cognitive aspects of personality, respectively: “We thus have a subordinate term, *personality*, subdivided into *temperament*, the non-cognitive aspects of personality, and *intelligence*, the cognitive parts of personality”(p.159)(see Figure 1.2). Although this version seems very akin to that in Figure 1.1, it emphasises the differences – rather than the similarities – between intelligence and personality (temperament). However Eysenck and Eysenck’s (1985) conception of temperament as the non-cognitive aspects of personality has not gained sufficient recognition and most experts in the field of individual differences seem to have



focussed on personality rather than temperament. As a consequence, personality and intelligence have resulted in independent areas of research (see Cronbach, 1949), and distinctions between personality and intelligence have therefore been based on methodological rather than epistemological grounds.

Following Cronbach (1949), the constructs of personality and intelligence may be conceptualised and differentiated in terms of their respective assessment methods. Measures of *maximal* performance comprise items with correct and incorrect answers, which the respondent needs to solve as problems. Hence there is an objective answer for each item. Measures of *typical* performance comprise items that refer to the respondent's behaviour, attitudes, feelings or thoughts, and are answered through a Likert scale (e.g., according to the extent that participants agree or disagree with each statement). As such, typical performance is assessed through self-reports or preferences rather than problem solving or power measures, and is scored not in one but in two directions (i.e., answers are neither correct nor incorrect but can be representative of one type of trait as much as its opposite).

Table 1.1 presents a few sample items for typical/self-report and maximal/objective questions. Cronbach's methodological distinction is useful to illustrate the differences in measurement approach between intelligence (maximal performance) and personality (typical performance). It should be noted that this applies to most, but not all, personality and intelligence measures since there have been (rather original) attempts to "swap" assessment criteria and measure personality through objective tests (Boyle, 1985; Cattell, 1987; Schmidt, 1988; Schuerger, 1986) and assess intelligence

through self-report inventories (see Hofstee, 2001 for a discussion; see also section 1.2.3.3).

Table 1.1: Sample items for objective/maximal and self-report/typical measures

Maximal/objective	Typical/self-report
“What is the capital of Japan?”	“I usually enjoy waking up early in the mornings.”
“A is preceded by B – BA.” True/False	“How often do you visit art galleries?”
“How much is 8% of 12.000?”	“When I hate somebody, I never let him/her know.”
“ $27 \times 5 = ?$ ”	“I enjoy going to parties.”
“Please complete the following sequence: 3 - 12 - 48 - ? - ?”	“I spend most of the time worrying about stupid things.”

Despite using different assessment techniques, many researchers have attempted to show how personality and intelligence are empirically related (Furnham, Forde & Cotter, 1998ab; Zeidner, 1995). These attempts have come from two different approaches. The first is the psychometric approach, which focuses predominantly on the measurement and structure of personality and intelligence and seeks to identify correlations between these concepts. The second is the cognitive science approach, which looks at biological, cognitive and adaptive processes which contribute to both constructs (Zeidner & Matthews, 2000).

Whereas psychometric assessment is driven by differences between individuals, the cognitive science approach emphasises differences between responses on particular tasks (Matthews, Davies, Westerman & Stammers, 2000). Although research should

ideally attempt to integrate both methodological approaches, practical limitations such as constraints in the number of participants or time availability from each subject make integration a difficult, perhaps unrealistic, goal. Psychometric methods appear to be the most suitable method to identify relationships between individual differences at a structural and descriptive level (Boyle, 1991). Furthermore, it is only for the psychometric method that latent concepts such as intelligence and personality have been scientifically measured in psychology. Hence the present review will focus on the psychometric approach to the relationship between personality and intelligence. However experimental findings will also be presented, particularly to overcome the descriptive (lack of causal explanatory) nature of the psychometric approach.

1.2.1 Psychometric intelligence and the notion of g

Although it goes beyond the aims of the present review to provide an in depth discussion on the topic of intelligence, it may be useful to examine some of the theories underlying the concept of human ability in order to address the relationship between personality and psychometric intelligence.

Most theories of intelligence are based on hierarchical models. These models were originated by Spearman (1904, 1927), who proposed that intelligence consisted of a general (g) factor as well as a set of specific (s) factors. Spearman's theory derived from correlational evidence from the study of schoolchildren, whose scores on different academic subjects were all positively correlated. According to Mayer (2000), the g hypothesis has long been present at the very heart of early pedagogic principles;

specifically the doctrine of formal discipline which held that certain subjects like Latin and Geometry would facilitate the development of diverse skills. Spearman provided a scientific approach and statistical method (factor analysis) to test this hypothesis: g is given by the multiple correlations between the results of different ability tests (Jensen, 1998).

Influenced by the work of Spearman (1904, 1927), Cattell (1971) elaborated one of the most prominent theories of intelligence, distinguishing between fluid (Gf) and crystallised (Gc) intelligence. Broadly speaking, Gf represents information-processing and reasoning ability, that is, inductive, conjunctive, disjunctive reasoning capability used to understanding relations and abstract prepositions (Stankov, 2000). On the other hand, Gc is used to acquire, retain, organise, and conceptualise information rather than information-processing. Whereas Gf is dependent on the efficient functioning of the central nervous system, Gc is dependent on experience and education within a culture. Accordingly tests of Gf require little previous knowledge or learning from part of the examinee, while measures of Gc emphasise previous knowledge and education. Measuring both Gf and Gc is beneficial in the sense of indicating both a person's learning potential as well as his/her accumulated learning (Stankov et al, 1995).

Although several experts have argued that Gf represents the core of intelligent behaviour (Carroll, 1993; Gustafsson, 1988, 2001) and even general intelligence itself (Mackintosh, 1996, 1998), current trends in individual differences seem to lead not only to a differentiation between Gc and Gf, but also to stress the importance of Gc and acculturated knowledge (see Ackerman, Beier & Bowen, 2000; Robinson, 1999; Stankov, 2000). Besides, it is important to distinguish between Gc and Gf for personality traits

may be distinctively associated to each type of intelligence. Whereas personality traits may play a relevant role during the processes of knowledge acquisition and learning (which are characteristic of the development of Gc)(Ackerman, 1996), the relationship between reasoning capacity (as conceptualised by Gf) and personality does not seem so evident. Accordingly, the relationship between personality and intelligence may depend on the type of ability measured (see section 1.2.3.2).

It is however worth noticing that researchers in the field of human intellectual ability have yet to reach a total consensus on the nature and quantity of what is meant by 'intelligence' (Deary, 2001; Eysenck, 1998). Whereas some have supported Spearman's notion of a general factor underlying all specific abilities, others (notably Gardner, 1993; 1999) have claimed that these specific abilities are independent, and that each of them constitutes a different type of intelligence (e.g. verbal, logical, body-kinaesthetic, intrapersonal, interpersonal). Further, some researchers have put forward theories that, albeit not providing a psychometric approach or neglecting g, have also gained considerable support. Such is the case of Sternberg's (1991) triarchic theory of intelligence and other theories dealing with non-traditional (e.g., emotional, practical, social, successful) types of intelligence (see Goleman, 1995; Petrides & Furnham, 2001; Sternberg, Wagner, Williams & Horvath, 1995). However such theories, sometimes known as *hot* intelligences, have found little empirical evidence to gain support at an academic level, either because they were assessed by self-report scales (Ford & Tisak, 1983; Thorndike, 1920) or because they have lacked psychometric validity (Davies, Stankov & Roberts, 1998; Gottfredson, 2003).

Although there appears to be as much evidence for the existence of a general factor of ability, as for the co-existence of specific mental abilities (e.g., visual and auditory perception, retrieval ability, cognitive and processing speed, general memory and learning), after Carroll's (1993) study consensus on the existence of a general ability factor has increased to the extent of classifying the theories that neglect g as "pseudo-scientific" or "semi-popular" (Deary, 2001). Besides, after almost a century of Spearman's (1904) proposition, g has become the most important statistical variable in differential psychology. The general ability factor represents the most powerful predictor of formal education, marital choice, professional success and political conceptions, and has been shown to explain more variance than most psychological variables put together (Brand, 1993; 1994; Gottfredson, 2002, 2003). This review will employ the term "psychometric intelligence" to refer to individual ability test results as well as the general factor g, which results from the correlations between several ability tests. Thus psychometric intelligence will be used to refer to any standardised, objective and power measure of cognitive performance. Section 1.2.3 will examine and discuss the ability correlates of personality, that is, the relationship between personality and psychometric intelligence.

1.2.2 Personality: the Big Five

In the area of personality structure, most researchers (e.g., Busato, Prins, Elshout, & Hamaker, 2000; De Raad, 1996; Digman, 1990; Furnham, 1996ab, 1997) have agreed on the psychometrical advantages of the Big Five Model proposed by Costa and McCrae (1992), often concluding that the Five Factor Model is nearly universal (Costa, 1997; Costa & McCrae, 1992; Deary & Matthews, 1993; McCrae & Costa, 1997b).

Nevertheless several researchers seem reluctant to support the Big Five as a dominant framework for the assessment of personality, usually preferring Eysenck's (Eysenck, 1967b; Eysenck & Eysenck, 1985) Gigantic Three model (see Barrett & Eysenck, 1984; Robinson, 1996), but also other models like Cattell's 16PF (Cattell, Eber & Tatsuoka, 1970)(see Austin, Hofer, Deary & Eber, 2000).

According to the Five Factor Model, there are five higher-order personality traits (or factors), namely Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness. Table 1.2 presents the complete NEO-PI-R (Costa & McCrae, 1992) super and primary traits with their respective checklist and sample items. Sample items for each sub-facet are presented in Table 1.3.

The first main personality trait is Neuroticism and can be described as the tendency to experience negative emotions, notably anxiety, depression and anger (Busato, Prins, Elshout & Hamaker, 2000). It is a widely measured personality factor and can be assessed through both the EPQ (Eysenck & Eysenck, 1985) as well as the NEO-PI-R (Costa & McCrae, 1992). Furthermore, Neuroticism finds its equivalent or similar expression in the Anxiety trait of Cattell's model (Cattell, Eber & Tatsuoka's, 1970). Neurotic individuals can be characterised for their tendency to experience anxiety, as opposed to the typically calm, relaxed and stable (low Neuroticism) personalities.

The second major personality dimension is Extraversion. This factor refers to high activity (arousal), the experience of positive emotions, impulsiveness, assertiveness, and a tendency toward social behaviour (Busato, Prins, Elshout & Hamaker, 2000). Conversely, low Extraversion (introversion) is characterised by rather quiet, restrained

Table 1.2: NEO-PI-R (Costa & McCrae, 1992) super and primary traits (facets) with checklist items.

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Table 1.3: NEO-PI-R (Costa & McCrae, 1992) primary traits (facets) with sample items.

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and withdrawn behavioural patterns. Like Neuroticism, Extraversion is present in both Eysenck and Eysenck's (1985) and Costa and McCrae's (1992) personality models.

A third¹ dimension, namely Openness to Experience, derived from the ideas of Coan (1974), and represents the tendency to involve in intellectual activities, and experience new sensations and ideas (Busato, Prins, Elshout & Hamaker, 2000). This factor is also referred to as Creativity, Intellect or Culture (Goldberg, 1994; Johnson, 1994; Saucier, 1994, Trapnell, 1994), and Tender-mindedness or Affection (Brand, Egan & Deary, 1993). It comprises 6 scales, namely fantasy, aesthetics, feelings, actions, ideas, and values. In a general sense, Openness to Experience is associated with intellectual curiosity, aesthetic sensitivity, vivid imagination, behavioural flexibility and unconventional attitudes (McCrae, 1993). People high on Openness to Experience tend to be dreamy, imaginative, inventive and non-conservative in their thoughts and opinions (Costa & McCrae, 1992). Poets and artists may be regarded as typical examples of high Openness scorers (McCrae & Costa, 1997a).

A fourth factor, Agreeableness (also known as Sociability), refers to friendly, considerate, and modest behaviour. This factor is associated with a tendency toward friendliness and nurturance (Busato, Prins, Elshout & Hamaker, 2000). It comprises the sub-facets of trust, straightforwardness, altruism, compliance, modesty and tender-mindedness. Agreeable people can thus be described as caring, friendly, warm and tolerant (Costa & McCrae, 1992). This personality trait is negatively related to

¹ Although throughout most of this thesis (tables, analyses, and discussions) Openness will be listed in the third place, this order is only in accordance with the denomination of Costa and McCrae's (1992) questionnaire, i.e., the NEO (Neuroticism-Extraversion-Openness) personality inventory. It is however noteworthy that most of the literature tends to refer to Openness as Factor Five.

Psychoticism and (together with Conscientiousness) is a main exponent of social behaviour in general.

Finally Conscientiousness is associated with responsibility and persistence (Busato, Prins, Elshout & Hamaker, 2000). This factor includes the minor dimensions of competence, order, dutifulness, achievement-striving, self-discipline, and deliberation. Conscientious individuals are best identified for their efficiency, organisation, determination and productivity. This dimension of personality may therefore be associated with differences in performance (see section 1.3.3.5).

The Five Factor Model has sometimes been criticised for its lack of theoretical explanations on the development and nature of the processes underlying some of its personality factors. Particularly Openness, Agreeableness and Conscientiousness (see Matthews & Deary, 1998 for a detailed discussion). However (perhaps as a consequence of its high validity and reliability) most of the recent literature dealing with the personality-intelligence interface has focused on the relationship between psychometric intelligence and the Big Five personality factors (Ackerman & Heggestad, 1997; Brand, 1994; Zeidner & Matthews, 2000). Further, most researchers seem to agree on the existence of five main personality dimensions as well as on the advantages of assessing these dimensions through the NEO-PI-R (e.g., Busato, Prins, Elshout, & Hamaker, 2000; De Raad, 1996; Digman, 1990; Furnham, 1996ab, 1997).

Although the vast consensus on the use of Costa and McCrae's (1992) model would not totally justify the omission of other personality models (or traits)(see Brand, 1994), employing the same assessment instrument is essential to establish comparisons

between studies. Further, several personality traits included in other models (like Neuroticism, Extraversion and Psychoticism²) can also be assessed by the Five Factor Model. This review will therefore focus on the psychometric evidence for the relationship between intelligence and the Big Five personality traits.

1.2.3 The Big Five and g reviewed

Although the last decade has produced more research on the interface between intelligence and personality than any other, evidence for the relationship between the Big Five and psychometric intelligence is far from conclusive, proving that this is still a relatively fertile area for research. For instance Hofstee (2001) reports that between 1991 and 1997 the terms “personality and intelligence” combined in the title of no more than 25 papers (only six of which attempted to relate the constructs). Moreover, only few quantitative studies (notably Ackerman & Heggestad, 1997; Austin et al 2002) have analysed large and representative data-sets employing modern, well-validated and reliable psychometric instruments, providing sound psychometric evidence for the relationship between personality and intelligence (see also Austin, Hofer, Deary & Eber, 2000). Most studies have, on the contrary, employed diverse psychometric instruments and analysed data from samples that were often not large enough for the statistical analyses performed (e.g., correlations, factor analysis), leading to some apparent contradictions (Ackerman & Heggestad, 1997; Austin, Hoder, Deary & Eber, 2000). One of the aims of the present review is to clarify these contradictions. To this end, the results

of the most robust meta-analyses on the relationship between personality and psychometric intelligence will be discussed.

In a large meta-analysis which examined a total of 135 studies, Ackerman and Heggestad (1997) reported a significant, albeit modest, correlation between psychometric intelligence and Neuroticism ($r = -.15$). The authors also found that g was negatively and moderately correlated with self-report measures of test anxiety ($r = -.33$). This is consistent with the findings of what is considered the most important paper on the relationship between test anxiety and intelligence, namely Hembree's (1988) review of 273 studies. Here, correlations between test anxiety and ability test performance ranged from $r = -.06$ up to $r = -.29$ (with a mean correlation of $r = -.18$). These correlations were replicated by the results of another large study ($N = 36,000$) by Siepp (1991)(see also Austin et al, 2002).

With regard to Extraversion, Ackerman and Heggestad (1997) concluded that this personality trait is weakly but positively and significantly related to g ($r = .08$). This correlation may be larger in younger samples reaching $r = .21$ for males and $r = .19$ for females (see Lynn, Hampson & Magee, 1982). Nevertheless Austin et al (2002) found relatively few (and negative) correlations between psychometric intelligence and Extraversion.

It has been therefore suggested that the correlation between Extraversion and psychometric intelligence may be determined by the type of ability measures employed (see 1.2.3.2). Zeidner (1995) argued that introverts have an advantage in tasks related to

² This well-established personality trait is represented in the Five Factor Model under the form of

superior associative learning ability (verbal tasks), whereas extraverts have an advantage in tasks related to ready acquisition of automatic motor sequences (performance tasks). This argument had been previously exposed by Eysenck (1971) and Robinson (1985), who attributed these differences to interpersonal variation in cerebral arousability (excitation/inhibition of the autonomic system). Thus extraverts, who are naturally less aroused, find it harder to concentrate for long time and end up trading speed for accuracy. The converse should apply to introverts.

In this sense the positive correlation between Extraversion and psychometric intelligence would be consistent with the representation of intelligent individuals as characterised by higher speed of information-processing (Neubauer, 1997; Roth, 1964; Vernon, 1987). Most researchers would however agree that there is certainly more to intellectual ability than processing speed (Ackerman, 1996, 1999; Stankov, 1999). In fact even those who adopt RT-based approaches to intelligence have found only modest correlations between short RT measures and psychometric intelligence ($r = -.12$ to $r = -.28$ in Jensen's, 1987 meta-analysis). Thus further research is needed to clarify the inconsistencies in the relationship between psychometric intelligence and Extraversion (Roberts, 2002; Stough, et al, 1996).

Among the Big Five factors, Openness to Experience seems to be the most related to measures of ability. Ackerman and Heggestad (1997) reported an overall correlation of $r = .33$ between Openness to Experience and g . This correlation was replicated in a recent study by Austin et al (2002), who examined several large data-sets. Kyllonen (1997), examining a large sample of Air Force recruits, found the correlation between

Conscientiousness (-), Openness to Experience (+), and Agreeableness (-)(Eysenck, 1991, 1992).

Openness to Experience and IQ to be even higher ($r = .45$). As will be discussed below (see 1.2.3.3), interpretation of this correlation may be ambiguous, since Openness to Experience may be regarded as a self-report measure of ability (subjectively-assessed intelligence)(see also 1.4). Furthermore, the sub-facets of Openness seem to represent not only aspects of ability but also (and particularly) fantasy, aesthetics, values and feelings. In any case, this personality factor seems to be associated with Gc rather than Gf (Ackerman & Heggestad, 1997; Austin et al, 2002).

The remaining two personality factors of the Big Five, i.e., Agreeableness and Conscientiousness, have not been found to be significantly associated with g (Ackerman & Heggestad, 1997; Kyllonen, 1997). However, and as will be discussed in the specific sections for these factors (see 1.2.3.4 and 1.2.3.5), Agreeableness and Conscientiousness may both have a significant incidence on test performance. Further it has been often argued that traits classifiable as “adaptive” (i.e., help to achieve personal and social adjustment) should be positively related to general intelligence (Austin et al, 2002; Ackerman & Heggestad, 1997; Thorndike, 1940).

The forthcoming sections will review the studies looking at the relationship between specific ability tests and each of the Big Five personality traits. As will be seen, evidence for a consistent link between the Big Five and psychometric intelligence is often weak, and mostly dependent on other variables such as pressure, time limit and type of ability tested.

1.2.3.1 Neuroticism and test performance

There are several studies that present evidence for the significant correlation between Neuroticism and ability tests. Callard and Goodfellow (1962) were among the first to find a low but statistically significant association between IQ and Neuroticism. Kalmanchey and Kozeki (1983), examining a large sample (N = 642) of 10-14 year old children, also reported low but significant correlations between Neuroticism (as assessed by the EPQ) and psychometric intelligence. More recently, Furnham, Forde and Cotter (1998a) (N = 233) obtained modest but significant correlations between Neuroticism (as assessed by the EPQ) and the Wonderlic Personnel (Wonderlic, 1992) and Baddeley Reasoning (Baddeley, 1968) tests, two well-established measures of g and Gf, respectively.

Without salient exceptions, and even when the correlation does not reach significance levels (e.g., Matarazzo, 1972), the relationship between Neuroticism and psychometric intelligence is negative, implying that intelligence would decrease with negative affectivity, e.g., anxiety, worry, tension, depression, anger, etc. (Zeidner & Matthews, 2000). This does not necessarily imply that neurotic individuals are inherently less intelligent than stable ones. Rather, it may be the case that negative affects like anxiety and worry, which are more likely to occur in neurotic individuals, would interfere in the cognitive processes (e.g., memory, attention) required to solve ability tests. Indeed Hembree (1988) found moderate to high correlations between trait and test anxiety on one hand, and IQ test performance and test anxiety on the other (see Table 1.4).

Thus, the negative relationship between Neuroticism and psychometric intelligence has been mainly attributed to the anxiety components of the Neuroticism scale (Sarason, 1980; Zeidner, 1995, 1998), which have been found to impair intellectual functioning not only on intelligence tests, but also in school and university exams (Entwistle & Entwistle, 1970; Eysenck & Eysenck, 1985; Sharma & Rao, 1983; see also 1.3.3.1).

Boekaerts (1995) explained neurotics' impairment of intellectual functioning in terms of attentional interference. However this interference may only affect states of anxiety. It is thus necessary to distinguish between trait (chronically anxious) and state (currently anxious) anxiety, for only the latter individuals may experience a decrement of intellectual performance (Zeidner, 1995). Although performance may be a function of state rather than trait anxiety (Eysenck & Eysenck, 1985), Hembree (1988) has shown that there is a close relationship between the two constructs. Hence neurotic individuals would be particularly likely to experience states of anxiety, notably exam or test anxiety (see Table 1.4). It should also be noted that predicting performance from trait rather than state anxiety may have obvious practical benefits since it would facilitate intervention and prevention at an earlier stage.

The relationship between test-anxiety and IQ test performance may be interpreted in terms of the underlying "worry", as opposed to "emotionality", components of the Neuroticism trait (Zeidner, 1998). A useful distinction is that of Eysenck's (1981), who conceptualised worry as the cognitive aspect of anxiety, whereas emotionality represents the physiological aspect, e.g., tension, nervousness. It is likely that worry and negative expectations (e.g. fear of failure) make it difficult for neurotic individuals to focus on

their task (De Raad & Schowenburg, 1996). Particularly the working memory system would be affected by worry (task-irrelevant processing) components (Eysenck, 1979; see also Darke, 1988). It is noteworthy that the impairment of performance by worry may be significantly enhanced when pressure is involved (Morris & Liebert, 1969; Matthews, 1986).

Table 1.4: Correlates of test anxiety

	Test anxiety
IQ-test performance	.23**
General anxiety	.56**
Trait anxiety	.53**
State anxiety	.45**
Worry	.57**
Emotionality	.54**

Adapted from on Hembree (1988) ** p < .01

As Strelau, Zawadski and Piotrowske (2001) explained, individuals who complete an ability test are usually presented with difficult tasks, exposed to the judgement of others, and affected by the consequences of their performance. Sarason (1975) likewise suggested that anxiety may affect performance on ability tests only in competitive settings, whereas under neutral conditions the differences between anxious and non-anxious individuals would be minimal. This was confirmed in a study by Markham and Darke (1991), who found that high anxiety inhibited verbal reasoning only under highly demanding circumstances. In a similar way, Dobson (2000) showed that only under stressful situations (e.g., time pressure or when the results have important consequences

for the individual) is Neuroticism associated with lower performance on numerical reasoning tests, and that these situations under-estimate neurotics' true intellectual ability.

As Zeidner (1995) points out, the fact that Neuroticism may impair test performance should not question the validity of ability tests, but rather provide additional information about the individual who completes the tests (see also Furnham, Forde & Cotter, 1998a). This argument is based on the assumption that anxiety will affect real world performance in the same way it affects (impairs) test performance. Although Neuroticism may be more related to IQ test performance than to 'actual' intelligence (Child, 1964; Eysenck, 1971; see also section 1.3), this personality trait could thus be useful to predict performance under stressful conditions. If non-intellective components may influence test results, including personality traits in the assessment of intellectual competence may provide additional information on the individual as well as improve the prediction of his/her performance in real-life settings (Wechsler, 1950).

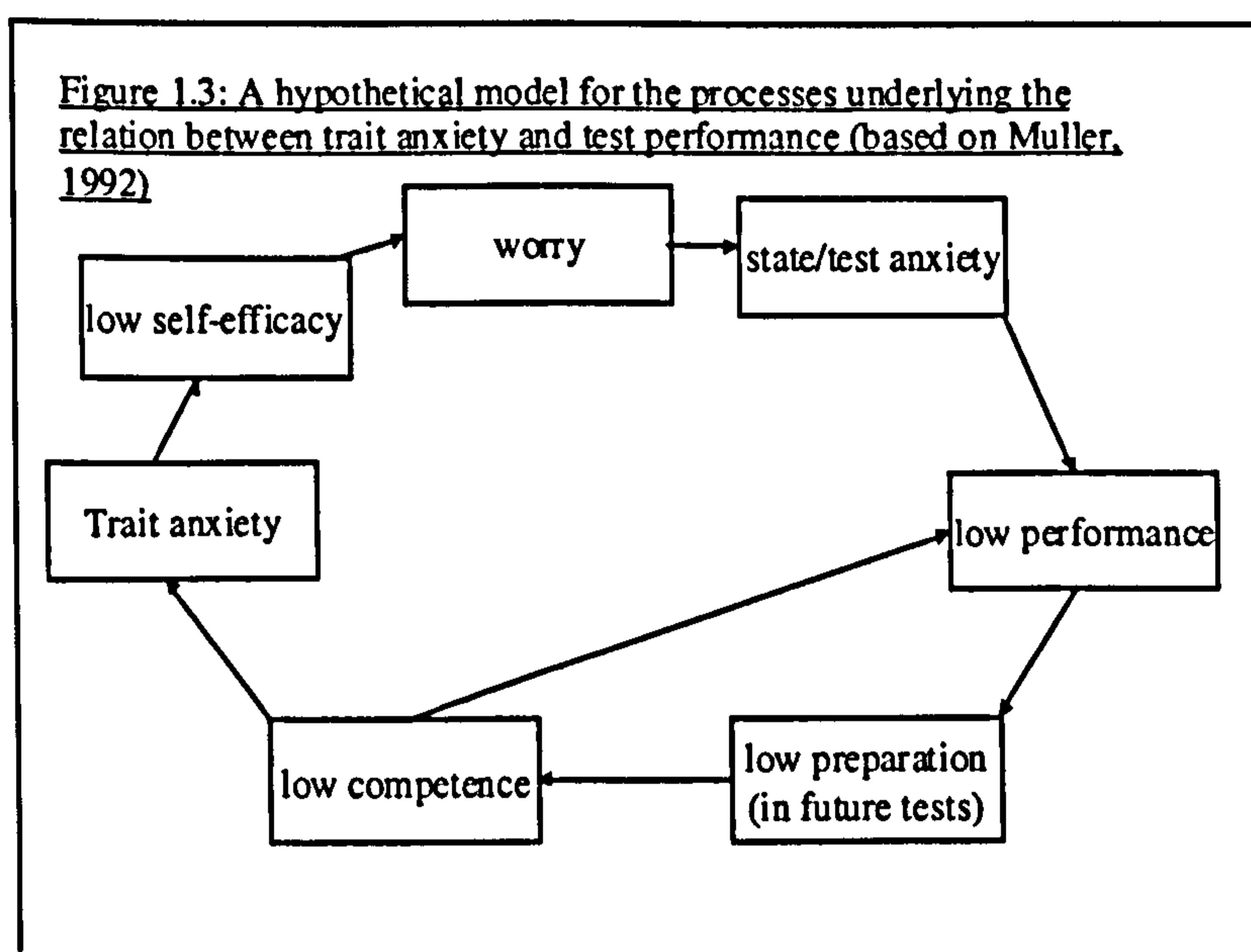
1.2.3.1.1 Alternative interpretations

An alternative interpretation to the significant correlation between Neuroticism and intelligence has been proposed by Muller (1992). The author argued that the correlation between Neuroticism and psychometric intelligence may indicate the influence of actual intellectual competence on anxiety, rather than the effects of anxiety on ability test performance. Hence Muller inverted the causal direction usually attributed to this correlation. The central argument for this hypothesis is based on the concept of "self-efficacy" (Bandura, 1986). At an early stage, Neuroticism is negatively associated

with self-efficacy (individuals high on trait anxiety would be more likely to have lower self-efficacy), but not with intellectual competence. However low self-efficacy may lead to worry and impair test performance through test/state anxiety. At a second stage, these individuals would be less likely to invest in preparation and engage in intellectual stimulating activities. This lack of engagement would lead to low intellectual competence. Finally, a third stage is conceived in which low competence affects both test performance and trait anxiety, in that it would lead to both low self-efficacy and poor test results. Hence poor performance may be regarded as a self-fulfilling prophecy: the initial fear of failure is eventually justified by objective low competence. This feedback or vicious cycle can be illustrated by the path in Figure 1.3.

Some researchers (e.g., Lynn & Gordon, 1961) have also suggested that the relationship between Neuroticism and psychometric intelligence may be curvilinear rather than linear. Such suggestions are mainly based on Eysenck's (1957) and Eysenck and Eysenck's (1985) theory on the biological basis of personality and intelligence, which attributes individual differences on these constructs to differences in cerebral arousability. Recent support for this theory can be found in the numerous papers by Robinson (1989; 1996; 1998). Eysenck (1957) argued that higher Neuroticism is associated with greater activation on the sympathetic division of the autonomic nervous system. Since the sympathetic activation may increase cerebral activation (and vice-versa), it is implied that there is a positive relationship between Neuroticism and cerebral arousal (Robinson, 1996). Furthermore, since psychometric intelligence is associated with intermediate arousability (Robinson, 1989), extreme – i.e., very high and very low - levels of Neuroticism would be negatively associated with psychometric intelligence.

Another interesting approach to the relationship between Neuroticism and psychometric intelligence has been proposed by Austin, Deary and Gibson (1997), who pointed out that *g* seems to be stronger at higher levels of Neuroticism. This would imply that the magnitude of the correlation between different ability tests (for instance measures of *Gc* and *Gf*) should be expected to increase with levels of Neuroticism (see also Austin et al, 2000).



It may be argued that the increase in the correlation between different ability tests may be a consequence of Neuroticism, specifically high test anxiety. That is, the consistent effect of anxiety on different ability measures may increase the correlation between these measures, in that it reduces cognitive sources of variability between tests. Conversely at low levels of Neuroticism the effects of test/state anxiety would be practically irrelevant, allowing for a greater cognitive variability between measures.

Thus anxiety is regarded as a source of distortion in the measurement of abilities and may influence not only test results but also correlations among these tests. An array of experimental difficulties may however underlie the feasibility to experimentally test and replicate these results; notably the fact that *state* (rather than *trait*) anxiety is assumed to inflate the correlation of different ability measures. Thus it would require not only reliable measures of state anxiety but also replicable levels of state anxiety across studies and individuals (Austin, 2002).

1.2.3.2 Extraversion and test taking style (speed vs. accuracy)

Unlike Neuroticism, the correlation between psychometric intelligence and Extraversion has been found to vary from positive to negative. Revelle, Amaral and Turriff (1976) were among the first to observe these contradictory results were due to the use of different types of ability tests, and suggested that the link between psychometric intelligence and Extraversion was, to an important extent, dependent on the test conditions (as opposed to tests itself). This interaction was later explained by Eysenck and Eysenck's (1985) arousal theory, which states that the resting level of cortical arousal for introverts is higher (i.e., have lower reactive inhibition) than that of extraverts. Hence introverts tend to avoid arousing stimuli while extraverts tend to seek them (Eysenck, 1991). One may therefore predict that the relationship between psychometric intelligence and Extraversion will differ in arousing and non-arousing situations, favouring extraverts or introverts, respectively.

Extraverts also show greater vigilance decrement than introverts and consequently trade off speed for accuracy when taking an ability test. Thus extraverts may have slightly different results than introverts, depending on the style of the test (whether it is timed and how long it takes). Specifically, extraverts would seem to have an advantage when tests are short (2 to 5 minutes) and timed, whereas introverts would benefit from long (e.g., 40 minutes) and un-timed tests. Accordingly, introverts can be expected to outperform extraverts on verbal tests and problem-solving tasks that require insight and reflection (Matthews, 1992), whereas extraverts would outperform introverts on speed (i.e., timed) test. This hypothesis was tested by Rawlings and Carnie (1989), who showed that the relationship between Extraversion and IQ is partly a function of time pressure. The authors found that the timed version of the WAIS favoured extraverts, whereas the untimed version favoured introverts. Eysenck (1994a) also showed that Extraverts have a general tendency to spend less time doing a test (and even tend to give up towards the end of a test) and concluded that Extraversion is related to speed of working. Table 1.5 (adapted from Matthews, 1999) resumes some of the strong and weak test features associated with high and low Extraversion.

However two studies by Rawlings and Skok (1993) and Furnham, Forde and Cotter (1998a) (N = 233) have failed to replicate these results. Further, Furnham et al (1998a) showed that, while it could well be the case that the relationship between Extraversion and psychometric intelligence is influenced by the type of test used or the type of intelligence being measured, introverts can also outperform extraverts on speed tasks. It is however arguable that the type of test used by Furnham et al (1998a), i.e., the Baddeley Reasoning Test (Baddeley, 1968), may also have tapped aspects of verbal

ability, since this measure is based on grammatical transformations, and not just speed. This may have benefited the performance of introverts (Matthews, 1992). In any case, the relationship between Extraversion and psychometric intelligence is far from well-established and therefore remains an interesting topic of research for differential psychologists.

Table 1.5: Test related features to high and low Extraversion

Extraversion level	High	Low
Divided attention	+	-
Long term memory	-	+
Reflective problem solving	-	+
Resistance to distraction	+	-
Retrieval from memory	+	-
Short-term memory	+	-
Vigilance	-	+

Adapted from Matthews (1999)

1.2.3.3 Openness to Experience and intellectual ability

The personality factor most frequently associated with intelligence is Openness to Experience (Ackerman & Heggestad, 1997; Austin, Hofer, Deary & Eber, 2000; Brand, 1994; Goff & Ackerman, 1992; Zeidner & Matthews, 2000). It has even been argued (Ferguson & Patterson, 1998; McCrae, 1994) that Openness to Experience should be interpreted as an ability rather than a personality factor. This argument has been

discussed thoroughly by Brand (1994) (see also Goldberg, 1994; Saucier, 1994; Trapnell, 1994), who proposed an alternative psychometric approach to the Five Factor Model of personality. According to Brand, and following Cattell, the Five Factors should be replaced by Neuroticism, Extraversion, Conscientiousness, Pathemia/Affection (instead of Agreeableness), Will or Independence (instead of Openness to Experience), and the inclusion of psychometric intelligence (g) - traditionally considered a separate domain - as a sixth factor.

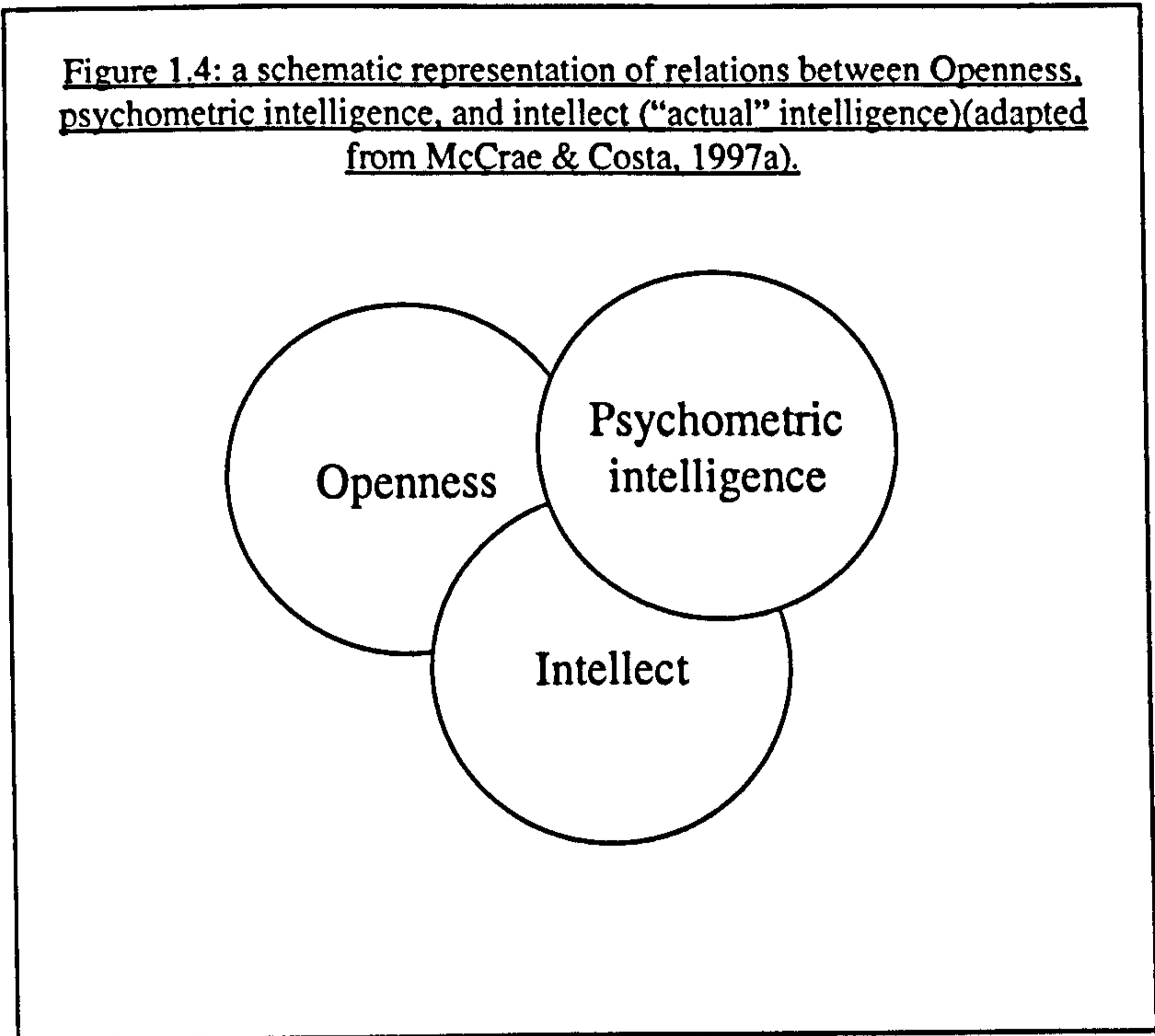
The inclusion of an intelligence factor in self-assessed measures of personality was anticipated by some of the work of Cattell, specifically the 16 Personality Factor Questionnaire (16PF)(Cattell, Eber, & Tatsuoka's, 1970). Further, research supporting the conceptualisation of a Six rather than a Five Factor Model of personality is not rare (Birenbaum & Montag, 1989; Brand, 1984; Cattell, 1973; Deary & Matthews, 1993). In a recent study, Fergusson and Patterson (1998) suggested that the Five Factor Model should be interpreted as a Two Factor Model, with Neuroticism, Extraversion, Agreeableness, and Conscientiousness items all loading on a single factor, and Openness to Experience items loading on a separate one, which the authors interpreted as ability. However the sample used may be regarded as too small (N = 101), particularly if one considers the large validation studies of Costa and McCrae (1985, 1988, 1992), who identified a five factor solution across diverse and very large sample.

Brand (1994) argued that about 40% of the 'true' variance of Openness to Experience in the general population could be attributed to g. Support for Brand's hypothesis about the overlap between Openness to Experience and intelligence can be found in McCrae (1987a)(but not McCrae & Costa, 1997a). In addition, Openness to

Experience has also been reported to correlate highly with the Intuition scale of the Myers-Briggs Type Indicator (McCrae & Costa, 1989), which has been consistently associated with IQ (Brand, Egan & Deary, 1993). Although Brand's (1994) claims are theoretically sound, psychometric research has yet to provide consistent evidence for the overlap between Openness to Experience and intelligence as measured by objective tests rather than self-report inventories.

On the contrary, several researchers have provided evidence for the psychometric differentiation between intelligence and Openness to Experience (Ashton, Lee, Vernon, & Jang, 2000; Costa & McCrae, 1992; Goff & Ackerman, 1992; McCrae, 1987; 1993; 1994). Further McCrae and Costa (1997a) have emphasised that, even when Openness may tap aspects of intelligence, this personality factor also (and perhaps mainly) accounts for non-cognitive individual differences such as need for variety, mood variability, and tolerance of ambiguity. Figure 1.4 (adapted from McCrae & Costa, 1997a) presents a schematic conceptualisation of the relationship among Openness, psychometric intelligence and "intellect" (a term which is employed to refer to the latent and non-measurable variable of "actual" intelligence). It should however be noted that "intellect" can be *partly* measured, not only by psychometric intelligence but also by Openness. Thus psychometric intelligence and Openness are related variables for they represent measures of the same (latent) construct, namely "intellect". Nevertheless it is clear from the Venn-diagram in Figure 1.4 that an important part of Openness (perhaps aesthetic sensitivity, fantasy life and feelings) is unrelated to psychometric intelligence, whereas an equally important aspect of psychometric intelligence (particularly Gf) may be orthogonal to Openness.

The differentiation between Openness and intelligence has also been explained in terms of differences in measurement approach. Thus Openness is correlated with



psychometric intelligence but it is measured as a personality factor. Cronbach's (1949) division between maximal and typical performance illustrates the different approaches that differentiate the measurement of intelligence (*maximal* performance) from that of personality assessment (*typical* performance). It is likely that this division may account for the separate factorial constitution of intelligence with regard to Openness to Experience (Hofstee, 2001). That is, even if Openness to Experience may, to some extent, be a measure of intellectual competence, it would be different from psychometric

intelligence in the sense of being self-report and typical, rather than objective and maximal (see also sections 1.2 and 1.4).

Despite the methodological distinctiveness between Openness to Experience and psychometric intelligence, several researchers have shown that the two variables are significantly correlated and therefore not independent. McCrae and Costa (1985) reported a correlation of $r = .32$ between Openness to Experience and the vocabulary sub-test of the WAIS, a highly reliable and valid measure of intellectual ability. Furthermore, McCrae (1993, 1994) and Holland, Dollinger, Holland, and McDonald (1995) later found that Openness to Experience factor was also related ($r = .42$) to the full IQ scale from the WAIS-revised (Wechsler, 1944).

Studies on authoritarianism or conservatism (Wilson & Patterson, 1978) - in some sense the opposite of Openness to Experience – may also provide evidence for a link between Openness to Experience and intelligence, since authoritarianism has been found to be negatively correlated with both Openness on one hand ($r = -.57$ in Trapnell, 1994), and intelligence on the other (up to $r = -.50$, Zeidner & Matthews, 2000). Further, Trapnell (1994) regarded liberalism as an aspect of Openness itself. Likewise Zeidner and Matthews (2000) suggested that open individuals would be more willing to question moral, political and religious values to adopt less conservative views. Thus conservative attitudinal systems involving prejudice, antidemocratic sentiments and right wing authoritarianism would be more common in less open individuals (see also Adorno, Frenkel-Brusnwick, Levinson & Sanford, 1950). Negative correlations between Openness and authoritarianism may thus be indicative of the positive relationship between Openness and intellectual competence. Furthermore, one may hypothesise,

specifically, that high Openness may lead to both low authoritarianism and high intellectual competence.

1.2.3.3.1 Openness as a correlate of psychometric intelligence

Although it is often not possible to fully explain the relationship between Openness to Experience and psychometric intelligence (Zeidner, 1995), it is important to point out that not all aspects of intelligence may be associated with Openness to Experience. There is vast research indicating that Openness to Experience may only be related to crystallised or the *knowledge* - as opposed to the fluid or *reasoning* - aspects of human intellectual ability (Ackerman & Rolfhus, 1999; Brand, 1994). These results may reflect the importance of Openness in knowledge acquisition as well as its relatively independence from the more biologically based processes underlying Gf (for a discussion of this point see sections 1.2.3.3.2 and 1.2.3.3).

Jackson (1984b) found Openness to Experience to be moderately and significantly correlated with the crystallised (specifically verbal) sub-test of the Multidimensional Aptitude Battery (Jackson, 1984a), but only weakly with the fluid sub-test, and in the near-zero order when the test-stimuli were not pictures. Likewise, Goff and Ackerman (1992) reported Openness to Experience to correlate moderately ($r = .32$) with Gc, but only modestly ($r = .13$) with Gf. In a recent study involving more than 500 Canadian sibling pairs, Ashton, Lee, Vernon, and Jang (2000) replicated both the moderate ($r = .37$) correlation between Openness to Experience and Gc, and the modest ($r = .18$) correlation between Openness to Experience and Gf, using Jackson's (1984b) Multidimensional

Aptitude Battery. Hence the authors concluded that Openness is orthogonal to the ability to reason and to process information.

1.2.3.3.2 Interpretations

Theoretically, the significant correlation between Openness to Experience and psychometric intelligence may be interpreted in several ways.

First, it may be possible that people who are more open to experience (e.g., intellectually curious, non-conservative, imaginative) tend to engage in activities that are likely to develop and strengthen their intelligence. This is consistent with Cattell's (1971) ideas on the historical effects of interests (i.e., investment) on the development of Gc (see also Ackerman, 1996; Hammond, 1998). An open personality would thus lead to high levels of intellectual competence. It should however be noted that the development of intellectual competence may depend not only on the Openness of one's personality, but also on the intellectual richness (or "Openness") of the environment. One should therefore bear in mind that education may moderate the relationship between Openness and intellectual competence (as it has in fact been shown with authoritarianism)(see Christy, 1954).

Second, intellectual curiosity, vivid imagination, artistic sensitivity and other characteristics of highly open people could be a consequence of their high intelligence. In this case, high intellectual ability would pre-exist (and to some extent cause) the development of a highly open personality. That is, the need for cognition and rich

intellectual experience would be prompted in more able and handicapped in less able individuals. However correlational evidence (specifically correlations between Gf and Openness) in support of this interpretation is poor (Ackerman & Rolfhus, 1999; Brand, 1994; Jackson, 1984a).

A third option would be that of an interaction between high intelligence (specifically Gf) and Openness to Experience – in terms of highly intelligent people engaging in (intellectual, artistic, or non-conservative) activities that would lead to high intellectual competence (Goff & Ackerman, 1992) and vice-versa. As Matthews et al (2000) pointed out, objective competence support interests as much as interests may enhance competence. This hypothesis can be resumed in path of Figure 1.5.

A fourth option, also supported by Goff and Ackerman (1992), is that of Openness to Experience as a self-report measure of intelligence, specifically Gc (see sections 1.4 to 1.5) This hypothesis is based upon Cronbach's (1949) methodological distinction between maximal and typical performance as well as the conceptual similarities between subjectively-assessed intelligence and several self-report items in the Openness scale. There is however a variation in the way Openness items address subjectively-assessed intelligence, namely indirectly. Items such as "I often enjoy playing with theories and abstract ideas", "I found philosophical arguments boring", "I often lose interest when people talk about very abstract, theoretical matters", "I enjoy working on mind-twister-type puzzles, all taken from the Openness scale of the NEO-PI-R (Costa & McCrae, 1992), are directed to "interests", rather than proficiency. Hence Openness differs from subjectively-assessed intelligence in that it assesses estimates of *preferences* rather than skills. The conceptual relationship between Openness and self-

estimates of intelligence may thus be compared to that of skills and interests (see Matthews et al, 2000).

Finally, yet without being conclusive, a fifth interpretation for the significant psychometric relationship between the Openness to Experience factor and measures of intellectual ability would be that intelligence may also comprise the *ability* to score higher on Openness to Experience. In a general way, this hypothesis has been proposed by Sternberg and Wagner (1993) and Hofstee (2001) and assumes that personality inventory items, albeit bipolar, can arguably be scored as correct or incorrect, and that respondents (particularly high intelligent ones) are able to identify the logic behind the scoring of items. Items that, for instance, tend to disclose a social desirable response (e.g. “I have a very active imagination”, “Aesthetics and artistic concerns aren’t very important to me”, “I consider myself broad-minded and tolerant of other people’s lifestyles.”) are more likely to be affected by the respondents’ ability to identify the correct answer, and can therefore result in significant correlations between psychometric intelligence and the Openness trait.

However several studies have indicated that the relationship between psychometric intelligence and socially desirable responses is negative rather than positive (Austin et al, 2002; see also Ackerman & Heggestad, 1997). A possible explanation for this may be that highly competent individuals would be more confident and thus find little need to conform to others when choosing the responses of a personality questionnaire. In any case, socially desirable responding may be more related to social than to general or academic intellectual competence (see Kihlstrom & Cantor, 2000).

Although several possible interpretations to explain the relationship between psychometric intelligence and Openness have been examined, most of these hypotheses have specific weaknesses. The idea that Openness may increase (and even result from) high Gf, in the sense that intellectual interests would support native abilities, has not been supported by correlational evidence (for Openness relates to Gc rather than Gf). For the same reason an interaction between ability (Figure 1.5) and Openness can not be considered as valid explanation. Arguments from psychometric (methodological) reasons could also be rejected (at least partly), as Openness refers to estimates of preference (interests) rather than abilities (skills). Further, it has been argued that even if Openness would overlap with (and be compared to) subjectively assessed intelligence, this personality scale comprises more and mostly items referred to conventionality, experience seeking and fantasy life (McCrae & Costa, 1997). The hypothesis that the relationship between Openness and psychometric intelligence may be an artefact of the ability to score high on a socially desirable trait may also be rejected on the basis of negative correlations between socially desirable responding and psychological intelligence. Thus the idea that Openness may determine intellectual investment through interests and curiosity seems the best explanation to understand correlations between Openness and psychological intelligence. This argument has been thoroughly considered and further conceptualised in the construct of Typical Intellectual Engagement (Goff & Ackerman, 1992).

1.2.3.3 Typical Intellectual Engagement (TIE)

Among studies attempting to clarify the nature of the Openness to Experience factor, as well as its relationship to intellectual ability, an interesting approach is that of Goff and Ackerman (1992) and Ackerman and Goff (1994), who examined the association between Gc, Openness to Experience, and TIE (a construct put forward by these authors). When compared to personality measures, TIE - a self-reported inventory - showed to be highly correlated with Openness ($r = .65$) (Ackerman & Goff, 1994). Moreover, after correcting for attenuation, Goff and Ackerman (1992) found that the correlation between Openness to Experience and the “abstract thinking” sub-scale of the TIE inventory was $r = .72$, and after adding Conscientiousness, Neuroticism and Agreeableness as predictors the attenuation-corrected multiple correlation was nearly $r = .90$.

The authors (Goff & Ackerman, 1992) found that Gc was positively and significantly related to TIE, Openness, absorption (in tasks), hard work, and interests in art and technology. However when the TIE inventory was examined against high school and university performance, its predictive validity was zero, whereas (maximal performance) intelligence test had validities as high as $r = .4$. It is thus important to bear in mind that personality traits like TIE and Openness may be influential in the processes of knowledge acquisition in terms of motivation and interests, but without necessarily leading to excellence in performance. Furthermore, TIE may be more related to self-report than to actual knowledge and only in certain areas such as arts and humanities (Rolfhus & Ackerman, 1996).

1.2.3.4 Agreeableness, modesty and test taking attitude

Among the Big Five personality factors, Agreeableness seems to be the least related to ability. This runs counter to Thorndike's idea that "intelligence is in general correlated with virtue and good will toward men" (Thorndike, 1940; p. 274). Ackerman and Heggestad's (1997) and Kyllonen's (1997) papers revealed positive but very modest and non-significant correlations between ability measures and Agreeableness. These results would confirm the theoretical independence of Agreeableness from intellectual competence, since none of its primary factor scales, i.e., trust, straightforwardness, altruism, compliance, modesty, tender-mindedness, appear to be conceptually related to intellectual competence. Nevertheless, there may be at least three reasons to expect some significant correlations between Agreeableness and ability measures.

First, in situations where test results do not have important consequences for the examinee (unlike in work or university recruitment/applicant samples) agreeable people would be more collaborative and may have more positive attitudes towards taking the test. Conversely, less agreeable individuals may be unwilling to concentrate and perform at the highest level. In such cases, Agreeableness may be positively related to ability test results.

Second, it may be hypothesised that intelligence can influence responses on the NEO-PI-R, that is, through socially desirable responding. This possibility applies primarily to situations where both personality and ability scores have decisive consequences for the examinee. Thus respondents higher on intelligence may be more

able to identify the more “correct” (socially desirable) answers, many of which could involve agreeable items. However recent studies (notably Austin et al, 2002) have found negative associations between psychometric intelligence and socially desirable responding. Furthermore, several circumstances in which low Agreeableness is preferable (for instance in competitive jobs) may require the respondents to do just the opposite and attempt to score low on the scale. Hence intelligent individuals may be more likely to manage their impression and score in the direction of the desired profile.

Thirdly, the “modesty” sub-facet included in the Agreeableness scale may indirectly reflect people’s intellectual competence. Since people are, to some extent, able to judge their own intellectual abilities (Furnham & Rawles, 1999; Paulhus, Lysy & Yik, 1998), highly intelligent people could be expected to have a higher opinion of themselves. Likewise, less bright individuals would be more likely to be modest in their judgements about themselves. Further, modesty may be regarded as conceptually related to (low) self-confidence and self-concept, which have been associated with performance on a variety of cognitive/ability tests (Crawford & Stankov, 1996). Being modest about one’s ability may thus have a negative impact on test-performance (as a self-fulfilling prophecy effect). Accordingly, the relationship between modesty and intellectual ability may be reflected in a negative correlation between ability test results and Agreeableness.

Although the above arguments may lead to expect small but significant correlations between Agreeableness and psychometric intelligence, the direction of the correlation appears to vary from negative to positive. Moreover, previous research has failed to identify significant correlations between psychometric intelligence and

Agreeableness. It is thus necessary to explore this relationship, even when there may be several (even conflicting) arguments and hypotheses.

1.2.3.5 Conscientiousness (need for achievement)

Conscientiousness is associated with persistence, self-discipline, and achievement striving (Busato, Prins, Elshout & Hamaker, 2000). However, large-scale studies seem to indicate that Conscientiousness, like Agreeableness, may be only weakly related to psychometric intelligence (Ackerman & Heggestad, 1997; Kyllonen, 1997; Zeidner & Matthews, 2000). When examined in more detail, evidence on the relationship between Conscientiousness and psychometric intelligence is characterised by a lack of consistency.

On one hand, Eysenck's Psychoticism factor (Eysenck & Eysenck's, 1985), a negative correlate and subordinate of Conscientiousness (Digman, 1990; Eysenck, 1991, 1992), may be sufficient to expect positive associations between Conscientiousness and psychometric intelligence. Psychoticism reflects an increased tendency to express aggressive behaviour, generally as a reaction of frustration or unconditioned punishment (Eysenck, 1981). Like anxiety, this type of behaviour is also likely to impair test performance and, indeed, Eysenck (1971) showed that Psychoticism was significantly and negatively correlated with psychometric intelligence.

On the other hand two recent studies have found negative associations between Conscientiousness and psychometric intelligence. Moutafi, Furnham and Crump (2003)

analysed data from approximately 900 job-applicants and found that individuals high on Conscientiousness tended to score lower in several cognitive ability tests. The authors explained the negative relationship between Conscientiousness and psychometric intelligence in terms of “compensation”. Specifically less able individuals would become more conscientious as a result of attempting to compensate for their low intellectual ability. Conversely, more able people would be less likely to become conscientious since their high intellectual ability may be enough to excel or at least perform acceptably in a variety of settings. Further, the results and hypothesis of this study were confirmed shortly after by the analyses of a larger-scale sample (N = 4859) of applicants. Conscientiousness was significantly correlated with measures of numerical ($r = -.17$), verbal ($r = -.23$), abstract ($r = -.16$) and general ($-.22$) ability, more so than the rest of the Big Five traits (see Moutafi, Furnham & Patei, 2003).

Further support for the “compensation” hypothesis can be found in the numerous studies looking at the relationship between Conscientiousness and performance, both work and academic (Barrick & Mount, 1991; Blickle, 1996; De Raad, 1996; De Raad & Schouwenburg, 1996; Geisler-Brenstein & Schmeck, 1996; Goff & Ackerman, 1992; McHenry, Hough, Toquman, Hanson & Ashworth, 1990; Rothstein, Paunonen, Rush & King, 1994; Wiggins, Blackburn & Hackman, 1969; see also section 1.3.3.5). Since these studies have shown there is a positive relationship between Conscientiousness and performance, “compensation” may be a valid explanation for the differential relationship between Conscientiousness and psychometric intelligence on one hand, and performance on the other. Further, correlational evidence, particularly significant correlations

between Conscientiousness and Gf, may be needed to support the “compensation” hypothesis.

1.3 Personality traits and academic performance (AP)

The previous sections have examined the most salient literature on the relationship between personality traits and psychometric intelligence. The forthcoming sections will examine the relationship between personality traits and AP.

Although psychologists have rarely presented definitions of AP (this may be due to the familiarity with the concept), AP can be simply defined as performance in academic settings, that is, formal education, such as elementary and secondary school, undergraduate and postgraduate levels. There are several ways to measure individual differences in AP; most commonly these would include written examinations (essay type or multiple choice), designed to assess students’ understanding and knowledge of curricular content. Other (perhaps less frequent) methods may include oral examinations (viva), dissertations (supervised long-term production), group work (long-term production with co-workers) and continuous assessment (course work, essays, attendance, participation in class).

Like psychometric intelligence, AP may be regarded as an indicator of intellectual competence. In fact AP has always been the criterion par excellence for the validity of ability measures, which originated as an attempt to distinguish between competent and non-competent student (Binet & Simon, 1905/1961a, 1905/1961b, 1908/1961c; see also

Cronbach, 1984; Rolfhus & Ackerman, 1996). In this sense, the relationship between psychometric intelligence and AP may be compared to that of weather forecast and actual weather: an evaluation of the variables that may determine weather (e.g., temperature, pressure, wind, etc) results in a forecast.

The validity of this technique depends on the predictability of actual weather in a very specific place. Likewise, the measurement of certain mental operations (speed of response, reasoning ability) is only effective (valid) to the extent that it successfully predicts longitudinal performance in academic settings. Thus whereas psychometric intelligence may be more indicative of a person's capacity, AP may reflect not only intellectual capacity but its actual manifestation in real life. As such, AP can be considered a measure of long term intellectual competence, and its relationship to personality traits may provide important information about non-cognitive individual differences underlying real world performance.

Before focussing on the link between AP and personality traits, it may be useful to briefly review the literature on AP and psychometric intelligence.

1.3.1 Psychometric intelligence and the prediction of AP (school and university)

For more than a century psychological and educational researchers have attempted to effectively predict AP (e.g., Binet, 1903; Binet & Simon, 1905; Busato, Prins, Elshout & Hamaker, 2000; Ebbinghaus, 1897; Elshout & Veeman, 1992; Galton, 1883; Goh & Moore, 1987; Harris, 1940; Neisser, Boodoo, Bouchard, Wade, Brody,

Ceci, Halpern, Loehlin, Perloff, Sternberg, & Urbina, 1996; Savage, 1962; Terman, 1916; Thurstone, 1919; Willingham, 1974). These attempts have prompted the development of psychometric measures and, more specifically, modern ability tests (see Cronbach, 1984; Robinson, 1999). Since their design, and particularly since the 1930's, ability tests have been widely employed in school performance prediction and college placement selection (Brody, 2000; Jensen, 1980; Zeidner & Matthews, 2000; Wolf, 1972). Terms such as "under-achievement" and "over-achievement", usually used to refer to discrepancies between ability test results (potential) and AP (outcome), may reflect the prestige of these measures (Boyle, 1990), and several studies have presented longstanding evidence for the predictive validity of psychometric intelligence.

Bright (1930) reported high correlations between ability measures and both academic and citizenship grades in public schools. Ten years later Springsteen (1940) replicated these correlations in a sample of mentally handicapped school pupils. Tenopyr (1967) examined the predictive validity of cognitive (SCAT) and social ability and found that the former was a powerful predictor of academic achievement (these findings were partially replicated in a more recent study by Riggio, Messamer & Throckmorton, 1991). In a larger sample (N = 230) of Hindi female school students, Sharma and Rao (1983) reported high correlations between AP and non-verbal intellectual ability (Raven's Progressive Matrices). Bachman et al (1986) compared the criterion validity of IQ and pathological behaviour with regard to AP in a large sample (N = 873) of primary school students; IQ test results accounted for most of the variance in academic success. The relationship between psychometric intelligence and AP in school has been thoroughly reviewed by Walberg, Strykowski, Rovai & Hung (1984), who meta-analysed more than

3000 studies and reported an impressive correlation of up to $r = .71$ between the two constructs. More recent studies have replicated this correlation (e.g., Gagne & St. Pere, 2001).

Research has also provided evidence for the predictive power of cognitive ability tests with regard to AP in higher levels of education. Willingham (1974) reported on the significant criterion validity for the graduate record examination test (GRE)(like IQ tests, this is a standardised measure of verbal, mathematical and logical ability), particularly its advanced version. In a more recent large scale meta-analysis ($N = 82,659$), Kuncel, Hezlett and Ones (2001) tested the validity of the Graduate Record Examinations (GRE) and undergraduate grade point average (UGPA) as predictors of AP at a postgraduate level. It was found that both GRE and UGPA were consistently and significantly related to grade point average in the first postgraduate year of education, overall examination scores, publication citation index, as well as faculty ratings. It is however noticeable that both predictors, albeit measures of ability, were also indicative of previous knowledge (as assessed by specific sub-tests in the case of the GRE and content-based examination in the case of the underlying exams of UGPA). Thus the extent to which a student directs his/her efforts to study, revise, and carefully prepare a specific topic, may also affect GRE and UGPA scores. Although it would exceed the aims of this dissertation to include an exhaustive review of all the studies reporting significant (and moderate to high) correlations between ability tests and AP, the literature seems to indicate that psychometric intelligence is the most established predictor of AP (Elshout & Veenman, 1992; Gagne & St. Pere, 2001; Neisser et al, 1996; Sternberg & Kaufman, 1998). Ability tests are not only the most significant predictors of AP, but educational level in general

(Brand, 1994). Furthermore, psychometric intelligence has been shown to be very stable across time (Schaie, 1996; Deary, 2000), which would explain why it has been often found to be the most significant predictor, not just of educational level, but of marital choice, occupational success, moral values, law abidingness, and liberalism in political attitudes (Burt & Arps, 1943; Brand, 1994; Gottfredson, 1996, 1997; Herrnstein & Murray, 1994; Jensen, 1998).

There is however a considerable amount of research suggesting that the relationship between psychometric intelligence and AP may often be weaker than expected and even fail to reach statistical significance levels (e.g., Thompson, 1934; Sanders, William, Osborne & Greene, 1955; Seth & Pratap, 1971; Metha & Kumar, 1985; Singh & Varma, 1995). This is true especially at higher levels of formal education.

In fact some researchers have shown that in higher levels of education (after 1, 2, 3 years of college) the predictive power of psychometric intelligence declines (see Ackerman, 1994; Wolf, 1972). For example Jensen (1980) reports correlations ranging from $r = .60$ to $r = .70$ between psychometric intelligence and AP in elementary school, dropping to $r = .50$ in secondary school, and $r = .40$ in college (see also Boekaerts, 1995). Likewise, Hunter (1986) argued that measures of g as well as verbal and quantitative abilities, have only been found to be modest predictors of academic success for adults. This has led both theoretical and applied researchers to examine the predictive validity of other constructs that may account for unique variance in AP. Perhaps non-cognitive traits such as interests, motivation and personality may start to play a relevant role as individuals grow older and progress through the formal educational system. These traits could interact with cognitive ability and even direct it towards the development of adult

intellectual competence (see Ackerman & Beier, 2003; Ackerman & Heggestad, 1997). Thus the decrease of the predictive validity of psychometric intelligence with regard to AP at more advanced stages of education may have its counterpart in the increase of the predictive validity of non-cognitive traits. Hence, non-cognitive individual differences have received increased interest with regard to AP, particularly in the last six years. As Ackerman and Rolfhus (1996) have argued, “abilities are only one part of the complex causal framework that determines whether a student pursues the acquisition of knowledge and skills within a particular domain. Two other components of the equation are interests and personality traits” (p. 176).

1.3.2 Personality traits and the prediction of AP

“It ought to be clear at the outset that no psychologist is foolish enough to suppose that native intelligence is the sole factor in academic success” (Whipple, 1922, p.262)

The interest in personality traits with regard to AP is not new. Webb (1915) put forward a construct which he labelled “persistence of motives” (a modern version of this factor was developed by Digman, 1990), and considered it of great relevance in intellectual performance. Likewise, other non-cognitive but performance-related variables can be identified in Garnett and Thomson’s (1919) “cleverness” and Alexander’s (1935) “factor X”, which was believed to determine interests and learning efforts. Hence Ryans (1938) emphasised the importance of assessing “persistence” to improve the predictability of academic attainment by IQ tests alone.

Even when ability tests have been found to be significantly correlated with grades, it has been noted that it may not be effective to predict academic success from intelligence scores, mostly because “the energy output of the individual student varies independently of ability” (Stanger, 1933, pp. 648). Several researchers have thus emphasised the need to include other variables than intelligence in the prediction of AP, suggesting that academic achievement involves other factors apart from intellectual ability. Turning up to class, doing the homework, participating in discussions, getting along with other students and teachers, stressing out during an exam, are all (non-intellectual) variables which could be expected to influence AP. Individual differences in personality may therefore play an important role in academic achievement.

The next sections will examine the most salient research on personality and AP. To this extent, several empirical studies looking at the relationship between different indicators of AP (notably exam grades) and well-established personality traits (Big Five and Gigantic Three)(Costa & McCrae, 1992; Eysenck & Eysenck, 1985) will be reviewed.

1.3.3 The Gigantic Three and AP

Studies looking at the relationship between personality and AP attracted a considerable amount of research in the 50's but it wasn't until the development of Eysenck's (1947, 1970) and Eysenck and Eysenck's (1985) personality model that

researchers could examine the same personality traits, which would of course provide a better mean to establish comparisons between studies. The Eysenckian-based personality inventories assess either two (Extraversion and Neuroticism)(MPI, EPI) or three (Extraversion, Neuroticism, and Psychoticism)(EPQ, EPQ-R) main personality traits that are components of a psychobiological model of personality (Cloninger, 1987; Eysenck, 1967b; Matthews & Gilliland, 1999; Zuckerman, 1991).

Although Eysenck's personality model will not be discussed in detail, the biological basis of these traits refers to differences in arousability (Eysenck, 1967, 1994b). Eysenck identified the physiological basis for personality, located in the cortico-reticular loop (thalamus, ascending reticular activating system and cerebral cortex) and the viscerocortical loop that connects the cerebral cortex with the "visceral brain" (see also Matthews & Deary, 1998). Variability levels in the first of these two neural circuits determine individual differences in Extraversion (introverts are more easily aroused than Extroverts), while variability in the second neural circuit (which comprises the limbic system) determines differences in Neuroticism.

As could be observed (see section 1.2.2) Neuroticism and Extraversion are apparent in the Five Factor models of personality and are thus well-established. In conjunction with the Big Five (Costa & McCrae, 1992), the Eysenckian 3 personality super factors represent the two predominant conceptual frames to the approach and assessment of personality (see Jackson, Furnham, Forde & Cotter, 2000 for a comparative study and review). Table 1.6 presents some of the characteristics of high and low scorers on the three main personality traits of the Eysenckian Model.



Several studies have provided evidence for the significant relationship between the Gigantic Three (i.e., Neuroticism, Extraversion and Psychoticism) and AP. Given that Neuroticism and Extraversion are present in both Eysenck's (Eysenck & Eysenck, 1985) and Costa and McCrae's (1988, 1992) models, sections 1.3.3.1 and 1.3.3.2 will also review studies where Neuroticism and Extraversion were assessed through the NEO-PI-R.

Table 1.6: Some characteristics of high vs. low Neuroticism, Extraversion and Psychoticism scorers

	<u>Neuroticism</u>	<u>Extraversion</u>	<u>Psychoticism</u>
High (+)	Inferiority, Moody, Anxious, Unstable	Sociable, Impulsive, Assertive Active	Disorganized, Careless, rude Artistic, creative Risk-taking
Low (-)	Calm, Relaxed, Content Confident	Quiet, Restrained, Withdrawn	Sympathetic, Efficient, systematic Cautious, conscientious

Adapted from Matthews et al (2000)

1.3.3.1 Neuroticism, worry and exam stress

Neuroticism has often been associated with AP, largely negatively (Cattell & Kline, 1977; De Barbenza & Montoya, 1974; Furnham & Medhurst, 1995; Furnham & Mitchell, 1991; Goh & Moore, 1987; Lathey, 1991; Rindermann & Neubauer, 2001; Sanchez-Marin, Rejano-Infante & Rodriguez-Troyano, 2001; Savage, 1962; Weiss, 1998). Two large scale studies by Hembree (1988) and Siepp (1991) reported a correlation of $r = -.20$ between Neuroticism and AP. This correlation is consistent with

the modest but negative relationship between Neuroticism and psychometric intelligence (see section 1.2.3 and 1.2.3.1). Since AP and psychometric intelligence are both measured through maximal performance tests (examinations or ability measures), there is a considerable theoretical overlap for the negative correlation between Neuroticism and both indicators of intellectual competence. One would thus expect that stress, impulsiveness and anxiety under test/exam conditions may account for the negative correlations between Neuroticism and AP, in the same way they may account for the negative association between Neuroticism and psychometric intelligence.

It has been even suggested that, in heightened emotional situations, Neuroticism may moderate the relationship between AP and intellectual ability. In this respect Boyle (1983) observed that the correlation between AP and psychometric intelligence drops from $r = .35$ under neutral conditions to $r = .21$ under “arousing” conditions. However it is also likely that Neuroticism may affect AP in a more general way, i.e., not in stressful environments (Halamandaris & Power, 1999). This may involve study habits and even attendance as Neuroticism has been showed to have negative physical consequences such as racing heart, perspiration, gastric disturbances and muscle tension)(Matthews, Davies, Westerman & Stammers, 2000) and may thus lead to greater absenteeism. With regard to take-home assignments, evidence is more ambiguous (Boyle, 1983; Halamandaris & Power, 1999).

Several authors have concluded that evaluation – particularly on demanding tasks – may be over-arousing for neurotics and thus exceed optimal arousal levels for performance (Corcoran, 1965; Humphreys & Revelle, 1984), leading to cognitive processing impairment (Eysenck, 1982; Spielberger, 1972). It is thus noteworthy that

Neuroticism differences in arousal and cognitive performance may only be evident under stressful conditions (Eysenck, 1992a; Stelmack, 1981). Furthermore, whereas Neuroticism may attenuate AP in less able/proficient students or under stressful conditions, it may even facilitate AP in more able/proficient students or under non-arousing situations. Accordingly, Geen (1985) and Zeidner (1998) suggested that, under non-observed and more relaxed conditions anxiety may be positively related to performance - possibly because it can increase motivation, serving as a drive (Spielberger, 1962). However several studies have failed to find evidence for the positive effects of Neuroticism on performance under non-arousing conditions (Szymura & Wodnjacka, 2003). Besides, AP usually involves intellectual competence under pressure, which would undermine the applied relevance of the relationship between Neuroticism on non-demanding tasks.

As has been discussed (see section 1.2.3.1), the tendency to worry is an inherent characteristic of high Neuroticism. The processes underlying the relationship between worry and stress have been thoroughly described by Matthews et al (2000), who emphasised the subjective components of stress: a stressful situation depends more on the individual's perception than on the stressor itself (see also Lazarus & Folkman, 1984). Likewise Selye (1976) argued that stress reactions depend on the person's appraisals of his/her competence to cope with environmental demands. Thus worrying about one's performance or fearing to fail an examination may lead to the experience of stress, which would result in a poor exam performance (Halamandaris & Power, 1999). Wine (1982) and Sarason et al (1995)(see also Matthews et al, 2000) also pointed out that anxious individuals tend to waste time on self-evaluative conditions that would divert their

attention from the actual test. This may lead to difficulties in understanding exam/test instructions (Tobias, 1977).

In the case of neurotics, worry is likely to emerge frequently as a consequence of their lack of confidence in their abilities (Wells & Matthews, 1994). Whether this lack of confidence is merely irrational or a true reflection of neurotic's intellectual competence is difficult to address, but it is certainly possible that "fear of failure" or low "hope of success" (characteristics of Neuroticism) may be a consequence of learning difficulties and poor study habits (and even low intellectual ability). In any case, it is likely that both actual and perceived competencies interact creating a "neurotic" feedback, leading to low AP. As Busato, Prins, Elshot and Hamaker (1999) observed, "unsuccessful studying may result in more neurotic feelings and an increasing sense of failure, which results in a less conscientious working method, less openness studying and less achievement motivation in general" (p. 138).

Most of the research between Neuroticism/anxiety and AP has examined university rather than school students. However Rindermann and Neubauer (2001) provided recent evidence for the negative relationship between AP in secondary school and a German scale of anxiety (Angstfragebogen für Schüler: Wiczerkowski, Nickel, Janowski, Fittkau & Rauer 1986). De Barbenza and Montoya (1974) and De Raad and Schouwenberg (1996) found that stable students outperformed neurotics in university. Ackerman and Heggestad's (1997) meta-analysis showed that Neuroticism was negatively related to knowledge and achievement in 11 samples. However in some studies this association was dependent on the criterion variables used (De Fruyt & Mervielde, 1996; Furnham & Mitchell, 1991; Kline & Gale, 1971). Further, recent

papers have failed to replicate the negative relationship between Neuroticism and AP, in both school (Heaven et al, 2002) and undergraduate (Busato et al, 2000; Halamandaris & Power, 1999) students. It is thus important to bear in mind that the influence of Neuroticism on AP may almost certainly be moderated by a number of variables, from Gc and Gf to assessment methods and stress.

1.3.3.2 Extraversion and study habits

There is also some evidence for the significant correlations between AP and Extraversion, although the literature seems to indicate that other variables such as age, level of education and type of assessment may play a crucial role and even determine the sign (i.e., positive or negative) of this correlation. With regard to age, Eysenck and Cookson (1969) suggested that the correlation between AP and Extraversion changes from positive to negative around the ages of 13/14 (see also Entwistle, 1972). In an earlier manual to the EPI Junior Eysenck (1965) also specified gender difference for this change, namely 14 for females and 15 for males. Eysenck (1994) attributed the change of sign in the correlation between Extraversion and AP to the replacement of the social and easy atmosphere of primary school by the rather formal atmosphere of secondary school. Alternatively Anthony (1973) argued that age may merely reflect the fact that the less able individuals become extraverted and vice-versa. In this sense, study habits would be a consequence of introvert's investment strategies, while socializing may be regarded as a result of extraverts' low intellectual investment.

It is generally accepted that introverts may have an advantage over extraverts with respect to the ability to consolidate learning, as well as lower distractibility and better

study habits (Entwistle & Entwistle, 1970; Eysenck & Cookson, 1969; Sanchez de Marin et al, 2001). It would appear that introverts condition faster and have slower decay of their conditioned behaviour (Eysenck & Eysenck, 1979). Accordingly a recent study by Sanchez-Marín, Rejano-Infante and Rodríguez-Troyano (2001) also showed that extraverts tend to fail their courses more often than introverts (see also Busato et al, 2000). Rolfhus and Ackerman (1999) found negative relations between Extraversion and several knowledge tests, and suggested that these relations may be related to differences in knowledge acquisition time between introverts (spend more time studying) and extraverts (spend more time socializing). Further Goff and Ackerman (1992) found introverts to outperform extroverts in two levels of formal education, i.e., high school and undergraduate. This is also consistent with the findings of Goh and Moore (1987), Humphreys and Revelle (1984) and Amelang and Ulwer (1991)(see also Furnham, 1995).

On the other hand, some studies have also reported higher AP by extraverts, specifically in school settings (Entwistle, 1972; Anthony, 1973), suggesting that introversion may be an advantage only under high intellectually demanding tasks. De Barbenza and Montoya (1974) also reported positive correlations between Extraversion and academic success in university students. This correlation was replicated not only in undergraduate (De Fruyt & Mervielde, 1996) but also in postgraduate (Rothstein, Rush & King, 1994) students.

In one of the rare studies to examine not only grades but also course work, Furnham and Medhurst (1995) found that extraverts were rated higher for their seminar performance albeit receiving lower marks in their exams. This may alert researchers (as well as educators) about the possibility that assessment methods may be differentially

related to personality traits. Particularly differences between oral and written assessment methods are likely to be associated with individual differences in Extraversion (see Robinson, Gabriel & Katchan, 1993).

Further inconsistencies concerning the psychometric relationship between Extraversion and AP were added by the results of several studies that failed to reach significance levels (in either directions). Heaven et al (2002) found Extraversion to be unrelated to performance in school. Halamandaris and Power (1999) replicated these results on a university sample (see also Furnham & Mitchell, 1991). In Ackerman and Heggestad's (1997) meta-analysis Extraversion was virtually unrelated to knowledge and achievement.

1.3.3.3 Psychoticism and poor AP

With regard to Psychoticism, the literature is less ambiguous and seems to indicate that this personality trait is significantly and negatively related to academic attainment (Aluja-Fabregat & Torrubia-Beltri, 1998; Furnham & Medhurst, 1995; Goh & Moore, 1987; Maqsud, 1993; Sanchez-Marin et al, 2001). It has been suggested that Psychoticism may affect responsibility and interests in studies, therefore limiting academic success (Aluja-Fabregat & Torrubia-Beltri, 1998). Accordingly Furnham and Medhurst found that Psychoticism was negatively correlated not only with grades but also with course work (seminar reports). Furthermore, several studies have recently shown that Conscientiousness - a strong negative correlate of Psychoticism (Digman, 1990; Eysenck, 1991; 1992) - is a consistent positive predictor of academic success (Blickle, 1996; Busato, Prins, Elshout & Hamaker, 2000; De Raad, 1996). Studies have

replicated this relationship in school (Wolfe & Johnson, 1995) as well as undergraduate (Busato et al, 2000; Goff & Ackerman, 1992) and postgraduate (Hirschberg & Itkin, 1978; Rothstein et al, 1994) education.

Haun (1965) was among the first to provide correlational evidence for the idea that academic excellence is negatively associated with indicators of pathology. This association may be explained by the fact that Psychoticism is linked to poor overall adjustment (Halamandaris & Power, 1999; Hussain & Kumari, 1995). People high on Psychoticism are more likely to be solitary, insensitive and uncaring with others and tend to reject implicit and explicit social norms that are indispensable for interaction with others (Pervin & John, 1997). Thus one can expect Psychoticism to have a negative (maladaptive) consequence not only in educational but all settings.

Maqsud (1993) found negative correlations between Psychoticism and academic attainment, and positive correlations between academic attainment and academic self-concept. These correlations suggest that Psychoticism (like Neuroticism) could affect students' self-conceptions of AP. As will be discussed (see section 1.4) negative self-judgements may impair performance, especially when combined with low or intermediate levels of intellectual ability.

However not all the characteristics of Psychoticism seem to be problematic for academic achievement. Besides low responsibility, low self-concept, lack of interests and lack of cooperation, Psychoticism is also positively associated with creativity (Eysenck, 1995b). Further, one of the positive correlates of Psychoticism is Openness which has been often regarded as beneficial for education (De Raad et al, 1996). Although Psychoticism and Openness are positively related, Psychoticism is associated

with low AP, while Openness has often been associated with high AP. In this sense, it is important to examine how other correlates of Psychoticism such as Agreeableness and Conscientiousness (and intellectual competence itself) may moderate the relationship between Psychoticism and AP. Eysenck (1995b) himself has strengthened the fact that creativity should be conceived as a function or by product of both Psychoticism and intellectual ability. Further, the author's distinction between trait creativity and productive talent may denote the importance of traits such as Agreeableness and Conscientiousness, which may provide the necessary order and sociability to obtain productivity (this idea was already present in Freud's concept of sublimation).

1.3.3.4 Openness and AP

As mentioned above, Openness to Experience has been found to be positively associated with AP (see also De Raad & Schouwenburg, 1996; Blickle, 1996; Geisler-Brenstein, Schmeck & Hetherington, 1996). This association has been replicated in studies involving both undergraduate (De Fruyt & Mervielde, 1996), and postgraduate (Rothstein et al, 1994) students.

The positive relationship between AP and Openness has often been interpreted in terms of the fact that Openness seems correlated with psychometric intelligence in the range of $r = .20$ to $r = .40$ (see McCrae & Costa, 1985, see also section 1.2.3.3). Particularly the use of vocabulary and general knowledge are likely to be more proficient in open personalities (Ackerman & Heggestad, 1997; Ashton, Lee, Vernon & Jang, 2000; Goff & Ackerman, 1992). Blickle (1996) suggested that Openness to Experience would enable individuals with a wider use of strategies and learning techniques, e.g., critical

evaluation, in depth analysis, open-mindedness, which would positively influence their performance in academic settings (see also Mumford & Gustafson, 1988). Accordingly Sneed, Carlson and Little (1994) found that Openness to Experience (along with Conscientiousness) was considered the most important personality trait by teachers (when it comes to predict academic excellence). However Goff and Ackerman (1992) found that TIE, a scale correlated with Openness in the range of $r = .60$ to $r = .80$ (see Rocklin, 1994; see also section 1.2.3.3) was a poor predictor of high school and university GPA. Further, in one of their studies Rothstein et al (1994) failed to replicate significant correlations between Openness and AP in a sample of postgraduate students.

Although it may seem surprising that some studies have failed to find evidence for the predictive validity of AP by Openness, there are theoretical reasons to explain this; specifically the conceptual similarities between some of the aspects of Openness and Psychoticism. Openness and Psychoticism may both be related to low inhibition of attention to task-irrelevant stimuli (Beech & Williams, 1997). Hence, as much as the positive and significant correlation between Openness and AP may be understood in terms of the ability loadings of Openness, the fact that this personality trait is positively correlated with Psychoticism would make it equally possible to expect negative associations between Openness and AP. In the words of McCrae and Costa (1997a): “very open people appear to have some of the characteristics of schizotypal thinking; whether these are adaptive or maladaptive will probably depend on other aspects of personality and on the individual’s social environment” (p.24). It is however important to emphasise the differences – rather than the similarities – between Openness and Psychoticism. These differences can be represented in terms of adaptability. Hence

McCrae and Costa (1997a) argue that the relationship between Openness and personality disorders may be dependent on other variables such as Agreeableness and Conscientiousness.

1.3.3.5 Agreeableness and AP

Although research has generally failed to find any significant relationship between AP and Agreeableness (see Ackerman & Heggestad, 1997; De Fruyt & Mervielde, 1996; Rothstein et al, 1994), one may expect high Agreeableness to be beneficial for AP. Specifically, one may expect agreeable students to be more helpful with other students and, moreover, make a positive impression on teachers (but not in anonymous exams). These two aspects may contribute to higher AP, particularly when course work involves working in groups and when students are not “blindly” assessed. This hypotheses can be supported by the findings of a recent study by Farsides and Woodfield (2003), who found positive and significant correlations between Agreeableness and AP. Furthermore, it was shown that Agreeableness was significantly related to several indicators of “application” (e.g., attendance, course work).

It is likely that Agreeableness is more related to academic behaviour than exam performance (Farsides & Woodfield, 2003). However studies on personality and AP have predominantly examined grades. To this extent it would be interesting to examine whether personality traits in general (not just Agreeableness) play any important role in student’s behaviour beyond examination performance. Specifically, it would be interesting to examine whether individual differences in personality and intellectual

ability are likely to influence academic behavioural variables such as truancy, exclusions and absenteeism.

While there appears to be a lack of psychological research on the relationship between undesirable school behaviour and individual differences, there is some evidence in the recent literature that links truancy to other, more severe, anti-social behaviours (e.g., juvenile offending, substance abuse). Fergusson, Lynskey and Horwood (1995) found that truancy was very frequent (almost 40%) in 12-16 year school children. Results also indicated that truancy was significantly related to dysfunctional (disadvantaged) home environments as well as early conduct problems. Other studies (notably Williamson & Cullingford, 1998) have also provided evidence for the negative association between self-esteem and truancy (as well as exclusions and other disruptive school behaviorus). Furthermore, undesirable academic behaviour has been negatively related to empathy (particularly in males)(Cohen & Strayer, 1996; Roberts & Strayer, 1996).

The literature on truancy and exclusions suggests that these variables could be positively related to Neuroticism (low self-esteem) and Psychoticism (lack of empathy). Hence it could also be expected that undesirable academic behaviour would be negatively correlated with the Big Five traits Agreeableness and Conscientiousness. Further, to the extent that truancy and exclusions are negatively associated with academic exam performance, these variables could also be expected to be negatively related to intellectual ability.

1.3.3.6 Conscientiousness and AP

It seems that the personality factor more consistently associated with AP is Conscientiousness (Costa & McCrae, 1992; Goff & Ackerman, 1992; Blickle, 1996; De Raad, 1996; De Raad & Schouwenburg, 1996; Busato, Prins, Elshout & Hamaker, 2000; Kling, 2001). Researchers have shown that this association is present at school (Wolfe & Johnson, 1995), undergraduate (Busato et al, 2000; Goff & Ackerman, 1992), and post-graduate (Hirschberg & Itkin, 1978; Rothstein et al, 1994) level. Further, Conscientiousness appears to be a solid predictor of occupational performance throughout a variety of settings (Barrick & Mount, 1991, 1993; Matthews, 1997). Early studies (notably Smith, 1969) had attributed the relationship between Conscientiousness and performance to the so-called “strength of character” factor.

Another explanation has been that Conscientiousness is conceptually related to motivation, a variable of considerable importance with regard to all types of performance (Andersson & Keith, 1997; Boekaerts, 1996; Busato et al, 2000; Furnham, 1995; Hamilton & Freeman, 1971; Harris, 1940; Heaven, 1990; Pelechano, 1972). According to Campbell (1990), motivation can be understood as the choice of a) expending effort, b) the level of effort, and c) persisting at that level of effort. It is noteworthy that one of the sub-facets of Conscientiousness is achievement striving, which is likely to affect goalsettings and achievement. It has been therefore suggested that Conscientiousness is closely related to motivation and that this personality trait is a significant predictor of performance, particularly when extrinsic determinants of motivation are held constant (Barrick, Mount & Strauss, 1993; Sackett, Gruys & Ellingson, 1998). Furthermore other sub-facets as competence, order, dutifulness, self-discipline and deliberation were found

to be significant predictors of AP in university as measured by examination grades (De Raad & Schowenburg, 1996).

An interesting point has been recently made by Kling (2001), who observed that Conscientiousness is differentially related to AP and intellectual ability (see also section 1.2.3.5). The author argues that Conscientiousness may be a better predictor of academic achievement than psychometric intelligence. This would explain why females score lower on IQ test but obtain higher grades than males. Since females are usually more Conscientious than males, Conscientiousness may be considered as important as intellectual ability in the prediction of students' performance. In other words, careful, organised, hard working persevering and achievement-oriented students may succeed in academic settings despite their low intellectual ability. Personality (notably Conscientiousness) may thus moderate the relationship between intellectual capacity and AP. Hence a higher score on either psychometric intelligence or Conscientiousness may compensate for a low score on the other as well as predict good AP.

1.3.4 Current directions on personality traits and AP research

Much of the current interest in personality and AP is due to Ackerman's (Ackerman, 1996, 1999; Ackerman & Beier, 2003; Ackerman & Heggestad, 1997) recovery of the work by Snow. In his dissertation, Snow (1992, 1995) suggested that personal variables such as abilities, attitudes, personality traits and prior knowledge, interact to affect learning and AP. Snow was particularly interested in identifying which aspects and levels of these personal variables would result in the best combination for

achieving efficient learning. Hence, the author concluded that non anxious learners with low IQ, and able learners who are highly anxious are equally handicapped in academic settings. However it was not until the work of Ackerman and his colleagues that systematic and robust research began to explore the possible combinations (i.e., trait complexes) of cognitive and non-cognitive traits for the prediction of learning and knowledge acquisition.

In line with Snow's (1992, 1995) proposition, Ackerman and Heggestad's (1997)(see also Ackerman, 1999; Ackerman & Beier, 2003; Goff & Ackerman, 1992) psychometric meta-analyses identified four main trait complexes, namely social, clerical/conventional, science/mathematical, and intellectual/cultural. The social trait complex (which does not comprise any ability traits) represent Extraversion and social (interpersonal) skills. The clerical/conventional trait complex includes both Conscientiousness and a predisposition for traditional/conventional interests (in a sense the negative expression of Openness to Experience). Like the social trait complex, the traditional/conventional does not represent individual differences in ability. On the contrary, the science/mathematical trait complex is mainly defined by intellectual abilities, particularly visual and spatial. Finally the intellectual/cultural trait combines Gc, Openness, TIE as well as art interests. As such this trait complex comprises a mix between interests, personality and ability, representing a clear example of integration between non-cognitive and cognitive individual differences. Trait complexes may thus be regarded as a fundamental contribution to understanding the development of expertise as an interaction between individual differences and the environment as jointly influencing human performance (Snow, 1992, 1995).

1.4 Subjectively-assessed intelligence (SAI)

The previous sections have discussed the literature regarding the relationship between personality and intellectual competence as measured by standardised ability tests (psychometric intelligence) or academic examinations (AP). In both cases, an individual's capacity was measured by more or less objective parameters and according to competition in tasks that require intellectual performance. Although this approach is considered to be the predominant paradigm to the study of the relationship between personality and intellectual competence (Hofstee, 2001; Zeidner & Matthews, 2000), it should be noted that non-psychometric methods may also be examined in order to obtain a better understanding of the relationship between intellectual competence and personality traits. Within these assessment approaches, a particularly interesting and promising field is that which considers subjective indicators of ability such as self-estimated or subjectively-assessed intelligence (SAI)(Furnham, 2001b; Stankov, 1999; Sternberg, 1985).

Although SAI may have been an implicit concept in differential psychology for many decades (conceptualised by the higher order constructs of self-concept, self-efficacy, or even in theories such as social cognition), it was not until Eysenck that researchers considered it an alternative approach to the assessment of intelligence. Eysenck and Eysenck (1985) conceptualised three types (or approaches to the measurement) of intelligence, namely genotypic, psychometric and self/other-assessed intelligence. These three types of intelligence or "dimensions of the structure of intellect"

(Eysenck, 1979; see also Strelau et al, 2001) can be differentiated on the basis of their assessment methods.

Genotypic (also known as biological, for it is influenced by biological factors) intelligence cannot be measured directly but only through elementary and cognitive tasks (e.g., inspection time, reaction time, etc)(see Rindermann & Neubauer, 2001). However such tasks can only provide a partial indicator of genotypic intelligence. Psychometric intelligence, as observed in section 1.2.1, can be measured through IQ/ability tests, which usually refer to hierarchical models. This type of intelligence is not only influenced by biological but also cultural factors (think of Gc). Finally, self/other-assessed intelligence, as its name indicates, is judged and measured by one self or the others. Researchers have argued that this type of intelligence is influenced not only by biological and cultural, but also by personality factors (Eysenck, 1986; Rinderman & Neubauer, 2001).

Hence SAI (which is equivalent to self/other assessed intelligence) seems a relevant concept in the relationship between personality and intelligence. Specifically, the importance of examining SAI may rely in the fact that this variable could be significantly related to both personality and psychometric intelligence, as well as having direct paths to performance. Further, indicators of SAI (such as single self-estimates of intelligence) are easy to obtain and may be thus added to personality inventories or ability measures without resulting in time-consuming procedures. The study of SAI may therefore provide important information on the relationship between personality and intellectual competence, beyond psychometric intelligence and AP.

1.4.1 SAI and psychometric intelligence

Given the popularity of the concept of intelligence, individual differences in ability have been a topic of both academic and popular writings. There are a number of popular books that attempt to explain theories of intelligence to non-academics (e.g. Gardner, 1999; Sternberg, 1997), and knowledge or problem-based types of riddles are available to everyone through newspapers and magazines (see Furnham, 2001b). Moreover, it has been suggested that lay theories of intelligence are not radically different from scientific ones (Sternberg, 1982). Hence one may expect lay persons to have some insight into their intellectual abilities. Studies looking at the relationship between SAI and psychometric intelligence have tested this hypothesis.

However it was not until relatively recently that investigators included indicators of SAI on a regular basis (see Furnham, Clark & Bailey, 1999). Thus there are little more than 20 published papers on estimated or SAI (Furnham, 2001b). Researchers' decision to look at SAI has usually been driven by the idea of using them as proxy intelligence tests (Paulhus, Lysy & Yik, 1998). This would enable them to overcome disadvantages of some intelligence tests such as being expensive, time consuming and perceived as threatening by respondents.

In a pioneering study, De Nisi and Shaw (1977) asked students to predict their scores on 10 different ability tests (including measures of verbal, spatial and numerical intelligence). Correlations between psychometric and SAI were significant in the $r = .30$ order, to which the authors concluded that SAI should not be used as a replacement of

psychometric intelligence tests. However several researchers have begun to conduct similar studies in the 90's.

Borkenau and Liebler (1993) examined the relationship between SAI and psychometric intelligence in a sample of German students. Measures of verbal and non-verbal ability correlated with SAI in the range of $r = .29$ to $r = .32$. Thus results supported both the findings of De Nisi and Shaw (1977) as well as their conclusion that SAI can not replace psychometric indicators of intelligence. Further, Borkenau and Liebler (1993) found that participants' estimations of strangers' intelligence (as shown in a brief video) correlated by $r = .43$ with targets' (i.e., strangers') psychometric intelligence. This (rather surprising) result may suggest that the correlation between self and psychometric intelligence is relatively low (since individuals may be better at judging strangers than themselves).

Reilly and Mulhern (1995) examined students' SAI with regard to the digit and vocabulary sub-tests of the WAIS. Findings revealed significant differences in SAI, with males giving higher estimates than their scores, and women giving lower estimates than their scores (gender differences in SAI are thoroughly reported in section 1.4.3).

Another study that aimed at examining the relationship between psychometric and estimated intelligence was that of Furnham and Rawles (1995). Although this study replicated the significant correlation between SAI and psychometric intelligence (in this case a measure of spatial ability), the correlation was rather modest ($r = .16$) and gender-dependent ($r = .27$ for men and $r = .09$ for women). A similar ($r = .19$), modest, correlation between SAI and psychometric intelligence was obtained in a cross-cultural

study by Furnham, Fong & Martin (1999), who compared estimates with scores on the Raven Standard Matrices.

Although significant correlations between SAI and psychometric intelligence have been consistently replicated, they have rarely been found to exceed $r = .30$ (Borkenau & Liebler, 1993; Paulhus et al, 1998). As Brand (1994) suggested, this correlation is likely to be even smaller in the general population, since most of the studies on this relationship involved data from highly educated (usually psychology) university students. Gabriel, Critelli and Ee (1994) found that, even when these samples are composed of individuals across which ability levels are not homogeneous (like in students from competitive universities), the correlation between SAI and psychometric intelligence does not exceed $r = .27$ (see also Brand, Egan & Deary, 1994). Nevertheless it is argued that SAI is important regardless of its accurate (i.e., whether it does correlate highly with psychometric intelligence). People's estimations of their own abilities are important because they can have a significant impact on performance (e.g., academic, work, and even IQ tests). This shall be discussed in the next section.

1.4.2 SAI and AP

The relationship between SAI and AP is representative of a longstanding research area (Social Cognition) which includes several overlapping constructs such as self-concept (Burns, 1982), self-efficacy (Bandura, 1986), success expectations, perceived controllability, attributional style (Metalsky & Abramson, 1981; Ryckman & Peckham, 1987), specifically "internal causes" (e.g., ability, effort).

Although the predictive power of SAI may be considerably lower than the one by psychometric intelligence, it is also well documented. However performance is more dependent on actual intellectual ability than on SAI. Thus believing one is intelligent when in fact one is not will not influence test scores much, while the opposite pattern (low SAI and high IQ) might. This phenomenon is usually referred to as expectancy effect, and has been found in a number of related constructs, e.g., self-monitoring (Stankov, 1999), self-handicap (Rhodewalt, 1990), self-evaluation (Morris & Liebert, 1974; Flett, Hewitt, Blanckstein & Gray, 1998), self-motivation (Zeidner, 1995), self-efficacy (Bandura, 1986; Matthews, 1999), self-concept (Rinderman et al, 2001), self-esteem and self-confidence (Koivula, Hassmen & Fallby, 2002).

Although research has yet to examine the relationship between SAI (as given by single or multiple estimations of one's intellectual ability/abilities) and the above listed constructs, it is likely that subjective self-beliefs in general affect performance (Zeidner, 1995). Moreover, there is also evidence that others' (as opposed to self) expectations, for instance parents' estimations of their children's abilities, may also influence objective performance (see Goodnow, 1980; Sigel, 1985; Furnham, 2000b). Hence the importance of examining not just objective but also subjective (or perceived) competencies.

Although all these variables seem to indicate that self-concepts (such as SAI) need not to be accurate in order to affect performance, there are conflicting hypotheses about the direction of this effect. Whereas some have identified and explained the processes by which low SAI may lead to poor performance (Bridgeman, 1974; Stipek & Gralinski, 1996), others have argued (and shown) that beliefs about superior ability may, if erroneous, lead to arrogance, complacency and equally impair performance.

Conversely, self-beliefs of poor intellectual ability may also lead to enhanced efforts and improve performance.

Dweck and her colleagues (e.g., Bempechat, London, & Dweck, 1991; Dweck, 1986) argued that personal beliefs and SAI may not be related to actual intellectual competence and yet have direct paths to performance (particularly in educational settings). Generally this would involve high SAI leading to performance improvement and vice-versa, although it is also possible that over-confidence or excessively high SAI may lead to the believe that academic success is a natural consequence of native intelligence and therefore undermine motivation and actual performance (Mueller & Dweck, 1998; see also section 1.4.4). Accordingly Furnham and Ward (2001) noted that “whilst some researchers seem concerned to study and help females who are seen to be biased in favour of modesty and lower-than-actual estimations (Beloff, 1992; Beyer, 1999), others believe it is more important to examine male biases and the potential negative consequences of hubris in self-estimated intelligence”(p.58). However negative concepts may not always lead to improved performance. As Nauta, Epperson and Wagoner (1999) showed, persistent university students tend to interpret their success as a consequence of their efforts, rather than their ability (this was found even when controlled for intelligence). Thus the relationship between SAI and AP remains to be examined. Further, given the likelihood that SAI have self-enhancing (or self-defeating) effects on AP, it seems of capital importance to examine other correlates of SAI, notably gender.

1.4.3 SAI and gender

In one of the first papers reviewing empirical evidence on indicators of SAI, Hogan (1978) reported the results of 11 different studies of American university students. These studies assessed participants' estimations of their own and their parents' intelligence, as well as their estimates of males' and females' intellectual ability in general. In comparison to males, females were found to underestimate their intelligence (give lower indicators of SAI) and that of their mothers' (in comparison to that of their fathers'). A later study by Beloff (1992) replicated these results on a Scottish sample and further specified and quantified the differences in estimation between gender, namely 1 SD higher for males (see also Byrd & Stacey, 1994). The author concluded that "young women students see themselves as intellectually inferior compared to young men... women see equality with their mothers, men with their fathers. Women see themselves as inferior to their fathers and men superior to their mothers. Mothers therefore come out as inferior to their fathers. The pattern has been consistent each year" (Beloff, 1992, p. 310).

Reilly and Mulhern (1995) compared SAI and psychometric intelligence in a sample of students who completed sub-tests of the WAIS and estimated their scores (after taking the test). It was found that males tended to give significantly higher estimations than their actual scores, while the opposite applied to females (although not significantly).

Most of the research on SAI has been directed by Furnham and colleagues (Furnham, 2000b; Furnham & Baguma, 1999; Furnham, Clark & Bailey, 1999; Furnham,

Fong & Martin, 1999; Furnham, Hosoe & Tang, 2003; Furnham & Rawles, 1995; Furnham, Shahidi & Baluch, 2003), who have paid particular attention to gender differences in self-estimates of intelligence.

Furnham and Rawles (1995) replicated the results of Beloff (1992) and Byrd and Stacey (1994), confirming that males tend to estimate their intelligence higher than females and that both tend to think of their fathers as more intellectually able than their mothers. The study also looked at gender differences in estimations of grandparents' intelligence and results showed the effect was also present here since both males and females rated their grandfathers' intelligence higher than their grandmothers'. In another study, Furnham and Gasson (1998) found that males' over-estimations were also present when participants were asked to estimate their children's intelligence.

A central question to interpret the systematic over-estimation of males' intelligence compared to that of females is whether gender differences in SAI correspond to gender differences in actual intellectual competence or whether, on the contrary, they are merely the reflection of inaccurate stereotypes. Accordingly Furnham and Rawles (1999) examined the relationship between SAI and psychometric intelligence (in this case a measure of spatial ability). The authors found that, although males tended to estimate their ability significantly higher than females, these differences were also present in psychometric intelligence. That is, males outperformed females in the cognitive ability test. However the correlation between SAI and psychometric intelligence was rather modest ($r = .16$), and would possibly have been even lower if different abilities had been assessed (as gender differences in psychometric intelligence are especially noticeable on spatial ability tests).

Research variations on the study of gender differences in SAI have included estimations of multiple – as opposed to general or single – intelligences. Studies in this area are usually based on Gardner’s (1983, 1999) theoretical framework. Although academics in the area of individual differences tend to support a single (or dual) rather than a multiple dimensional theory of intelligence, it is possible that lay people have differential evaluations (SAI) about their different skills or abilities. Further, they may also believe that men are better in *some*, but not in other, domains of intelligence.

This hypothesis was tested by Furnham (2000b), who examined parental beliefs of their own and children’s multiple intelligences. Fathers gave significantly higher estimates of mathematical ability for themselves, while mothers gave significantly higher estimates of mathematical and spatial ability for their children than fathers. Also parents in general believed their sons to be better in math than their daughters. Since mathematical and logical intelligence are considered the very essence of intellectual competence, Furnham (2000b) speculated that lay conceptions of intelligence may be male-normative.

Although the reviewed literature seems to indicate that estimations of males’ abilities are consistently higher than that of females’, a recent study has failed to replicate these results. Furnham, Rakow and Mak (2003) found that, although fathers tended to estimate their own spatial and mathematical intelligences higher than mothers and children, there were no significant gender differences in parents’ estimations of children’s intelligences. This has lead Furnham (2001b) to conclude that “the results of these studies seem reliant on the simple fact that we still are not clear whether the disparity

between male and female IQ estimates is a male overestimation, a female underestimation, a combination of both, or an accurate reflection of reality” (p.1394).

In another recent study involving more than 600 participants from New Zealand, Furnham and Ward (2001) asked people to estimate their multiple intelligences and found associations between gender and mathematical/logical, spatial and existential. Hence it is likely that these types of intelligences are male-normative. Also noteworthy was that subjects who had previously completed an ability test gave higher SAI on 8 of the 10 types of intelligences. It is thus possible that having taken an IQ test in the past may lead people to give higher estimations of their abilities. Alternatively, however, it may be the case that people with higher SAI tend to test their abilities more often (perhaps in the search of some feedback or confirmation of their high estimations).

Although the topic of gender differences in intellectual ability has always been academically controversial (Flynn, 1987; Furnham, 2001b; Lynn, 1998, 1999; Mackintosh, 1998), it is usually acknowledged that gender differences in psychometric intelligence are far too small to consider gender a relevant predictor of ability tests performance (Hyde, 1981; Reilly & Mulhern, 1995). It is therefore likely that the so called gender differences in SAI may be more precisely understood in terms of lay beliefs or stereotypes about gender on one hand and intelligence on the other (rather than in terms of gender differences in actual IQ). Hence the belief that men are more intelligent than women may vary across cultures, age and even gender (as it has been observed that men are more likely to support the belief of men superiority than women)(Flugel, 1947; see also Furnham, 2001b). Furthermore, Shipstone and Burt (1973) showed that stereotypes about gender differences in intelligence may suffer changes over time. Thus

gender difference may be stereotype-dependant rather than intrinsic, and lay conceptions of intelligence may determine the extent to which men and women underestimate and overestimate their intellectual ability.

As seen in the previous section (1.4.2) SAI may influence performance, not only in that it affects confidence on specific tasks such as examinations, but also in the sense of determining differences in motivation to invest on intellectual activities or prepare for specific examinations (particularly in academic settings). Beyer (1990, 1998, 1999) has also demonstrated that SAI (in terms of expectations and self-beliefs) may affect performance on ability tests. Thus stereotypes about gender differences in intellectual ability may lead to gender differences in psychometric intelligence, which would imply that SAI may have self-fulfilling effects rather than merely reflect differences in intellectual ability. Hence the importance of examining specific lay conceptions with regard to SAI.

1.4.4 SAI and lay conceptions of intelligence

Lay conceptions can be defined as implicit theories or beliefs constructed by individuals but not on the basis of academic research or scientific empirical evidence (Sternberg, 1990). These implicit theories are “constructions of people (psychologists or lay person or others) that reside in the minds of these individuals, whether as definition or otherwise” (Sternberg, 1990, p.54). The importance of this topic may result from at least three reasons.

First, the nature of beliefs or knowledge about intelligence is likely to influence self-judgements on ability, in the sense of providing a framework or comparative basis for the evaluation of one's skills. Thus if one believes intelligence is defined, say, as the capacity to solve maths problems, one will base his/her estimations on that specific capacity, and so on. Further, lay conceptions of intelligence may also determine people's assessment of others' intellectual competence (Sternberg, 1990). Second, conceptions about intelligence may have significant educational and social consequences. Particularly beliefs or attitudes related to the measurement of intelligence (psychometric intelligence) may be of special importance. If, say, one believes ability tests to be biased or flawed, he/se will be likely to discourage their use in many settings such as school and job recruitment (Furnham, 2001b). Third, it is possible that lay conceptions of intelligence may affect not only SAI but also actual performance (Pommerantz & Ruble, 1997). As Beyer observed, "self-perceptions that are out of touch with reality not only reveal a lack of self-knowledge but may also impede effective self-regulation and goal setting in academic, professional and interpersonal situations" (Beyer, 1999, p.280). It is however not clear under what specific circumstance self-beliefs may be positive or negatively correlated with performance, as both negative and positive self-beliefs may result in poor performance, through either self-fulfillment of prophecies or complacency, respectively (Furnham, 2001b). A fourth reason could also be added, namely that lay conceptions may be precursors of academic hypotheses (Sternberg, 1985). Thus exploring people's beliefs about intelligence may encourage research on new hypotheses and help to develop further theories. As Sternberg noted, lay conceptions may expand and change academic theories, "as we come to realise those aspects of cognition or affect

which the current explicit theories of intelligence, creativity, and wisdom do not encompass, but possibly, should encompass” (Sternberg, 1985, p.625).

In what may arguably be considered the first research paper examining popular views on intelligence, Flugel (1947) analysed responses (N = 302) on a 16-item questionnaire. He found that lay people were more likely to confuse the concepts of intelligence, knowledge, experience and achievement. Moreover, the author found that lay individuals tend to overrate the importance of knowledge in ability tests. It is interesting that 50 years after Flugel’s (1947) study, research on individual differences has seemed to shift from a more Gf-based paradigm to a rather Gc (and knowledge) conception of intelligence (see Ackerman, 1999). However Shipstone and Burt (1973) replicated Flugel’s experiment on a sample (N = 575) of British adults and found that lay persons tended to adopt more unidimensional conceptions of intelligence (such as the general factor of ability). Whether this difference may have been due to differences in samples or time (a period of 25 years) between the studies may be difficult to confirm. In any case, Shipstone and Burt’s (1973) results reflect the variability of lay theories of intelligence (across groups and periods of time) as well as the diversity of (often conflicting) concepts and perspectives they comprise. This may illustrate how lay conceptions can precede academic theories (Sternberg, 1985, 1990).

Noteworthy is, that negative attitudes towards ability tests were present in both Flugel’s (1947) as well as Shipstone and Burt’s (1973) studies. Lay conceptions on IQ and testing may therefore be a crucial topic for research and testers since they may negatively predispose testees and participants involved in studies employing ability/IQ tests. As Eysenck (1998) observed (in a criticism to Gardner, 1983), “you only have to

attack the IQ to become famous and popular; however nonsensical the attack, and however weak the alleged evidence for your system” (p.109).

Perhaps the most influential aspect underlying lay conceptions of intelligence is concerned with the aetiology of intellectual competence, specifically whether intelligence may increase over time (incremental) or remain unmodified and stable from its origins (entity)(Faria & Fontaine, 1997). Nicholls (1990) and Dweck (1986) first noted that students who hold entity conceptions of intelligence were more likely to perceive their poor performance as a true reflection of their capacity. Further, these students would be less likely to engage in systematic studying and commit their efforts to improve (see also Pommerantz & Ruble, 1997). By contrast, individuals who support incremental theories of intelligence would be more likely to conceive poor AP as contingent and motivate themselves to improve their performance (see also Boekaerts, 1995). Hence lay conceptions and SAI may be propaedeutic (i.e., preparatory and conditional) to learning, rather than mere correlates of AP.

1.4.5 SAI and personality traits

Although there is currently no consensus on whether the SAI dimension should be considered part of intelligence (Stankov, 2000) or personality (Hofstee, 2001), it could be that, as Eysenck and Eysenck (1985) have argued, personality is related to SAI rather than psychometric abilities. This is certainly true from a methodological perspective, since SAI is essentially a self-report measure. However only few studies have provided empirical evidence for the relationship between SAI and personality. Furnham, Kidwai and Thomas (2001) found Neuroticism (negatively) and Extraversion (positively) to be

significantly correlated with SAI, i.e., stable extraverts estimated their intelligence significantly higher than others. These two personality traits were found to account for nearly 20% of the variance in SAI. This relationship may be attributed to the high and low confidence of extraverts and neurotics, respectively.

As discussed (1.2.3.3.2), it is also likely that Openness to Experience is related to SAI, since both variables refer to self-report intellectual competence. Regarding the other two Big Five personality super-traits, Agreeableness and Conscientiousness, hypotheses are not so clear. Agreeableness may be expected to be negatively related to SAI, since agreeable individuals tend to be more modest than disagreeable ones. However Conscientiousness may be equally expected to relate to high or low SAI: on one hand, it is possible that the fact that Conscientiousness is positively associated with AP may lead conscientious individuals to give higher SAI. On the other hand, recent studies have indicated that Conscientiousness may be negatively related to IQ. Thus (if individuals can accurately estimate their ability) conscientious individuals would be more likely to give lower SAI. Given the lack of evidence on the relationship between well-established personality traits and SAI, and considering the importance of SAI with regard to academic as well as IQ-test performance, it is necessary to further explore the link between personality traits and SAI.

1.5 Conclusions and research hypotheses

The first section of this review has examined the literature on the relationship between personality and psychometric or measured intelligence. Several researchers have recently argued that this relationship is of fundamental importance within the study

of individual differences, for both constructs (personality and intelligence) account for most of the psychological variability between individuals (Austin et al, 2002; Ackerman & Heggestad, 1997; Hofstee, 2001). However empirical evidence is far from established; on the contrary the literature often refers to conflicting findings and there appears to be more disagreement than agreement on the dimension (size), direction (positive or negative) and nature (underlying processes) of the relationship between personality and psychometric intelligence.

Meta-analytical studies, which represent the most robust psychometric attempt to identify empirical links between latent constructs, have clarified many inconsistencies by providing sound correlational evidence for the relationship between the Big Five (Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness) and the two main dimensions of psychometric intelligence, namely Gf and Gc (see Akerman & Heggestad, 1997). Results indicated that Neuroticism, Extraversion and Openness to Experience are significantly related to psychometric intelligence. However correlations were not large enough to establish a consensus and, even when researchers have referred to the same data, their conclusions have been different enough to either support (Zeidner, 1995, 1998; Zeidner & Matthews, 2000) or reject (Ackerman & Heggestad, 1997; Austin et al, 2002) the idea that personality and intelligence are essentially unrelated constructs.

Part of the disagreement may be overcome by looking specifically at each personality factor and the different variables that may mediate or moderate its relationship to psychometric intelligence.

Studies on Neuroticism (trait anxiety) have suggested that this personality dimension is mainly related to performance impairment (particularly under stressful conditions)(Sarason, 1980; Zeidner, 1995, 1998). Hence the modest correlations between psychometric intelligence and trait anxiety inventories may be understood as a product of psychometrics, since intelligence is measured through performance, and usually under arousing conditions. However it has been also pointed out that the feelings of negative self-concept associated with neurotic personalities may eventually impair intellectual competence and not just test-performance (Muller, 1992). In that sense it may be important to examine how subjective beliefs or estimations of ability may relate to both Neuroticism and psychometric intelligence.

Studies on Extraversion suggest that its relationship to psychometric intelligence may depend on the type of ability measured (verbal, numerical, spatial) as well as more specific characteristics of the tests (e.g., timed/un-timed, length, written/oral)(see Eysenck, 1994a; Rawlings & Carnie, 1989; Revelle, Amaral & Turiff, 1976). However several studies have yielded conflicting findings, suggesting that the generality of the results on Extraversion and ability measures may be problematic (see Rawlings & Skok, 1993; Furnham, Forde & Cotter, 1998a). Perhaps it is necessary to examine other indicators of intellectual competence such as AP in order to understand whether Extraversion may merely affect test-taking styles, or also play a significant role in the development of skills and knowledge.

The third correlate of psychometric intelligence, namely Openness to Experience, has been a central topic of most of the theoretical debate about the personality-intelligence interface. Although Openness appears to be more related to psychometric

intelligence than Extraversion and Neuroticism (Ackerman & Heggestad, 1997), its status within the realm of individual differences is not clear. Moderate correlations between Openness and psychometric intelligence, particularly Gc (Ackerman & Heggestad, 1997; Austin et al, 2002; Jackson, 1984a), have led some researchers to interpret this factor as a dimension of intelligence rather than personality (see Brand, 1994). Others have however preferred to regard Openness as part of personality, mainly because it is assessed by self-report inventories rather than maximal performance tests (see Cronbach, 1949; Hofstee, 2001; McCrae & Costa, 1997a). In that sense Openness could be expected to relate to typical rather than maximal intelligence, as it has in fact been proposed by Ackerman (Ackerman & Goff, 1994; Goff & Ackerman, 1992). In that case, Openness appears to be influential for the actual development of intellectual competence, rather than merely affect ability test performance (like Neuroticism and Extraversion). However psychometric evidence on the relationship between Openness and intelligence is far from conclusive; research should explore not only the links between Openness and psychometric intelligence, but also AP and subjective indicators of intelligence (such as self-estimates of abilities).

The relationship between psychometric intelligence and the Big Five traits Agreeableness and Conscientiousness remains an even more important research question, as these personality dimensions have not been as thoroughly examined as Openness, Neuroticism, and Extraversion. Although some meta-analytical and reviews have suggested that Agreeableness and Conscientiousness are virtually unrelated to intellectual ability, recent papers (notably Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003) may question this. Thus further research is needed to shed light on the

relationship between intellectual competence, Agreeableness and Conscientiousness; particularly their relationship to subjectively-assessed intelligence and AP appears to be a fertile and promising research field, since both Agreeableness and Conscientiousness may be related to self-concept of intelligence (SAI) as well as course work (AP).

The second section of this review was concerned with the relationship between personality and AP, rather than psychometric intelligence. Further, personality was conceived not only in terms of the Big Five, but also the Gigantic Three (Eysenck & Eysenck, 1985). Previous research on the relationship between AP and the main Eysenckian personality dimensions seems to suggest that (to a greater or smaller extent) Neuroticism, Extraversion and Psychoticism are all negatively associated with academic success (Anthony, 1973; Entwistle & Entwistle, 1970; Eysenck & Eysenck, 1985; Goh & Moore, 1987). Evidence based on more recent research has indicated that the Big Five traits Openness and Conscientiousness may be also significantly (but positively) related to AP (see De Raad, 1996; De Fruyt & Mervielde, 1996; Busato et al, 2000). It is likely that several personality traits (notably Neuroticism and Conscientiousness) may have a significant impact in the processes underlying AP, and may thus partly determine the results of school/college examinations.

It appears that the main aspects through which personality traits may be beneficial in educational settings are motivation and the ability to become absorbed in tasks (Dobson, 2000; Sarason, Sarason & Pierce, 1995). The importance of motivation may be reflected in the correlations between AP and Conscientiousness (positively) on one hand, and AP and Psychoticism (negatively) on the other (see Barrick, Mount & Strauss, 1993; Sackett et al, 1998). Motivation, achievement striving, dutifulness and responsibility are

all positively represented in Conscientiousness and negatively in Psychoticism. It thus seems likely that individual differences in these traits may result in either lazy or hard-working students, which would lead to differences in AP.

On the other hand, the negative correlation between Extraversion and AP may reflect introverts' advantage to concentrate in academic tasks, inside and outside the classroom (e.g., studying at home). Certain aspects of personality, such as the tendency to worry (high Neuroticism) or to be uncooperative (high Psychoticism, low Agreeableness, low Conscientiousness), may impair, rather than facilitate, academic achievement. To the extent that these personality traits are negative predictors of AP, it would be important to distinguish between low intellectual ability (capacity) and low grades (actual performance). In a way, this difference is reflected in the distinction between maximal and typical performance, since intellectual capacity may be manifested on a performance test, but not on a day-to-day basis.

However, a consistent psychometric relationship between personality traits and AP has yet to be demonstrated. Even if the prediction of AP may be improved with measures of typical performance (e.g., personality inventories), individual differences in AP seem to be less central to personality than to ability (Matthews et al, 2000). At this stage, empirical and theoretical reasons may be insufficient to encourage the use of personality inventories in the prediction of AP, but not to discourage further research on personality and AP. If personality traits are more related to AP than to psychometric intelligence (Rindermann et al, 2001), research on AP may reveal important aspects on the relationship between personality and intellectual competence and, further, demonstrate the relevance of personality traits to educational settings.

The third section of this review has discussed the relationship between SAI and a number of constructs such as gender, AP, lay conceptions of intelligence and personality traits. Although the study of SAI has been initially aimed at examining an individual's accuracy to estimate his/her intellectual competence (Furnham, 2001b), several areas of research have evidenced the importance of SAI itself (rather than merely in relationship to actual IQ scores).

There is a longstanding tradition in social psychology concerned with the study of self-concept or self-evaluation. Within this area (usually referred to as social cognition), there are several authors that have been concerned with the real-life correlates of subjective measures such as self-efficacy (Bandura, 1986), self-monitoring (Stankov, 1999), or attributional style (Metalsky & Abramson, 1981). The more recent concept of SAI is thus relevant with regard to indicators of performance, not only on academic exam grades, but also on psychometric intelligence tests.

There is relatively recent but consistent evidence that SAI is significantly correlated with psychometric intelligence (Furnham, 2001b; Furnham & Rawles, 1995, 1999). Although this correlation has usually been interpreted in terms of "insight" (which would imply an effect of *actual* ability on SAI)(Furnham & Rawles, 1995; Paulhus et al, 1998), it is equally possible that people's estimations (SAI) may directly affect performance on IQ tests (Bandura, 1986). Thus SAI may have self-fulfilling effects: feeling "bright" may enhance confidence and improve performance (for instance on exams or psychometric tests), while the opposite feeling may impair it.

Hence intellectual competence should not only be conceptualised in terms of psychometrically measured intelligence or AP, but also considering SAI. Further, it is

likely that SAI is also related to a number of non-cognitive variables such as gender (Furnham, Fong & Martin, 1999), interests (Ackerman & Heggestad, 1997), lay theories of intelligence (Furnham, 2001b), and personality (Furnham & Thomas, 2003). Particularly the relationship between SAI and personality traits has yet to be explored and appears an important aspect of the more general area of research that concerns the personality and intellectual competence interface.

Table 1.7: Conceptual framework presenting correlations among personality traits and indicators of intellectual competence

	Psychometric intelligence	Academic performance	Subjectively-assessed intelligence
Neuroticism	-	--	--
Extraversion	+/-	--	++
Openness	++	+	++
Agreeableness	(+)	+	--
Conscientiousness	-	++	(+)

+ = positive relation, - = negative relation, +/- variable, () = weak, ++, -- = moderate

To conclude, Table 1.7 presents a conceptual framework for the prediction of the relationships between personality traits and intellectual competence (psychometric, academic, and subjectively assessed). Each of the cells is ought to be tested in order to obtain a clear understanding of the relationship between personality and intellectual ability. Specific hypotheses will be presented and discussed in the correspondent sections of the following empirical chapters.

Chapter 2: The relationship between the Big Five, psychometric and subjectively-assessed intelligence (four studies reported)

STUDY 1

2.1 Introduction

As noted in chapter 1, although in the history of research into individual differences most researchers have treated personality and intelligence as relatively independent (Barratt, 1995; Zeidner & Matthews, 2000), some have attempted to show how these two constructs are conceptually and empirically related. These attempts have come from two different approaches. The first is the psychometric approach, which focuses predominantly on the measurement and structure of personality and intelligence, and seeks to identify correlations between these phenomena (e.g., Ackerman & Heggestad, 1997; Furnham, Forde & Cotter, 1998ab; Zeidner, 1995). The second is the cognitive science approach, which looks at biological, cognitive and adaptive processes that contribute to both constructs (Eysenck, 1982; Matthews, 1986; Revelle, Amaral & Turiff, 1976; Robinson, 1985). These studies are in the tradition of the psychometric approach.

One difficulty underlying the psychometric approach is that there are several competing theories for the structure of intelligence and (to a lesser extent) personality. Most theories of intelligence, notably Cattell's (1971), are based on hierarchical models. These models originated from Spearman (1927), who proposed that intelligence consisted of a general (g) factor and a set of specific (s) factors. Based on Spearman, Cattell (1941) elaborated one of the most prominent theories of intelligence, distinguishing between fluid (Gf) and crystallized (Gc) intelligence. While Gf is dependent on the efficient functioning of

the central nervous system, Gc is dependent on experience and education within a culture. Other current predominant theories that differentiate between types of intelligence include Sternberg's (1991) triarchic theory of intelligence and Gardner's (1999) theory of multiple intelligence, although these theories have yet to gain academic recognition among differential psychologists. In the area of personality structure, current researchers (Busato, Prins, Elshout, & Hamaker, 2000; De Raad, 1996; Digman, 1990; Furnham, 1996ab, 1997) seem to agree on the psychometrical advantages of the Big Five Model proposed by Costa and McCrae (1992). Most of the recent literature which deals with the main personality correlates of intelligence has thus focused on the relationship between intelligence tests and the Big Five personality traits, although there is an earlier literature looking at other personality traits (see Brand, 1994; Matthews & Deary, 1998).

In general, studies report non-significant or low correlations between personality traits and intelligence test scores (Brebner & Stough, 1995; Eysenck, 1994a). However, recent research has suggested that personality traits may have more important distal rather than primal role effects. Thus Furnham (2001a) suggested that personality variables influence test-taking style, which in turn influences intelligence test scores. This study will focus on another relate variable, namely self-estimated or subjectively-assessed intelligence (SAI). SAI is currently a topic of considerable research, specifically with respect to a widely replicated pattern for females to give lower SAI than males (Borkenau & Liebler, 1993; Furnham, 2001b; Gabriel, Critelli & Ee, 1994). Various studies have shown modest but significant (around $r = .30$) correlations between SAI and psychometric or measured intelligence (Hogan, 1978; Paulhus, Lysy & Yik, 1998). Recent studies have also shown that personality traits are significantly related to SAI (Furnham, Kidwai & Thomas, 2001,

Furnham & Thomas, 2003). It may thus be possible that personality traits influence SAI, which in turn is related to psychometric intelligence.

Furnham and Thomas (2003) examined parents' personalities with regard to SAI. Openness to Experience, Agreeableness and Neuroticism significantly predicted SAI (over and above demographic variables) and the Big Five traits in total accounted for 17% of the variance in SAI. Similarly, Furnham, Kidwai and Thomas (2001) examined the relationship between personality, SAI and psychometric intelligence using the Gordon Personality Profile, and measures of verbal, numerical, and spatial intelligence. SAI correlated significantly with numerical intelligence ($r = .42$) in males, and with verbal ($r = .40$) and spatial intelligence ($r = .55$) in females. Although personality dimensions did not predict psychometric intelligence, they were significantly related to SAI (notably Extraversion, positively). Again, personality accounted for 17% of the variance in SAI scores, and it was concluded that personality factors are more powerful predictors of SAI than of psychometric intelligence.

Theoretically it is possible to develop a link between each of the Big Five traits and measures of intelligence (Furnham, Forde & Cotter 1998a).

Neuroticism: In a large meta-analytical study, Ackerman and Heggestad (1997) reported a significant, albeit modest, correlation between intelligence and Neuroticism ($r = -.15$). According to Hembree (1988), Matthews (1986), and Zeidner (1995), at least three Neuroticism sub-facets - i.e., anxiety, angry hostility, and depression - may affect psychometric intelligence. Anxiety has been found to impair intellectual functioning in a variety of contexts, ranging from intelligence tests to school achievement. Results of Ackerman and Heggestad's (1997) study reported a correlation of $r = -.33$ between g and

self-report measures of test anxiety. Research on the effects of anger also revealed that there is a general tendency for low intelligence to be associated with increased aggression and delinquency (Zeidner, 1995). Previous research would also suggest that Neuroticism may be associated with lower SAI (Furnham & Thomas, 2003). Further, it has been argued that negative self-estimations may influence test performance (Wells & Matthews, 1994).

Extraversion: In a study of adolescents, Lynn, Hampson and Magee (1982) found correlations between intelligence and Extraversion of $r = .21$ for males and $r = .19$ for females. However, Ackerman and Heggestad (1997), in their meta-analysis, found a smaller, though still significant, correlation between g and Extraversion ($r = .08$). Further, it has been suggested that the correlation between Extraversion and psychometric intelligence may vary from positive to negative, depending on the type of ability measure. Zeidner (1995) proposed that introverts have an advantage in tasks related to superior associative learning ability (verbal tasks), whereas extraverts have an advantage in tasks related to ready acquisition of automatic motor sequences (performance tasks). In a pioneering study, Revelle, Amaral and Turriff (1976) noted an interaction between Extraversion and test conditions, which could be explained by the arousal theory (Eysenck & Eysenck, 1985). Extraverts consequently trade off accuracy for speed when taking an ability test, thus having slightly different results to introverts, depending on the demands of the test: specifically whether it is timed and how long it takes. Extraverts would seem to have an advantage when tests are short (2 to 5 minutes) and timed. Further, previous research would suggest that the self-confidence associated with Extraversion would mean Extraversion would be positively associated with SAI (Furnham, Kidwai & Thomas, 2001; Furnham & Thomas, 2003).

Openness to Experience: The personality factor which is considered to correlate most strongly with intelligence is Openness to Experience (Zeidner & Matthews, 2000). However, researchers have noticed that Openness specifically correlates with Gc (Brand, 1994). Goff and Ackerman (1992) reported a correlation of $r = .40$ between Openness to Experience and Gc. A possible explanation for this is that individuals who are open to experience are more motivated to engage in intellectual activities. Additional psychometric evidence in support of this hypothesis can be found in the high association between Gc and typical intellectual engagement (TIE), a scale developed by Goff & Ackerman (1992). When compared to personality measures, TIE showed a significant correlation with Openness to Experience ($r = .65$), as well as with Conscientiousness ($r = .27$) (Ackerman & Goff, 1994). Studies of authoritarianism - in some sense the opposite of Openness to Experience - also provide evidence for a link between Openness to Experience and intelligence. Authoritarianism has been found to be negatively correlated to both Openness to Experience ($r = -.57$; Trapnell, 1994) and intelligence (up to $r = -.50$; Zeidner & Matthews, 2000). Furnham and Thomas (2003) found Openness to be the strongest Big Five predictor of SAI, which requires replication.

Agreeableness: Among the Big Five personality traits, Agreeableness seems to be the least related to ability. In their meta-analysis, Ackerman and Heggestad (1997) reported a very low zero-order correlation between g and Agreeableness ($r = .01$). In another large-scale study, Kyllonen (1997) reported very modest correlations between ability measures and Agreeableness. This pattern of results confirms the theoretical independence of Agreeableness from g , since none of the primary sub-facets of Agreeableness, i.e., trust, straightforwardness, altruism, compliance, modesty, tender-mindedness, appear to be theoretically related to mental ability. However, it should be noted that the “modesty” scale

could be linked to intelligence indirectly, through SAI. There are two ways this could happen. On one hand, high modesty may be indicative of low SAI, and it is known that SAI are relatively accurate (Furnham, Fong & Martin, 1999). On the other hand, modesty may be associated with lack of confidence, which may result in lower performance, for instance on IQ tests. Indeed Furnham and Thomas (2003) found Agreeableness to be negatively correlated with SAI.

Conscientiousness: Like Agreeableness, most of the literature seems to indicate that Conscientiousness is only weakly related to ability (Ackerman & Heggestad, 1997; Kyllonen, 1997; Zeidner & Matthews, 2000). However, two recent studies have found significant and *negative* correlations between Conscientiousness and various measures of intelligence (Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003). The authors suggested that these correlations could be explained in terms of “compensation”. Thus less able individuals (particularly in competitive settings) may *compensate* for their lower intellectual ability by becoming more conscientious, i.e., trying to be more organized, disciplined, methodical and efficient. While evidence for the negative correlation between Conscientiousness and psychometric intelligence is far from conclusive, there is a great deal of research showing that Conscientiousness may have beneficial effects on both academic and occupational performance (Barrick & Mount, 1993; Blickle, 1996; De Raad, 1996; De Raad & Schouwenburg, 1996; Geisler-Brenstein & Schmeck, 1996; Goff & Ackerman, 1992; McHenry, Hough, Toquman, Hanson & Ashworth, 1990; Rothstein, Paunonen, Rush & King, 1994; Wiggins, Blackburn & Hackman, 1969). On the other hand, Furnham (1999) reported a negative, albeit nearly significant, relationship between Conscientiousness and creativity. Since the correlation between psychometric intelligence and creativity is positive, Furnham’s (1999) results may suggest that Conscientiousness is negatively related to Gf.

Studies on the correlation between Conscientiousness and SAI have shown few significant results (Furnham & Thomas, 2003).

Although the above-reviewed literature may provide psychometric evidence for the relationship between personality and psychometric intelligence on one hand, and personality and SAI on the other, the reported correlations are rather modest (and often non-significant). Moreover, the limited amount of empirical studies in this area seems to suggest that evidence on the relationship between personality and self-assessed as well as psychometric intelligence is far from conclusive. The present study will therefore investigate the relationship between personality traits (specifically the Big Five) and psychometric as well as self-assessed intelligence. Further, the relationship between gender, psychometric intelligence, and SAI will be also explored. To this end, the NEO-PI-R will be examined with regard to SAI and scores on two psychometric intelligence tests, i.e., the Wonderlic Personnel Test (Wonderlic, 1992)(a measure of general intelligence) and the Baddeley Reasoning Test (Baddeley, 1968)(a measure of fluid intelligence). Self-evaluation (SEV) of performance on the Wonderlic Personnel Test (immediately after completion of this test) will be examined as a direct indicator of participants' insight into their intellectual abilities.¹ These variables will be also examined with regard to gender. Several hypotheses will be tested:

H1: personality traits will be modestly related to psychometric intelligence. It is expected to replicate the results of previous researchers (e.g., Ackerman & Heggestad, 1997; Furnham et al, 1998ab; Lynn, Hampson & Magee, 1982; Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003) by finding significant correlations between

¹ Following Stankov & Crawford (1996), SEV and self-confidence are components of meta-cognition, i.e., "higher order knowledge or a 'super program' that regulates performance on a cognitive task" (p. 971).

intelligence test scores and some of the Big Five personality factors. Specifically, it is expected that:

H1a: there will be significant negative, albeit modest, relations between Neuroticism and both intelligence measures. These relationships would be in line with previous findings (e.g., Ackerman & Heggestad, 1997; Hembree, 1988), and confirm the idea that Neuroticism is likely to impair performance on examinations such as IQ tests.

H1b: Extraversion will be significantly and positively related to psychometric intelligence, particularly to Baddeley Reasoning scores (since this is a rather short, i.e., 3-minutes, intelligence test). Significant, albeit modest, correlations between Extraversion and intelligence would confirm the results of Ackerman and Heggestad's (1997) meta-analytic study, as well as other, smaller-scale, studies (e.g., Furnham, Forde & Cotter, 1998a; Lynn, Hampson & Magee; 1982).

H1c: Openness to Experience will be positively and significantly correlated with psychometric intelligence, particularly with the Wonderlic Personnel Test. Positive and significant correlations between these variables would replicate the results of meta-analytic (Ackerman & Heggestad, 1997) as well as more recent (e.g., Austin et al, 2002) studies. Since the Baddeley Reasoning test measures Gf rather than Gc, it is predicted that correlations between this test and Openness will be more modest than those between Openness and Wonderlic scores.

H1d: Conscientiousness will be significantly and negatively related to psychometric intelligence. This association would be consistent with recent studies that found negative and significant relationships between Conscientiousness and ability measures (Moutafi, Furnham & Crump, 2003; Moutafi, Furnham, & Patiel, 2003). Furthermore, confirmation

of this hypothesis would provide support for the idea that high Conscientiousness may partly develop as a compensation for low intellectual ability.

H2: SAI /SEV and intelligence test scores will be significantly related (between $r = .20$ and $r = .30$). This would suggest that people are, to some extent, aware of their intellectual abilities, as several studies have suggested in the last 10 years of research into SAI (Furnham, Fong & Martin; 1999; Furnham & Rawles, 1995; see Furnham, 2001b for a detailed review on the topic).

H3: SAI and SEV will be significantly associated with personality traits. Although very few papers (e.g., Furnham, Kidwai & Thomas, 2001) have examined the relationship between SAI and established personality traits, it is expected that:

H3a: Neuroticism will be significantly and negatively correlated with SAI/SEV. This would be interpreted in terms of the lack of confidence that characterises trait anxious individuals (Wells & Matthews, 1994)(see also Furnham, Kidwai & Thomas, 2001).

H3b: Extraversion will be significantly and positively correlated with SAI/SEV. This would be expected in terms of the assertive nature of extraverts (Costa & McCrae, 1992). Further, previous results have shown that extraverts tend to over-estimate their abilities (while the opposite applies to introverts)(see Furnham, Kidwai & Thomas, 2001).

H3c: Openness to Experience will be significantly and positively correlated with SAI and SEV. This would be consistent with Furnham and Thomas's (2003) study, in which Openness was found to be the strongest predictor of SAI. Theoretically, this can be explained by the fact that Openness and SAI/SEV are all measured through self-report items and refer to people's typical intellectual performance (see Cronbach, 1949; Goff & Ackerman, 1992; Hofstee, 2001).

H3d: Agreeableness will be significantly and negatively related to SAI/SEV. Since agreeable individuals are typically more modest than disagreeable ones (Costa & McCrae, 1992), it is expected that agreeable participants will report lower SAI and SEV than disagreeable ones.

H4: there will be significant associations between gender and SAI/SEV. Specifically, it is expected to replicate previous findings showing that males tend to report higher SAI than females (e.g., Borkenau & Liebler, 1993; Furnham, 2001b; Gabriel, Critelli & Ee, 1994).

H5: to the extent that H1 (a, b, c, and d) is confirmed, personality traits (Big Five) are expected to significantly predict psychometric intelligence scores. Hence there will be significant Big Five predictors of intelligence (Neuroticism, Extraversion, Openness and Conscientiousness). Further, it is expected that these personality traits will show some incremental validity with regard to SAI in the prediction of psychometric intelligence.

H6: there will be no significant correlations between gender and psychometric intelligence. Although some researchers support the idea that males outperform females on mathematical and spatial intelligence tests, whereas females outperform males on verbal intelligence tests (Maccoby & Jacklin, 1980), there is a general consensus that there are no significant gender differences in g (Brody, 2000; Deary, 2001; Halpern, 1992; Jensen, 1998; Loehlin, 2000).

To recap, this study will examine the relationship between gender, personality traits, self-assessed (SAI/SEV) and psychometric intelligence. It is expected that Neuroticism, Extraversion, and Openness will be significantly related to psychometric intelligence as well as SAI/SEV. Significant associations between Conscientiousness and psychometric

intelligence, and Agreeableness with SAI/SEV, are also predicted. SAI/SEV are expected to relate to both gender and psychometric intelligence. Finally it is hypothesised that personality traits will show some predictive validity with regard to psychometric intelligence. A series of correlations and hierarchical regressions will be performed on the data to test these hypotheses.

2.2 Method

Participants

Participants were 100 (63 of whom were females) undergraduate students at University College London. Their ages ranged from 17 to 45, with an arithmetic mean of 19.81 (SD = 3.71) years. Out of the 100 participants, 80 were native and 20 non-native (but fluent) English speakers. There were no significant native language differences in any of the measures (Wonderlic Personnel test, Baddeley Reasoning test, NEO-PI-R, SAI, and SEV).

Measures

The Wonderlic Personnel Test (WPT)(Wonderlic, 1992). This 50-item test is administered in 12 minutes and measures general intelligence. Scores can range from 0 to 50. Items include word and number comparisons, disarranged sentences, serial analysis of geometric figures and story problems that require mathematical and logical solutions. The test has impressive norms and correlates very highly ($r = .92$) with the WAIS-R (see Wonderlic, 1992).

The Baddeley Reasoning Test (BRT)(Baddeley, 1968). This 60-item test is administered in 3 minutes and measures Gf through logical reasoning. Scores can range from 0 to 60. Each item is presented in the form of a grammatical transformation that has to

be answered with 'true'/'false', e.g.: "A precedes B – AB" (true), or "A does not follow B – BA" (false). The test has been employed previously in several studies (e.g., Furnham, Gunter & Peterson, 1994; Hammerton, 1969) to obtain a quick and reliable indicator of people's intellectual ability.

The NEO Personality Inventory - Revised (NEO-PI-R)(Costa & McCrae, 1992). This 240-item, non-timed questionnaire measures 30 primary personality traits and its underlying "Big Five" personality factors, i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Items involve questions about typical behaviors or reactions that are answered on a five-point Likert scale, ranging from "strongly disagree" to "strongly agree". The manual shows impressive indices of reliability and validity (see Costa & McCrae, 1992).

Procedure

Participants were tested simultaneously in a large lecture theatre in the presence of five examiners who ensured the tests were appropriately completed. Participants were first requested to report their SAI. In order to standardize SAI, the normal distribution of intelligence scores (the possible range was 0-155), including labels for "retardation", "low average", "average", "high average" and "gifted", was presented to the participants. The bell curve showed standard deviation scores each with the appropriate label. After that, they completed the WPT, which had a time limit of 12 minutes. Once the WPT was completed, they were requested to estimate performance on that test (SEV)(like for SAI, the possible range for SEV was 0-155). Participants then completed the NEO-PI-R, for which there was no time limit. A week later, they were gathered in the same lecture theatre to complete the

BRT under similar test conditions. Completion of the BRT took 3 minutes and was supervised by four examiners.

2.3 Results

Correlations: Correlations between the NEO-PI-R, WPT and BRT scores are presented in Table 2.1. As can be observed, the only significant correlation between personality traits and psychometric intelligence was between Conscientiousness and BRT scores, $r = -.21$, $p < .05$ (i.e., high conscientious participants tended to have lower BRT scores). This confirmed H1d. There was also a modest and positive correlation between Extraversion and BRT scores, but this correlation did not reach significance levels, $r = .14$, $p = .19$. H1a, H1b and H1c were therefore not confirmed. Further, none of the Big Five traits were significantly correlated with WPT scores. The highest Big Five correlates of WPT scores were Neuroticism, $r = -.12$, $p = .24$, and Openness to Experience, $r = .11$, $p = .29$.

Table 2.1 Correlations between gender, Big Five, SAI, psychometric intelligence, and SEV

	SAI	BRT	WPT	SEV
Gender	.42**	.03	.11	.37*
Neuroticism	-.24*	-.08	-.12	-.25*
Extraversion	.06	.14	.09	.06
Openness	.12	.09	.11	.19
Agreeableness	-.23*	-.05	.02	-.17
Conscientiousness	-.03	-.21*	.01	-.06
SAI	-	.19	.27**	.77**
BRT	.19	-	.53**	.25*
WPT	.27**	.53**	-	.51**

** $p < .01$, * $p < .05$ N = 100

There was a high correlation between SAI and SEV, $r = .77$, $p < .01$, showing that participants who gave higher SAI tended to evaluate their performance on the WPT higher.

Confirming H2, WPT scores correlated significantly with SAI, $r = .27$, $p < .01$ (participants who gave higher indicators of SAI tended to score significantly higher on WPT and vice-versa), and with SEV, $r = .51$, $p < .01$ (participants who scored higher on the WPT tended to evaluate their performance on the WPT significantly higher and vice-versa). BRT scores correlated significantly with SEV, $r = .25$, $p < .05$ (participants who rated their performance on the WPT higher, tended to score higher on the BRT and vice-versa)(which further confirmed H2), but not with SAI, $r = .19$, $p = .08$. As predicted in H4, gender was significantly correlated with both SAI, $r = .42$, $p < .01$, and SEV, $r = .37$, $p < .01$ (males tended to give significantly higher SAI and SEV than females). Neuroticism correlated significantly with SAI, $r = -.24$, $p < .01$, and SEV, $r = -.25$, $p < .01$ (participants high on Neuroticism tended to give lower SAI and SEV)(this confirmed H3a), whereas Agreeableness correlated significantly with SAI, $r = -.23$, $p < .05$ (highly agreeable participants tended to give lower SAI)(this confirmed H3d).

Hierarchical regressions: In order to investigate more thoroughly the relationship between intelligence tests, personality traits, SAI, SEV, and gender, a number of hierarchical regressions were performed on the following dependant variables:

a) WPT: Model 1 showed that SAI was a significant predictor of WPT scores, accounting for 7% of the variance in ($F(1, 96) = 7.90$, $p = .01$, $Adj. R^2 = .07$, $st.\beta = .28$, $t = 2.81$, $p < .01$). This further confirmed H2. Model 2, which also included the Big Five personality traits as independent variables, and Model 3, in which gender was added as a predictor, did not significantly predict WPT scores. SAI remained the only significant predictor in both Model 2, ($st.\beta = .28$, $t = 2.65$, $p < .01$), and Model 3 ($st.\beta = .28$, $t = 2.46$, $p < .05$). Thus H5 was not confirmed, while H6 was.

b) BRT: Model 1 showed that SAI accounted for only 2% of the variance in BRT scores. Thus H2 was not further confirmed. Despite the small value, however, the model approached significance levels, ($F(1, 88) = 3.17, p = .08, \text{Adj. } R^2 = .02, \text{st.}\beta = .19, t = 1.78, p = .08$). Model 2, which also included the Big Five traits as independent variables, was not significant (this did not confirm H5). However, Conscientiousness on its own was found to be a significant predictor of BRT scores, ($\text{st.}\beta = -.22, t = 1.99, p < .05$)(this further confirmed H1d). Model 3 added gender as an independent variable but was not a significant predictor of BRT scores (this confirmed H6). Conscientiousness was again the only significant predictor in the model, ($\text{st.}\beta = -.23, t = 2.12, p < .05$)(which further supported H1d).

c) SAI: Model 1 showed that the Big Five personality traits significantly predicted SAI, accounting for 7% of the variance in SAI, ($F(5,96) = 2.46, p < .05, \text{Adj. } R^2 = .07$). This confirmed H3. Two out of five personality traits, i.e., Neuroticism, ($\text{st.}\beta = -.28, t = 2.42, p < .05$), and Agreeableness, ($\text{st.}\beta = -.22, t = 2.22, p < .05$), were significant predictors of SAI. This confirmed H3a and H3d, respectively (but not H3b and H3c) In order to investigate this further, the facets of Neuroticism and Agreeableness were entered, with gender, into two different additional multiple regressions that used SAI as a dependent variable. Neuroticism facets and gender accounted for 18% of the variance in SAI, ($F(7,96) = 3.93, p < .01, \text{Adj. } R^2 = .18$). However, only anxiety ($\text{st.}\beta = -.31$) and gender ($\text{st.}\beta = .37$) were significant predictors of SAI. In another regression, Agreeableness facets and gender were found to predict 22% of the variance in SAI, ($F(7,96) = 4.86, p < .01, \text{Adj. } R^2 = .22$). Among Agreeableness facets, modesty was the most powerful predictor of SAI ($\text{st.}\beta = -.34$). In Model 2 gender and the Big Five accounted for nearly 17% of the variance in SAI, ($F(6, 90) = 4.21, p < .01, \text{Adj. } R^2 = .16$). Gender was the most powerful (and only significant)

variable in the model ($st.\beta = -.35, p < .01$), accounting for nearly 10% of the variance in SAI. This supported H4.

d) SEV: In Model 1, the Big Five significantly accounted for 7% of the variance in SEV, ($F(5, 88) = 2.49, p < .05, Adj. R^2 = .07$). This provided further confirmation of H3. Neuroticism was the most powerful predictor in the model, ($st.\beta = -.30, t = 3.05, p < .01$)(this supported H3a), followed by Openness to Experience, which only approached significance levels, ($st.\beta = .20, t = 1.93, p = .06$). Thus H3b, H3c and H3d were not further confirmed. In Model 2, gender was added as a predictor and accounted for an additional 7% of the variance in SEV, ($F(6, 87) = 3.61, p < .01, Adj. R^2 = .14$). Gender was also the most powerful (and only significant) predictor in the model, ($st.\beta = -.30, t = 3.02, p < .01$). This supported H4.

Table 2.2 St. β coefficients for predictors of WPT, BRT, SAI, and SEV after hierarchical regressions

	WPT		BRT		SAI		SEV	
	st. β	t	st. β	t	st. β	t	st. β	t
SAI	.28	2.81**	.19	1.78				
Regression Model	F(1,96)=7.90**		F(1,88)=3.17		-		-	
Adj.R ²	.07		.02		-		-	
SAI	.28	2.65**	.18	1.54				
Neuroticism	-.02	.18	-.01	.05	-.28	2.43*	.31	2.60*
Extraversion	.07	.55	.12	.87	-.14	1.18	.20	1.56
Openness	.05	.44	-.02	.16	.11	1.00	.21	1.89
Agreeableness	.10	.92	.01	.08	-.22	2.22*	.15	1.50
Conscientiousness	.03	.27	-.22	1.99*	-.05	.49	.07	.73
Regression Model	F(6,96)=1.60		F(6,88)=1.42		F(5,96)=2.46*		F(5,96)=2.49*	
Adj. R ²	.04		.03		.07		.07	
SAI	.28	2.46*	.21	1.74				
Neuroticism	-.02	.16	-.04	.32	-.15	1.27	.20	1.67
Extraversion	.07	.55	.09	.62	-.03	.28	.10	.78
Openness	.05	.42	-.01	.07	.06	.59	.18	1.69
Agreeableness	.10	.91	-.01	.09	-.15	1.52	.08	.83
Conscientiousness	.03	.28	-.23	2.12*	.01	.14	.02	.19
Gender	-.01	.08	.11	.89	-.35	3.40**	.30	2.87**
Regression Model	F(7,96)=1.36		F(7,88)=1.32		F(6,96)=4.21**		F(6,96)=3.62**	
Adj. R ²	.03		.03		.17		.14	

* $p < .05$, ** $p < .01$

Results of the hierarchical regressions are presented in Table 2.2. It can be observed that the Adjusted R^2 for the WPT decreases in the second and in the third regression models. Detailed exploration of the data showed this was due to the fact that the variables added as predictors (the Big Five and gender) do not make any significant contribution to the accountable variation of the WPT scores, and not because any of the variables act as suppressors.

2.4 Discussion

This study aimed to investigate the relationship between personality, gender, SAI/SEV, and psychometric intelligence. Specifically, it attempted to explore whether psychometric intelligence and SAI/SEV correlate with personality and gender, and whether SAI/SEV correlate with psychometric intelligence.

The hypothesis of a significant correlation between the Big Five personality traits and intelligence test scores was only partially supported. Only Conscientiousness was significantly related to psychometric intelligence, correlating with BRT scores. It is worth noting that the correlation was negative, indicating that conscientious participants tended to have lower Gf and vice-versa. This is in line with Moutafi, Furnham and Crump's (2003) argument that people (especially university students) with lower Gf try to cope with this by becoming more organized, thorough, determined, persistent and methodological, all of which are characteristics of Conscientiousness. In that sense, Conscientiousness could be positively associated with Gc, in that it may lead to intellectual engagement (see Goff & Ackerman, 1992) and negatively with Gf, in that it would partly develop as a compensatory trait for lower native ability. While these two types of intelligence are related through g,

lack of Gf could lead to increased Gc and vice-versa. This assumption may also explain why Openness to Experience seems to relate to Gc, rather than Gf. Note that TIE, Goff and Ackerman's (1992) construct, encompasses aspects of both Openness and Conscientiousness, and is positively related to Gc. However, previous research has failed to find consistent evidence for the significant relationship between intelligence and Conscientiousness (Zeidner & Matthews, 2000). Even in the present study, Conscientiousness was not significantly correlated with the WPT (which measures Gc rather than Gf), and the relationship between Conscientiousness and BRT scores declined in the multiple regressions. In fact none of the Big Five traits was significantly related to WPT scores. Although these results run counter to that of previous studies (Furnham et al, 1998ab; Lynn et al, 1982; Zeidner, 1995), correlations are similar in size to that of Ackerman and Heggestad's (1997) meta-analytic study: Neuroticism, $r = -.12$ (present study), vs. $r = -.15$ (Ackerman & Heggestad, 1997), Extraversion, $r = .09$ (present study), vs. $r = .08$ (Ackerman & Heggestad, 1997), Agreeableness, $r = .02$ (present study), vs. $r = .01$ (Ackerman & Heggestad, 1997), Conscientiousness, $r = .01$ (present study), vs. $r = .02$ (Ackerman & Heggestad, 1997). Given the relatively small sample size in this study ($N = 100$), the resemblance is particularly striking. Further research examining the psychometric relationship between the Big Five and other intelligence tests would be needed to replicate this pattern of results.

As predicted, results showed that there were no significant gender differences in psychometric intelligence. Gender was tested as a predictor for both the WPT and BRT and in both cases was not significant. Further, there were no significant correlations between gender and WPT/BRT scores. This is in line with the general consensus that there are no

major gender differences in general intelligence as measured by standard intelligence tests (Brody, 2000; Deary, 2001; Halpern, 1992; Jensen, 1998; Loehlin, 2000).

The hypothesis that SAI and psychometric intelligence would be significantly correlated was supported (only) by WPT scores. In the present study, the correlation between WPT scores and SAI ($r = .27$) is consistent with previous research, ($r = .30$) (Borkenau & Liebler, 1993; Furnham, 2001b; Gabriel, Critelli & Ee, 1994), and suggests that people have some insight into their intellectual abilities. Furthermore, participants' SEV (made immediately after completion of the WPT) were highly associated with psychometric intelligence, suggesting that people's insight is more accurate when they are aware of the abilities they are requested to estimate. The highly significant correlation between SAI and SEV indicates that SAI is far more related to SEV than to actual test scores. This could suggest that people's conceptions of their own intellectual abilities are quite robust and to some extent unaffected by test performance or expert's criteria (e.g., psychometric intelligence).

As hypothesised, SAI/SEV were significantly related to personality and gender. Two significant Big Five correlates of SAI, namely Agreeableness (notably the modesty facet) and Neuroticism (notably the anxiety facet), which also correlated significantly with SEV, confirmed this hypothesis. Modest and anxious participants tended to give lower indicators of SAI, even though they did not differ in their actual intelligence scores. A high score on the anxiety facet represents anxious, fearful and pessimistic individuals, who tend to lack confidence in their abilities. Modesty, on the other hand, is also typical of non-assertive, unconfident, and pessimistic individuals. This suggests that both modesty and anxiety could affect the accuracy of people's insight of their intellectual abilities. However,

in the regressions, only gender was a significant predictor of SAI/SEV. Males gave significantly higher SAI/SEV than females, albeit not differing from them in actual intelligence scores. Thus, the present results not only replicate the robustness of the effect of gender in SAI (Furnham, 2000b; Furnham, Fong & Martin, 1999; Furnham & Rawles, 1995; Hogan, 1978), but also suggest that the accuracy of SEV may also be distorted by gender. The fact that there are gender differences in SAI, but not in psychometric intelligence was explained by Furnham (2000b), who proposed that SAI are based on specific abilities which are male normative, like mathematical and spatial intelligence. These abilities would lead to males giving higher SAI than females. It is therefore important to look at people's more general conceptions of intelligence and how they affect SAI. Study 2 shall attempt to examine the relationship between the Big Five, SAI, psychometric intelligence and people's attitudes towards intelligence.

STUDY 2

2.5 Introduction

Consistently with the previous literature (Furnham, 2001b; Furnham & Rawles, 1995; Paulhus et al, 1998), study 1 suggested that people have some insight into their intellectual abilities (i.e., SAI is significantly related to psychometric intelligence) and, furthermore, that this insight is a better predictor of psychometric intelligence than gender and personality. Results also indicated that SAI was only a modest predictor of psychometric intelligence. This suggests that people's insight (or at least estimation) of their intellectual abilities is limited: that is, people are only partially aware of their own intellectual capability. On the other hand, personality traits (especially Neuroticism and Agreeableness) and gender were related to SAI (see Furnham, Kidwai & Thomas, 2001; Furnham & Thomas, 2003), rather than to psychometric intelligence. The present study attempts to further explore the relationship between gender, personality traits, self-assessed and psychometric intelligence. To this end, people's SAI will be examined in relation to two measures of Gf (spatial ability and logical reasoning tests). On the other hand both Gf and SAI will also be examined in relation to the Big Five, gender, previous IQ test experience (whether participants had or not taken an IQ test in the past), and people's conceptions/beliefs about intelligence (CI). Several hypotheses will be tested:

H1: personality traits will be significantly, albeit modestly, related to psychometric intelligence (this hypothesis will be tested through both correlational and regression analyses). Although this hypothesis was not supported by the findings of study 1 (where only 1 out of 10 correlations between Big Five traits and psychometric intelligence was

significant), it attempts to replicate the results of Ackerman and Heggestad's (1997) meta-analytic study. Specifically, it is expected that:

H1a: Neuroticism is significantly (and negatively) related to psychometric intelligence. This would confirm that neurotics' predisposition to experience low confidence and test-anxiety is likely to impair their performance on psychometric tests (see Wells & Matthews, 1994).

H1b: Openness will be significantly (and positively) related to psychometric intelligence (particularly to spatial ability scores). This would be consistent with studies showing that Openness is a significant correlate of intelligence, particularly Gc (Ackerman & Heggestad, 1997), as well as with the conceptualisation of Openness as a self-report measure of intellect (see Goff & Ackerman, 1992; Hofstee, 2001).

H1c: Conscientiousness will be negatively related to psychometric intelligence. This association would replicate recent studies that found negative and significant correlations between Conscientiousness and ability measures (Moutafi, Furnham & Crump, 2003; Moutafi, Furnham, & Patiel, 2003). Furthermore, confirmation of this hypothesis would provide further support to the results of study 1.

H2: SAI and psychometric intelligence will be significantly related (between $r = .20$ and $r = .30$). This would further confirm the results of study 1, as well as the idea that people are capable of estimating their own intellectual ability (Furnham, Fong & Martin, 1999; Furnham & Rawles, 1995; see Furnham, 2001b).

H3: SAI will be significantly associated with personality traits (like H1, this hypothesis will be tested via correlations and regressions). Although very few papers (e.g., Furnham, Kidwai & Thomas, 2001) have examined the relationship between SAI and

established personality traits, study 1 confirmed that Neuroticism and Agreeableness are significantly related to SAI. Previous findings (but not study 1) also seem to suggest that Extraversion and Openness may also be significantly related to SAI. This study predicted:

H3a: Neuroticism to be negatively correlated with SAI. This would be interpreted in terms of the lack of confidence that characterises trait anxious individuals (Wells & Matthews, 1994)(see also Furnham, Kidwai & Thomas, 2001).

H3b: Extraversion to be positively correlated with SAI. This would be expected in terms of the assertive nature of extraverts (Costa & McCrae, 1992). Further, previous results have shown that extraverts tend to rate their abilities significantly higher than introverts (see Furnham, Kidwai & Thomas, 2001).

H3c: Openness to Experience to be positively correlated with SAI. This is in line with Furnham and Thomas's (2003) study, in which Openness was found to be the strongest predictor of SAI. Theoretically, this can be explained by the fact that Openness and SAI are both self-report scales that refer to people's *typical* rather than *maximal* performance (see Cronbach, 1949; Goff & Ackerman, 1992; Hofstee, 2001).

H3d: Agreeableness to be negatively related to SAI. Since agreeable individuals tend to be more modest than disagreeable ones (Costa & McCrae, 1992), it is expected that the former will report lower SAI. These correlations would also replicate those of study 1.

H4: gender to be significantly correlated with SAI. Specifically, it is expected to replicate previous results indicating that males tend to report higher SAI than females (e.g., Borkenau & Liebler, 1993; Furnham, 2001b; Gabriel, Critelli & Ee, 1994).

H5: gender will be significantly related to spatial, but not to logical intelligence. Many gender differences have been reported for performance in particular spatial ability

tests (e.g., Lynn & Petersen, 1985; Loehlin, 2000). Studies using spatial visualization tests (this type of task will be employed in the present study) consistently report male superiority: in Masters and Sanders' (1993) meta-analysis males were found to score an average of nearly 1 SD higher than females.

H6: previous IQ experience (i.e., having taken a test and got feedback from it) to be significantly related to Gf. It has been established that, although anxiety is likely to impair on intelligence test performance, past test-experience should reduce anxiety (Zeidner, 1995). It is thus possible that people who have already taken an intelligence test will tend to perform better than those who have not.

H7: SAI to be significantly correlated with participant's conceptions of intelligence (as measured by a brief inventory that assesses attitudes toward intelligence). Thus people with positive attitudes towards intelligence are expected to give higher SAI, while people with negative attitudes towards intelligence are expected to report lower SAI.

To recap, this study will examine the relationships between gender, personality traits, psychometric intelligence, and SAI (as in study 1). In addition, previous test experience and lay conceptions of intelligence will also be examined. It is expected that Neuroticism and Openness will be significantly related to both psychometric intelligence and SAI. It is also expected that Conscientiousness will be significantly related to psychometric intelligence (negatively), and Agreeableness with SAI (negatively). SAI is expected to relate to gender, conceptions of intelligence and psychometric intelligence. A series of correlational and hierarchical regressions will be performed on the data to test these hypotheses.

2.6 Method

Participants

A total of 131 (78 females and 53 males) British and American undergraduate economics students participated in this study. Their age ranged from 18 to 26, with an arithmetic mean of 20.22 (SD = 1.05) years. Out of all the participants, 109 were native English speakers, while 21 were non-native (but fluent) English speakers. There were no significant native language differences in any of the measures. Participants were all volunteers and received individual feedback on personality and intelligence measures.

Measures

The BRT Reasoning Test (Baddeley, 1968). As in study 1.

The NEO Personality Inventory Revised (NEO-PI-R; Costa & McCrae, 1992). As in study 1.

S & M Test of Mental Rotation Ability (Philips & Rawles, 1979). This is a quick measure of mental rotation based upon Shepard and Metzler's (1971) visual-spatial ability test. The S & M test is a timed version of Vandenberg & Kuse's (1978) mental rotation test and can be administered in 2 minutes. It comprises a total of 16 pairs of figures that participants must identify as rotated or unrotated.

Conceptions of intelligence. A brief inventory was designed to address people's conceptions of intelligence (CI). The inventory consisted of 6-items, 5 of which loaded on one factor that has labelled "positive attitudes toward IQ". These items showed sufficient internal reliability: $\alpha = .81$. Participants' total scores on this factor were calculated by

simply adding the scores for each item (i.e., “IQ test should be used more often in companies”, “IQ tests are very useful”, “IQ tests do not really measure intelligence”, reversed, “I’m interested in knowing what my IQ is”, and “Intelligence can be measured by IQ tests”). Participants indicated the extent to which they agreed or disagreed with each item on a five-point Likert scale (1 = “completely disagree”, 5 = “completely agree”). The other item, i.e., “have you ever tested your intelligence before”, which was responded by “yes” or “no”, did not load onto the “positive attitudes toward IQ” factor and was analysed separately as “previous IQ experience” (see results section).

Procedure

Participants were given the NEO-PI-R at the end of a lecture and completed it by the following week. After that, they were tested simultaneously in a very large lecture theatre. As in study 1, following a brief explanation of intelligence scores and their distribution (e.g., average, retardation, low, and above average levels), participants were asked to report their SAI on the back of one of the tests. In addition, participants’ CI was assessed via a brief inventory (described above). Demographic data (i.e., names, mother tongue, age, and gender) was also collected. Following this, participants were given instructions on the S & M test, and completed this test in exactly 2 minutes time. Due to the large number of participants, four examiners were present during this task to ensure test-administration was appropriate. After completing the S & M test, participants were given instructions on the BRT test, which they completed in 3 minutes time. Again, examiners were present to ensure that participants attained to the time limit of this task and completed the test properly.

2.7 Results

Although the correlation between S & M and BRT was modest, i.e., $r = .20$, $p < .05$, Gf was obtained by calculating the average standardised score in both intelligence measures, i.e., $Gf = [(BRT/64*100) + (S\&M/20*100)]/2$. Since participants had been asked to estimate their “intelligence”, rather than their spatial or reasoning abilities, it was considered that Gf would be more representative of “intelligence” than a single spatial or logical reasoning score. ANOVA showed no significant gender differences in Gf, ($F(1,100) = 1.83$, $p = .18$, $\text{Partial Eta}^2 = .02$). When performance differences in gender were examined in both intelligence measures separately, ANOVA showed that males scored significantly higher than females in spatial intelligence, ($F(1,101) = 5.13$, $p < .05$, $\text{Partial Eta}^2 = .05$).

Correlations: Pearson’s correlation coefficients for this study are presented in Table 2.3. Against expectations (H1)(specifically H1a, H1b, and H1c), there were no significant correlations between Big Five personality traits and Gf. Only two sub-facets of the Big Five, namely impulsiveness (from Neuroticism)($r = .24$, $p < .05$), i.e., impulsive participants had higher intelligence scores, and modesty (from Agreeableness), ($r = -.25$, $p < .05$), i.e., modest participants had lower intelligence scores, correlated significantly with Gf. SAI correlated significantly with Extraversion ($r = .24$, $p < .05$)(extraverts tended to report higher SAI), which confirmed H3b, and Conscientiousness ($r = .21$, $p < .05$)(conscientious participants reported higher SAI). However there were no significant correlations between SAI and Neuroticism, Agreeableness or Openness to Experience (which did not confirm H3a, H3d and H3c)(H3 was therefore not supported). On the other hand there were significant correlations between SAI and CI ($r = .35$, $p < .01$) (positive conceptions of intelligence were associated with higher SAI), which confirmed H7, and Gf ($r = .35$, $p <$

.01)(high intelligence test scores were associated with SAI), which confirmed H2. Against expectations, previous IQ test experience was not significantly correlated with Gf (H6 was not confirmed). As predicted, gender was significantly correlated with S & M scores, $r = .22$, $p < .05$ (males scored significantly higher on the test), which confirmed H5, but not with SAI (which did not support H4).

Table 2.3 Correlations between gender, Big Five, SAI, BRT, S & M, Gf, and CI

	SAI	BRT	S&M	Gf	CI
Gender	.17	-.03	.22*	.13	.17
Neuroticism	-.03	.04	-.06	.01	-.13
Extraversion	.24*	.08	-.12	-.03	.02
Openness	.02	.07	.06	.09	-.05
Agreeableness	-.15	-.11	.03	-.05	-.19
Conscientiousness	.21*	-.11	-.06	-.12	-.07
SAI	-	.27**	.25*	.35**	.35**
BRT	.27**	-	.20*	.75**	.02
S&M	.25*	.27**	-	.80**	.12
Previous IQ experience	.18	.16	.13	.19	.02

** $p < .01$, * $p < .05$

N = 130

Hierarchical regressions: Several hierarchical regressions were performed on the data in order to examine whether Gf, SAI, and CI, could be predicted from personality traits and gender. Table 2.4 exhibits standardised β coefficients for the predictors of each dependent variable.

a) Gf: In Model 1, SAI and CI accounted for 11% of the variance in Gf, ($F(2, 94) = 6.67$, $p < .01$, $\text{Adj. } R^2 = .11$). SAI was the only significant predictor of Gf, ($\text{st.}\beta = .35$, $t = 2.85$, $p < .01$). This supported H2. Model 2, in which the Big Five were added to the predictors, only accounted for 7% of the variance in Gf and was not significant, ($F(7, 77) = 1.88$, $p = .09$, $\text{Adj. } R^2 = .07$). Model 3 also included gender and previous IQ experience,

accounted for 7% of the variance in Gf, and was not significant, ($F(9, 74) = 1.72, p = .10$, $Adj. R^2 = .07$).

b) SAI: In Model 1 Big Five traits significantly accounted for 9% of the variance in SAI, ($F(5, 80) = 2.64, p < .05, Adj. R^2 = .09$). This supported H3. Extraversion was the most powerful predictor of the model, ($st.\beta = .26, t = 2.11, p < .05$)(this further supported H3b), followed by Agreeableness ($st.\beta = -.25, t = 2.11, p < .05$)(which supported H3d) and Conscientiousness ($st.\beta = .23, t = 2.10, p < .05$). Model 2 also included gender and previous IQ test experience. These two predictors were shown to account for an additional 2% in the variance of SAI, ($F(7, 76) = 2.45, Adj. R^2 = .11$). Extraversion was the most powerful predictor in the model, ($st.\beta = .26, t = 2.34, p < .05$)(this further confirmed H3b), followed by gender ($st.\beta = .24, t = 2.57, p < .05$)(which supported H4).

Table 2.4 Standardized β coefficients for predictors of CI, SAI, and Gf after hierarchical regressions

	Gf		SAI	
	st. β	t	st. β	t
CI	.04	.35	-	-
SAI	.34	3.28**	-	-
Regression Model	F(2,94)=6.67**		-	
Adj. R ²	.11		-	
CI	.05	.40		
SAI	.35	2.86**		
Neuroticism	.05	.44	.01	.15
Extraversion	-.10	.86	.26	2.11*
Openness	.12	.98	.07	.49
Agreeableness	.02	.20	-.25	2.11*
Conscientiousness	-.12	1.03	.23	2.10*
Regression Model	F(7,77)=1.88		F(5,80)=2.64*	
Adj. R ²	.07		.09	
CI	.06	.48		
SAI	.30	2.37*		
Neuroticism	.05	.41	.01	.05
Extraversion	-.10	.80	.26	2.34*
Openness	.11	.93	.07	.57
Agreeableness	.06	.44	-.11	.91
Conscientiousness	-.12	1.09	.10	.90
Gender	.09	.78	.24	2.16*
Previous IQ Test	-.14	1.28	-.19	1.76
Regression Model	F(9,74)=1.70		F(7,76)=2.45**	
Adj. R ²	.07		.11	

* $p < .05$, ** $p < .01$

2.8 Discussion

As hypothesised, the results of the present study showed that gender is significantly related to spatial ability, but not to logical reasoning. Males outperformed females in the S & M test. The difference found in the present sample is consistent with the one reported by the authors of the test, that is, around 20% of women scoring above the median score of men. The present study therefore confirms that “male superiority on tasks requiring [spatial] abilities is among the most persistent of individual differences in all the abilities literature” (McGee, 1979, p.41). The fact that significant gender differences were only found in spatial ability, but not in Gf, also seems to confirm that, whereas the conception of multiple abilities may identify gender differences for a particular ability or intelligence, the conception of general intelligence neglects them. This is also consistent with study 1.

Against initial predictions (but consistently with study 1), the Big Five personality traits were not significantly related to Gf. Only two of the Big Five personality *facets*, i.e., impulsiveness (Neuroticism), and modesty (Agreeableness), were significantly related to Gf. Thus the results of the present study are not consistent with those of studies suggesting that personality and psychometric intelligence are not independent constructs (Ackerman & Heggestad, 1997). Rather, the present results seem to suggest that psychometric intelligence may only relate to certain primary - rather than super- traits of personality.

Unlike Gf, SAI was expected to relate to personality factors (study 1, Furnham, Kidwai & Thomas, 2001). Significant correlations between SAI and some of the Big Five traits partly confirmed initial predictions. Extraverts and highly conscientious participants reported higher SAI. Results of the hierarchical regressions showed that Agreeableness was

also a significant predictor of SAI. In addition, gender was the most significant predictor of SAI (males gave significantly higher SAI than females). These results do not only confirm the findings reported in the previous literature (Furnham, 2000b; Furnham, Fong & Martin, 1999; Furnham & Rawles, 1995; Hogan, 1978; see also study 1), but also suggest that gender affects people's insight into their intellectual abilities, since gender is significantly related to SAI, but not to Gf. Confirming Furnham's (2000b) hypothesis that this correlation may be interpreted in terms of specific lay conceptions of intelligence, the present study found CI (positive attitudes toward intelligence), to be significantly correlated with SAI. It is however noteworthy that the correlation between gender and CI was positive (males tended to have more positive attitudes towards IQ), but not significant. Furthermore, as it commonly happens when it comes to interpret significant correlation, it is necessary to be careful and distinguish between a mere relationship and the causal direction in that relationship. Do people think they are clever because they have positive attitudes toward intelligence, or do people have positive attitudes toward intelligence because they think they are clever? This question is difficult to answer.

It can be concluded that CI, gender, and personality traits are all related to SAI. Furthermore, it may be concluded from the results of this study that, although SAI may be affected by a number of non-cognitive and cognitive variables such as CI, gender and personality, SAI is significantly related to psychometric intelligence. This suggests that in general, people are indeed able to assess their intelligence with a certain degree of accuracy. Although relations between non-cognitive (CI, personality traits, gender) and cognitive (psychometric intelligence) traits appear to be weak, the present results suggest that SAI may be related to several variables in that it is likely to be influenced by personality, gender and CI, as well as related to Gf.

STUDY 3

2.9 Introduction

As noted before, a central question that has returned to the field of individual differences in the last ten years, is whether and how personality traits and intellectual ability are, or are not, related (Hofstee, 2001). Although this question is nearly as old as the study of intelligence and personality (see for instance Cattell, 1941; Spearman, 1927; Webb, 1915; Wechsler, 1950; Whipple, 1922), both constructs have been traditionally investigated independently, prompting the development of different methods and unrelated theories (Ackerman & Heggestad, 1997; Cronbach, 1949; Hofstee, 2001; Zeidner & Matthews, 2000).

Whereas general intellectual ability appears to be theoretically unrelated to non-cognitive traits (Brebner & Stough, 1995; Eysenck, 1994a; Zeidner & Matthews, 2000), traits have been proven to relate to test performance and, since intellectual ability is measured through performance (ability/IQ), it is not surprising that traits are often significantly correlated with intelligence. There is longstanding experimental evidence suggesting that Neuroticism (trait anxiety), for instance, is likely to affect performance negatively on examinations (Eysenck, 1982; Humphreys & Revelle, 1984; Wells & Matthews, 1994; Wine, 1982). Furthermore, individual differences in Extraversion/Introversion have been found to relate to different test taking styles (Eysenck, 1971; Furnham, Forde & Cotter, 1998ab; Rawlings & Carnie, 1989; Robinson, 1985). Despite this, meta-analytical studies (notably Ackerman & Heggestad, 1997) have shown that personality traits are, at best, only modestly related to general intelligence. Furthermore, studies 1 and 2 have shown that the relationship between personality and

intelligence at a psychometric level is weak and mostly non-significant. Accordingly, personality variables should be considered with IQ as predictors of other, more general or long term, types of everyday performance (i.e., occupational, academic success)(Anastasi, 1998; Hofstee, 2001). Furthermore, it is likely that personality and psychometric intelligence are also related to SAI (see studies 1 & 2).

A trait which has generated much controversy with regard to understanding personality-intelligence relationships, is Openness to Experience (see Brand, 1994; see section 1.2.3.3). Even in meta-analysis this personality factor has been shown to be moderately and significantly correlated with intelligence, particularly with its crystallized aspects (Gc)($r = .30$ in Ackerman & Heggestad, 1997). Unlike Neuroticism and Extraversion, Openness appears to be conceptually directly related to intelligence, rather than merely affect test performance (psychometric intelligence). According to Costa and McCrae (1992), Openness refers to aesthetic sensitivity, awareness of one's emotions, preference for novelty and non-traditional values, fantasy tendency, and ideas. However, other researchers have preferred to refer to Openness as Intellect or Culture, interpreting this personality trait in terms of introspective reflection and intellectual knowledge (see Goldberg, 1994; Johnson, 1994; Saucier, 1994). Openness is therefore associated with intellectual curiosity, vivid imagination and behavioral flexibility (McCrae, 1993; McCrae & Costa, 1997a), but also with understanding ability, knowledge in science, change and autonomy (see Ashton, Lee, Vernon & Jang, 2000). Since these variables are assessed through self-report inventories, it has been implied that Openness could be conceptualized as a self-report measure of intelligence, especially of Gc (Goff & Ackerman, 1992; Ackerman & Goff, 1994).

On the other hand, the fact that (like other personality traits) Openness is assessed through *typical*, rather than *maximal*, performance, may suggest that this personality trait could be related to other variables (e.g., interests, curiosity, creativity, motivation) that are relevant to everyday processes of knowledge formation. This idea was first present in Cattell's (1971/1987) investment theory and was later re-elaborated in Ackerman's (1996) PPKI (i.e., intelligence as processes, personality, knowledge and interests) theory. Goff and Ackerman (1992) also conceptualized a personality trait involved in the processes of Gc development, i.e., typical intellectual engagement (TIE), and provided a self-report inventory to assess it. TIE represents an attempt to conceptualise intelligence in terms of *typical* rather than *maximal* performance. Thus the scale comprises motivational and temperamental aspects that may affect the development of adult intellectual competence and knowledge acquisition, but are not assessed by cognitive performance measures (Ackerman & Goff, 1994; Goff & Ackerman, 1992; Hofstee, 2001; Rocklin, 1994). Studies have indicated that TIE is highly correlated ($r = .60$) with Openness (Ackerman & Goff, 1994; Goff & Ackerman, 1992). Furthermore, Rocklin (1994) has argued that TIE and Openness are interchangeable in terms of their relations with intellectual ability.

There are therefore two reasons why one could expect Openness to correlate with psychometric intelligence: First, this personality trait can be conceptualized as a type of self-reported Gc, and self-reports of intelligent behaviours have been consistently found to correlate (albeit modestly around $r = .30$) with psychometric intelligence (Furnham, Kidwai & Thomas, 2001; Furnham & Rawles, 1999; Paulhus, Lysy & Yik, 1998; Reilly & Mulhern, 1995; study 1). Second, Openness is also related to TIE and intellectual investment, which is likely to be a determinant of Gc and knowledge acquisition (Ackerman, 1996, 1999; Cattell, 1971/1987).

A few recent papers have also examined the relationship between personality inventories (notably the NEO-PI-R) and single self-estimates or indicators of subjectively-assessed intelligence (SAI)(Furnham, Kidwai & Thomas, 2001; studies 1 & 2). These are usually obtained by asking participants to rate their intellectual ability on an appropriately labeled bell curve (presenting them with a normal distribution of IQ scores, their means and standard deviations as well as labels for certain values, e.g., “gifted”, “retarded”, etc)(Furnham, 2001b). Significant, albeit modest, correlations were found between SAI and Neuroticism (negative), Agreeableness (negative), and Openness to Experience (positive)(Furnham, Kidwai & Thomas, 2001; Furnham & Thomas, 2003; studies 1 & 2). SAI may therefore be important (both conceptually and psychometrically) with regard to understanding the personality-intelligence crossroads.

The idea that personality traits may affect SAI has been previously considered. Eysenck’s (Eysenck & Eysenck, 1985) conceptualization of SAI (self/other assessed) was defined as being influenced by actual intelligence as well as personality traits. Likewise, Stankov (1998ab, 1999) has argued that self-confidence, self-monitoring and self-evaluation are “borderline” concepts between personality and intelligence. However both Eysenck and Stankov included SAI within the personality domain. This is consistent with the fact that (see above) Openness to Experience and TIE (perhaps two different types of SAI) can be conceptualised as personality correlates of psychometric intelligence. In any case, SAI (like creativity, motivation, curiosity and self-efficacy) seem to be affected by an array of both cognitive and non-cognitive variables (Zeidner, 1995).

The present study will examine the relationship between personality traits, SAI, and psychometric intelligence in a combined sample of British and American undergraduates

(from diverse courses and universities). Regarding the relationship between SAI, psychometric intelligence, and personality traits, several sets of hypotheses can be stated:

H1: SAI will be correlated with, and predicted by, Neuroticism (negatively), Extraversion (positively), Agreeableness (negatively), and Openness to Experience (positively). Specifically:

H1a: negative correlations between SAI and Neuroticism would support experimental studies indicating that neurotic individuals have a tendency to experience fear of failure as well as general poor self-concept and lack of confidence in their abilities (Wells & Matthews, 1994; see also study 1). Neurotic individuals, who tend to experience anxiety during tests, are also likely to have negative feedback on their previous performances on IQ/ability tests (conversely, stable individuals would be more likely to have positive feedback). This may also partly explain the negative correlations between Neuroticism and SAI.

H1b: negative correlations between SAI and Agreeableness can be expected to the extent that agreeable people tend to be more modest and pessimistic than disagreeable ones (Busato, Prins, Elshout & Hamaker, 2000; Costa & McCrae, 1992; studies 1 & 2).

H1c: conversely, positive correlations between SAI and Extraversion may be interpreted in terms of the assertive, optimistic nature of extraverts. In fact Furnham, Kidwai and Thomas (2001) and study 2 found the highest SAI in extraverts.

H1d: finally, positive correlations between SAI and Openness would support interpretations of Openness and SAI as conceptually related constructs since both variables

appear to be indicators of self-report abilities or intelligence (specifically Gc in the case of Openness) (Ackerman & Goff, 1994; Goff & Ackerman, 1992; Hofstee, 2001).

H1e: it is thus expected that the Big Five will significantly predict SAI.

H2: SAI will be also expected to correlate with psychometric intelligence (Gf). This would confirm previous findings (Furnham, Kidwai & Thomas, 2001; Furnham & Rawles, 1999; Paulhus, Lysy & Yik, 1998; Reilly & Mulhern, 1995; studies 1 & 2) and the idea that SAI is a function of both personality (if H1 is accepted) and intelligence. Specifically, significant correlations between SAI and Gf would suggest that participants have some insight into their intellectual ability (e.g., through test taking feedback, educational attainment), although it is equally possible that this correlation may reflect the influence of SAI on Gf; that is, people who give higher SAI would be more confident and therefore likely to perform better on the Gf measure. Thus SAI may reflect actual intellectual competence as well as have self-fulfilling effects.

H3: finally psychometric intelligence will be examined with regard to the Big Five personality traits (including Openness). Specifically, the present study will look at the relationship between the Big Five and a well-established measure of Gf (Raven's Standard Progressive Matrices)(Raven, Raven & Court, 1998).

H3a: given that results of the tests will not have any consequences for the participants (and consistently with studies 1 & 2), there will be no reasons to expect high state anxiety. It is thus predicted that Neuroticism will not be significantly correlated with Gf.

H3b: given that the Gf test is of intermediate length (15 to 20 minutes), Extraversion/Introversion differences are not expected either. This hypothesis is also derived from the findings of studies 1 and 2.

H3c: Agreeableness is not expected to correlate with psychometric intelligence either (for this trait has not been previously linked to intellectual ability)(Zeidner & Matthews, 2000). This prediction is also in line with the results of studies 1 and 2.

H3d: on the basis of previous results and the conceptualisation of Openness as a self-report measure of crystallised (rather than fluid) intelligence, this personality trait is expected to be modestly related to Gf (between $r = .10$ and $r = .20$)(see Ackerman & Heggestad, 1997; Ashton, Lee, Vernon & Lang, 2000).

H3e: finally Conscientiousness is expected to correlate negatively with Gf. Although meta-analytic studies have reported very low zero-order correlations between Conscientiousness and psychometric intelligence (Ackerman & Heggestad, 1997; see also Zeidner & Matthews, 2000), recent studies found small but significant correlations between this personality trait and Gf (study 1; Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003). These correlations were interpreted in terms of the possibility that high Conscientiousness may develop as a compensatory trait for poor Gf. However negative correlations between Conscientiousness and psychometric intelligence would decrease in situations where test-performance has no important consequences for the testee (e.g., opportunity sample, paid subjects). In those situations, conscientious participants may be more intrinsically motivated to complete and perform well on the test. Thus in the present

study (which involved an opportunity sample²) the negative correlation between Conscientiousness and Gf is not predicted to reach significant levels.

2.10 Method

Participants

A total of 182 undergraduate students from British and American universities participated in this study. Of these, 49 were male and 133 were female. Their age ranged from 18 to 53, with a mean of 19.79 and a standard deviation of 3.46. The participant aged 53 was excluded from the analysis as he was considered to be an outlier (with regard to age). Consequently, 49 males and 132 females were included in the statistical analysis, their age ranging from 18 to 38, with a mean of 19.58 and a standard deviation of 2.22 years. Students participated in this study as part of two lectures on personality and intelligence assessment and received individual feedback on their personality and intelligence scores (this occurred one month after the lectures).

Measures

The NEO Personality Inventory – Revised (NEO-PI-R; Costa & McCrae, 1992). As in study 1.

Raven's Standard Progressive Matrices. (Raven, Raven & Court, 1998). This is a 60-item, timed (20 minutes) ability test, measuring eductive ability, which is a component of Gf. Each of the items consists of a box that contains one or several figures, which are related by specific rules. An area of the box is missing and participants have to distinguish the

² It should be noted that the two largest samples to report significant correlations between Conscientiousness and psychometric intelligence were composed of job-applicants (Moutafi, Furnham & Crump, 2003; Moutafi Furnham & Patiel, 2003).

missing part among five or seven similar figures, by deducing the rules of each box. The 60 items are divided into five groups of 12 items, with increasing level of difficulty within each group. The manual reports that studies on a wide range of age groups, cultural groups and clinical as well as normal populations provide abundant evidence for the test's reliability and validity (Raven, Raven & Court, 1998).

Procedure

The testing procedure occurred on two occasions. On both occasions, participants were tested simultaneously in a large lecture theatre in the presence of five examiners who ensured the tests were appropriately completed. Participants were first requested to report their SAI. In order to standardize SAI, the normal distribution of intelligence scores was presented to the participants, with a range of 0 to 155, including labels for “retardation”, “low average”, “average”, “high average” and “gifted” (see Furnham, 2001b). Participants were then administered the Raven's Standard Progressive Matrices. Although the administration time recommended in the manual is 20 minutes, participants were given 15 minutes in order to avoid any ceiling effects (these have been encountered by the authors during previous testing experience). Participants then completed the NEO-PI-R, for which there was no time limit. A week after the testing procedure, feedback was individually given to each participant on both their personality traits and the IQ results.

2.11 Results

Correlations between Raven's test scores (Gf), SAI, the Big Five personality traits (and sub-facets), gender and age are presented in Table 2.5. Confirming H2, there were significant correlations between Gf and SAI ($r = .22, p < .01$). Of the Big Five factors, Openness correlated significantly with both Gf ($r = .21, p < .01$) and with SAI ($r = .20, p <$

.05)(this confirmed H3d and H1d, respectively), and Neuroticism correlated significantly with SAI ($r = -.20, p < .05$)(which confirmed H1a). Against initial predictions, there were no significant correlations between SAI and Agreeableness (H1b was not confirmed), or Extraversion (H1c was not confirmed). Further, Conscientiousness was not significantly correlated with Gf (which did not confirm H3e). Other non-significant (but predicted) correlations were found between Gf and Neuroticism (H3a confirmed), Extraversion (H3b confirmed) and Agreeableness (H3c confirmed).

Although no specific predictions were stated with regard to correlations between Gf and personality at the primary trait level (sub-facets), these were also investigated through both correlational and regression analysis. Of the Big Five sub-facets, Gf correlated significantly with aesthetics ($r = .20, p < .01$), ideas ($r = .17, p < .05$) and values ($r = .21, p < .01$)(all facets of Openness to Experience). Other sub-facets were not significantly correlated with Gf. Sub-facets were also examined with regard to SAI, which correlated significantly with three Neuroticism sub-facets, namely anxiety ($r = -.23, p < .01$), self-consciousness ($r = -.16, p < .05$), and vulnerability ($r = -.16, p < .05$), one Extraversion sub-facet, namely activity ($r = .17, p < .05$), and two Openness sub-facets, namely ideas ($r = .29, p < .01$) and values ($r = .20, p < .05$). There were no significant correlations between the demographic factors (gender and age) and Gf or SAI.

SAI

In order to investigate whether personality predicts SAI, two hierarchical regressions were performed, with SAI as the dependent variable. The independent variables were the Big Five personality traits for the first regression model, and the Big Five, gender and age

for the second regression model. Standardised β coefficients and t-values for both models are presented in Table 2.6.

Table 2.5 Correlations between gender, age, Big Five, SAI and psychometric intelligence

	SAI	Gf
SAI	-	.22**
Neuroticism	-.20*	-.01
anxiety	-.23**	-.08
anger-hostility	-.08	-.01
depression	-.15	.02
self-consciousness	-.16*	.01
impulsiveness	-.07	-.05
vulnerability	-.16*	.06
Extraversion	.08	-.02
warmth	-.01	-.07
gregariousness	-.05	-.04
assertiveness	.14	-.01
activity	.17*	.00
excitement seeking	.13	.03
positive emotions	-.02	-.00
Openness	.20*	.21**
fantasy	.13	.08
aesthetics	.06	.20**
feelings	.05	.13
actions	.10	.06
ideas	.29**	.17*
values	.20*	.21**
Agreeableness	-.08	.01
trust	.02	.12
straightforwardness	-.12	-.03
altruism	.03	-.01
compliance	-.02	.08
modesty	-.15	-.03
tender-mindedness	-.03	.00
Conscientiousness	.07	-.02
competence	.15	-.01
order	-.07	.04
dutifulness	.10	-.01
achievement-striving	.07	-.04
self discipline	.08	-.01
deliberation	-.01	-.05
Gender	.02	-.00
Age	.04	.01

* $p < .05$, ** $p < .01$

Confirming initial expectations (H1e) and the overall correlational pattern, the first model was significant ($F(5,157) = 3.83, p < .01$, with $\text{Adj. } R^2 = .08$). Significant predictors of SAI were Neuroticism ($\text{st.}\beta = -.23, t = 2.73, p < .01$)(which confirmed H1a), Openness

($st.\beta = .26$, $t = 3.12$, $p < .01$)(which confirmed H1d) and Agreeableness ($st.\beta = -.16$, $t = 1.98$, $p < .05$)(which confirmed H1b). The second model was also significant ($F(7, 132) = 2.74$, $p < .01$, with $Adj. R^2 = .08$). Significant predictors of SAI were again Neuroticism ($st.\beta = -.23$, $t = 2.37$, $p < .01$)(this further supported H1a), Openness ($st.\beta = .26$, $t = 2.83$, $p < .01$) (this further supported H1d) and Agreeableness ($st.\beta = -.23$, $t = 2.68$, $p < .01$) (this further supported H1b).

One further regression model was tested, using only Neuroticism, Openness and Agreeableness as the independent variables, to investigate whether these factors would account for a higher percentage of the variance of SAI, once the near significant predictors were excluded from the analysis. The model was significant ($F(3, 159) = 6.14$, $p < .01$, $Adj. R^2 = .09$) accounting for 9% of the variance. The $st.\beta$ values for the predictors were $st.\beta = -.24$ for Neuroticism ($t = 3.08$, $p < .01$), $st.\beta = .23$ for Openness ($t = 3.05$, $p < .01$) and $st.\beta = -.15$ for Agreeableness ($t = 1.99$, $p < .05$).

The relationship between SAI and the sub-facets of the NEO-PI-R was also investigated by a series of regressions. Five hierarchical regressions were performed using in turn the sub-facets of Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness as independent variables and SAI as the dependent variable; and one further multiple regression model was tested, using all the sub-facets simultaneously as predictors. The $st.\beta$ coefficients for these regressions are presented in Table 2.6.

The model which used the sub-facets of Extraversion as independent variables was significant ($F(6, 156) = 2.65$, $p < .05$, with $Adj. R^2 = .06$) with significant predictors being gregariousness ($st.\beta = -.23$, $t = 2.19$, $p < .01$), activity ($st.\beta = .19$, $t = 2.00$, $p < .05$) and excitement-seeking ($st.\beta = .22$, $t = 2.39$, $p < .01$). The model which used the sub-facets of

Openness was significant ($F(6, 156) = 3.72, p < .01$, with $\text{Adj. } R^2 = .09$) with ideas being a significant predictor of SAI ($\text{st.}\beta = .36, t = 3.66, p < .01$).

Table 2.6 st. β coefficients for predictors of SAI after hierarchical and multiple regressions

	SAI			
	st. β	t	st. β	t
anxiety	-.22	1.93	-.25	1.89
anger-hostility	.04	.41	-.02	.18
depression	.03	.21	.04	.30
self-consciousness	-.05	.51	-.05	.42
impulsiveness	-.01	.13	.04	.31
vulnerability	-.02	.18	-.03	.21
Regression Model	$F(6, 156) = 1.60$			
Adjusted R^2	.02			
warmth	-.04	.36	-.12	.91
gregariousness	-.23	2.19*	-.19	1.73
assertiveness	.13	1.50	-.05	.47
activity	.19	2.02*	.21	1.94
excitement seeking	.22	2.39*	.16	1.51
positive emotions	-.08	.84	-.09	.76
Regression Model	$F(6, 156) = 2.65^*$			
Adjusted R^2	.06			
fantasy	.13	1.44	.25	2.39*
aesthetics	-.17	1.76	-.17	1.65
feelings	-.11	1.20	-.08	.79
actions	-.06	.69	-.15	1.53
ideas	.36	3.66***	.24	2.25*
values	.15	1.68	.18	1.95
Regression Model	$F(6, 156) = 3.72^{**}$			
Adjusted R^2	.09			
trust	.01	.07	-.01	.06
straightforwardness	-.14	1.47	-.12	1.16
altruism	.08	.90	.06	.52
compliance	.04	.45	.05	.42
modesty	-.14	1.68	-.11	1.19
tender-mindedness	-.01	.09	.02	.23
Regression Model	$F(6, 156) = 1.03$			
Adjusted R^2	.00			
competence	.15	1.50	-.09	.69
order	-.15	1.60	-.19	1.80
dutifulness	.10	.95	.17	1.46
achievement-striving	.01	.13	.09	.72
self discipline	.05	.37	.07	.50
deliberation	-.09	.91	-.00	.03
Regression Model	$F(6, 156) = 1.31$		$F(30, 132) = 1.81^*$	
Adjusted R^2	.01		.13	

* $p < .05$, ** $p < .01$

The models which used the sub-facets of Neuroticism, of Agreeableness and of Conscientiousness as independent variables were not significant. The model which used all

the sub-facets simultaneously as independent variables, was significant ($F(30, 132) = 1.81$, $p < .01$) accounting for 13% of the variance. Significant predictors were fantasy ($st.\beta = .25$, $t = 2.39$, $p < .05$) and ideas ($st.\beta = .24$, $t = 2.25$, $p < .05$).

One further regression model was tested, using only the sub-facets of Neuroticism, Extraversion and Openness as the independent variables, to investigate whether they would account for a higher percentage of the variance of SAI, as these included the only sub-facets that correlated significantly with SAI. The model was significant ($F(18, 144) = 2.70$, $p < .01$), accounting for 16% of the variance in SAI scores. Significant predictors were activity ($st.\beta = .24$, $t = 2.55$, $p < .01$), fantasy ($st.\beta = .20$, $t = 2.11$, $p < .05$), aesthetics, ($st.\beta = -.20$, $t = 2.03$, $p < .05$) and ideas ($st.\beta = .27$, $t = 2.68$, $p < .05$). Thus results confirmed that SAI can be significantly predicted by personality traits (H1e).

Psychometric Intelligence

In order to investigate whether SAI and personality can predict psychometric intelligence, three hierarchical regressions were performed, with Gf as the dependent variable. The independent variables were SAI for the first model, SAI and the Big Five for the second model, and SAI, the Big Five, sex and age for the third model. The $st.\beta$ coefficients for these regressions are presented in Table 2.7.

The first model was significant ($F(1, 154) = 7.58$, $p < .05$, with $Adj. R^2 = .04$). SAI was a significant predictor of Gf, with $st.\beta = .22$ ($t = 2.75$, $p < .05$). This confirmed H2. The second model was significant ($F(6, 148) = 2.32$, $p < .05$, with $Adj. R^2 = .05$). Significant predictors of Gf were SAI ($st.\beta = .20$, $t = 2.36$, $p < .05$) (this further supported H2) and

Openness (st.β = .19, t = 2.16, p < .05)(which supported H3d). The third model, which added demographic variables, was not significant (F (8, 124) = 1.76, p = .09).

Table 2.7 st.β coefficients for multiple regressions of SAI and Gf

	SAI		Gf	
	st.β	t	st.β	t
SAI	-		.22	2.75**
Regression model	-		F(1,154) = 7.58**	
Adj. R ²	-		.04	
SAI	-		.20	2.36*
Neuroticism	-.23	2.73**	-.02	.25
Extraversion	-.04	.46	-.12	1.35
Openness	.26	3.12**	.19	2.16*
Agreeableness	-.16	1.98*	.03	.30
Conscientiousness	.06	.75	-.00	.05
Regression model	F(5,157) = 3.83**		F(6,148) = 2.32*	
Adj. R ²	.08		.05	

*p<.05, **p<.01

2.12 Discussion

The results of this study showed that three of the Big Five personality traits at the super and primary level were modestly but significantly related to SAI. As predicted, these traits were Neuroticism and Agreeableness (both negatively), as well as Openness to Experience (positively). Furthermore, one Extraversion sub-facet, namely activity, was also (positively) significantly related to SAI. Low SAI scores by neurotic and agreeable individuals may be both interpreted in terms of poor self-concept in the former and humility in terms of the latter (Wells & Matthews, 1994; studies 1 & 2). This is reflected in two sub-facets of Neuroticism, namely anxiety and vulnerability and the modesty sub-facet of Agreeableness (although the correlation between SAI and this sub-facet only approached significance levels in the present sample). Conversely, positive relations between SAI and Extraversion can be usually explained in terms of the over-confidence and assertiveness that

characterises high Extraversion (see study 2). With regard to the relationship between SAI and Openness, the positive and significant correlation may be indicative of the conceptual similarities between these two variables. Specifically, it is possible to conceptualise Openness as a type of SAI (specifically a self-estimation of crystallised abilities), although Openness may refer to interests rather than skills (McCrae & Costa, 1997a). Further, in the present sample the correlation between Openness and SAI was only moderate (and not larger than the one between Neuroticism and SAI). In that sense, it may only be suggested that Openness is associated with higher estimations of SAI, and vice-versa. To the extent that open individuals tend to score higher on psychometric intelligence tests, particularly those that measure Gc (Ackerman & Heggestad, 1997; Ashton et al, 2000), higher SAI in open individuals could be merely interpreted as a sign of accuracy. That is, since open individuals tend to have higher Gc, one would expect them to give higher SAI (it is however noteworthy that in studies 1 and 2 Openness was not significantly associated with neither SAI nor psychometric intelligence). The present results are therefore consistent with studies indicating that personality is related to self-assessed intelligence (Furnham, 2002; Furnham, Kidwai & Thomas, 2001; studies 1 & 2).

With respect to the relationship between SAI and Gf, a modest but significant correlation was found between these variables. This correlation confirmed the second hypothesis as well as the results of previous studies (Furnham, Kidwai & Thomas, 2001; Furnham & Rawles, 1999; Paulhus, Lysy & Yik, 1998; Reilly & Mulhern, 1995; studies 1 & 2). Further, and considering the above discussion, the present findings are consistent with the conceptualisation of SAI as a construct related to both personality and psychometric intelligence. In that sense, SAI may be influenced by both non-cognitive (e.g., modesty, assertiveness, anxiety, impulsiveness) and cognitive (Gf and Gc) variables.

Regarding the relationship between Gf and personality traits (as considered in the third hypothesis), correlational and regression analyses showed that only Openness was significantly (albeit modestly) associated with Gf. Although the correlation between psychometric intelligence and Openness was modest, it is slightly larger than expected since the Raven's Matrices measures Gf rather than Gc. A central question then is to what extent high Gf may be a precondition of high Openness (in that it may predispose the development of intellectual interests, intellectual curiosity, and intellectual personality in general). This hypothesis may be better understood in terms of adaptive models such as that proposed by Matthews (1999). In this model, the development of cognitive and non-cognitive traits are explained in terms of interactions underlying equally specific adaptations. The theory suggests that there are different cognitive patterns for different personality traits. Traits may thus be identified with adaptive and maladaptive behaviours. Accordingly, Extraversion for instance, may be understood in terms of adaptation to attentionally demanding environments (e.g., crowded rooms, parties), while Openness may be interpreted in terms of adaptation to academic, artistic or intellectual environments. Thus Openness reflects interests that are supportive of performance on tests of Gc (Ackerman & Heggestad, 1997). Openness and Gf may both underlie the development of Gc and adult intellectual competence, which would explain the significant correlation between these two variables. Another possible interpretation for the significant correlation between Gf and Openness is that of Openness as a type of SAI (since both SAI and Openness appear to be interchangeable with regard to Gf). However that would require higher correlations between SAI and Openness, and not modest correlations of $r = .20$ as it was found in the present sample.

On the other hand, there were no significant correlations between Conscientiousness and Gf. Although negative correlations between these two variables had been predicted, it

was also expected that this correlation would not reach significant levels. The rationale underlying the negative relationship between Conscientiousness and measures of Gf is that less able (low Gf) individuals become more conscientious over time as a way of compensating for their low intellectual ability (study 1; Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003). Conversely, one may expect highly able (high Gf) people to have a lower tendency to develop a conscientious (e.g., dutiful, organised, responsible) personality, and rely on their native ability, since their high intellectual competence would be sufficient to achieve their goal. However experimental problems may arise when participants are given a measure of Gf (or intelligence in general) in situations where the results have few significant consequences for them. A typical example would be that of opportunity samples (such as university students run in tutorials or compulsory testing-hours). In those situations, one may expect conscientious participants to take the task more seriously than low conscientious participants, thus leveling with their efforts their lack of intellectual competence. Although this remains an interesting hypothesis, it may explain the fact that no published papers have reported negative and significant correlations between Gf and Conscientiousness on opportunity samples (or in situations where participation had no relevant consequences for the subjects). However there are few (but robust) studies reporting this effect in participants (e.g., job-applicants) who may be assumed to have been highly motivated to obtain high scores on the cognitive tests (see Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003).

The present findings make an important empirical contribution to the current most promising theories of human aptitudes, notably Ackerman's (1996) PPKI theory. Specifically, the present results are consistent with the conception of Openness as both a relevant factor in the acquisition of skills and a self-report measure of assessed intellect

(Goff & Ackerman, 1992). It is interesting that this personality trait was correlated with psychometric intelligence, although a measure of fluid (and strictly non-verbal) intelligence was employed. Indeed, Ashton, Lee, Vernon and Jang (2000) argued that “Openness is oblique to the ability to process abstract, spatial or quantitative nature” (p. 203). However, if Raven’s own definition of Gf is considered, i.e., “making meaning out of confusion; developing new insights; going beyond the given to perceive that which is not immediately obvious” (Raven, Court & Raven, 1980, p.64) it is not surprising that Openness correlated with psychometric intelligence. Moreover, it is likely that objective competencies (e.g., high Gf) support intellectual interests such as those represented by the Openness trait (Matthews, Davies, Westerman & Stammers, 2000). Already Cattell (1971) had suggested that Gf is a pre-condition for knowledge acquisition and application.

Finally, this study (as studies 1 & 2) strongly supports the conception of SAI as a related concept to both personality and intelligence (Eysenck & Eysenck, 1985; Stankov, 1999). Given the current interest on understanding the personality-intelligence interface, the idea that SAI appears to be a fruitful concept for the development of novel, more integrated theories of individual differences, can be fully supported. It is perhaps time that psychology’s emphasis on psychometric intelligence takes into account people’s conceptions and self-estimations, since SAI may affect IQ test performance. The belief that individuals are born with unchangeable intellectual aptitudes may have more detrimental consequences than low intelligence itself and, as Holland (1973) has argued, interests may be more determined by SAI than “actual” intelligence. Thus high SAI or high Openness may lead to intellectual engagement, while low SAI or low Openness may lead to intellectual disengagement, regardless of one’s actual intellectual ability.

STUDY 4

2.13 Introduction

Various studies have looked at the ability of people to estimate their personality test scores (and that of others') as well as their intelligence test scores (and that of others') by correlating estimated score with actual test scores (Furnham, 1997, 2001b; studies 1, 2 & 3). This study examines both in the same population as well as the relationship between self-estimated personality and measured intelligence and assessed personality and estimated intelligence (SAI).

There is a small, but consistent, literature on the relationship between estimates of, and scores on, psychometrically validated personality tests. Various studies have looked at participants' ability to predict their own Extraversion scores (Blaz, 1983; Semin, Rosch, & Chassein, 1981). They demonstrated a conceptual overlap between the normative, lay-produced, and "scientific" conceptions of Extraversion-Introversion and indicated that people can significantly predict their scores. For instance Vingoe (1966) asked participants to estimate their Extraversion score on a 7-point scale that was then compared with the Eysenck Personality Inventory (EPI) score. He found that introverts were more aware of their Introversion than extraverts were of their Extraversion. Harrison and McLaughlin (1969) found a correlation of $r = .72$ and $r = .56$ between participants' ($N = 243$) estimates of their own Extraversion and Neuroticism, respectively, and their actual scores resulting from the EPI. Similarly, Gray (1972) replicated this on 131 nurses and found correlations of $r = .48$ for Extraversion and $r = .21$ for Neuroticism.

Studies in this area have used a large number of personality measures, including the Fundamental Interpersonal Relations Oriented-Behaviour (FIRO-B), the Myers-Briggs Type

Indicator (MBTI)(Furnham, 1996a), and locus of control measures (Furnham & Henderson, 1983). More recently Furnham (1997) used the NEO-FFI (Costa & McCrae, 1988) to measure the Big Five personality traits, and results of three samples were largely comparable, especially on the correlation between estimated and actual inventory scores. Participants were clearly able to estimate their personality scores fairly accurately. Overall, they were best at predicting Conscientiousness ($r = .57$), followed by Extraversion ($r = .52$) and Neuroticism ($r = .51$). They were least good at predicting their Openness to Experience score ($r = .33$), where one of the three studies reported a non-significant finding.

Still questions remain as to which personality trait dimension scores people in general are able, and not able, to predict with any degree of accuracy and whether some people are significantly better than others at predicting their own scores. It could be assumed that people are able to predict scores for dimensions that they understand or where they have some frame or schema of reference that they can decipher. If, for instance, a person is required to estimate his or her Extraversion or Conscientiousness score accurately, he or she would have to be familiar with the psychological concept, be clear about the situations or phenomena to which it applied, and be aware of how he or she compared with population norms. Concepts like Extraversion and Neuroticism, and to a lesser extent Conscientiousness, are part of everyday language, frequently discussed with respect to a variety of settings, and social comparisons are often made: hence it may be hypothesised that they could be significantly predicted (Goldberg, 1992). In a validity study, Costa and McCrae (1988) found highest correlations between questionnaire-derived scores and adjective-based self-reports for Conscientiousness, Neuroticism, and Extraversion. Thus, to do this task well, a participant needs to access and use a cognitive category or framework concerning personality traits. The inability to do so may indicate either a non-existent,

incorrect, or poorly formed category or an inability to use it comparatively. However, it could be argued that the relative low use of this term by lay people does not necessarily mean that the concepts represented by that factor are obscure and, likewise, that a poorly formed category cannot be described by a commonly used word.

Hence this study which looks at the primary traits, as well as the super-trait level, which appears not to have been done in previous studies. The level of description of the six primary traits that make-up each of the five super-factors in the FFM system of Costa and McCrae (1988, 1992) is more detailed and can be given in terms of everyday synonymous adjectives. Hence it may be expected that the size of the correlations are larger but more varied at the primary trait level. Furthermore it may be anticipated that even though the correlation between super-factor estimates and actual scores will not be significant (in the case of Openness to Experience and Agreeableness), some of the primary traits will be indeed significant. Specifically it will be these primary factors that are described in everyday language that will yield highest estimate-actual correlations.

A limited (but growing) number of studies have also investigated the relationship between SAI and psychometrically measured IQ (see studies 1, 2 & 3), using a fairly diverse series of measures, yet the results have been fairly consistent. De Nisi and Shaw (1977) gave 114 students 10 different ability tests from different batteries measuring spatial, verbal and numerical ability. Participants were also asked to rate their ability on a five-point scale. With one exception, all the correlations between the two scores were significant and positive with five being ($r > .30$). They concluded that self-reports of ability could not substitute for validated measures (i.e., IQ tests).

Borkenau and Liebler (1993) looked at both the correlation between self and an acquaintance rating and a nine part German intelligence test that measures both verbal and

non-verbal intelligence. Correlations for males and females, analysed separately, were almost identical and ranged from $r = .29$ to $r = .32$. Curiously they showed that when strangers rated the intelligence of people they saw relatively briefly on a video the correlation between other-estimate and actual score was $r = .43$. However, it was the aggregated score of six judges (strangers) that constituted the estimated score and this was inevitably more reliable than a single judge. They found stranger ratings of intelligence are not only related to self-reports and partner ratings but also to actual performance on an intelligence test, the size of the correlations indicated they could not reliably be used as substituted for actual test scores.

Reilly and Mulhern (1995) asked students to complete the Digit Symbol Vocabulary Test from the Wechsler Adult Intelligence Scale (WAIS) and then to estimate their IQ's. The men's SAI were significantly higher than their measured IQ's, whereas the women's SAI were lower, but not significantly so. A few outliers, however, significantly determined the sex differences in scores. The authors note that IQ-estimates/SAI research should not be based on the "assumption that gender differences at group level represent a generalised tendency on the part of either sex to either over-confidence or lack of confidence with regard to their own intelligence" (Reilly & Mulhern, 1995, p.189).

More recently, Furnham and Rawles (1999) asked 53 male and 140 female British undergraduates to estimate their overall IQ (g). About 4 months later, they completed a spatial-intelligence (mental-rotation) test. The men estimated their scores significantly higher than the women did and also obtained significantly higher test scores than did the women. There was a very modest but significant correlation between SAI and actual IQ score ($r = .16$). The correlation was significant for the men $r = .27$ but not for the women ($r = .09$). Removal of a small number of outliers had no significant effect on the results.

In a cross-cultural study comparing British and Singaporean students Furnham, Fong & Martin (1999) required 172 participants (68 male, 104 female: 84 British and 88 Singaporean) to complete the Raven's Standard Progressive Matrices and give their SAI. Males scored lower on the psychometric measure of intelligence than females, though there were no cultural differences. The British had higher self-estimate scores than the Singaporean though there were no cultural differences on the actual IQ test score. The correlation between estimated and measured IQ was $r = .19$ overall (British $r = .14$; Singaporeans $r = .26$) the highest correlation was for Singaporean females ($r = .51$) and lowest for British females ($r = .08$).

Paulhus, Lysy and Yik (1998) reviewed the salient literature and found that correlations between single-item self-reports of intelligence and IQ scores tended to rarely exceed ($r = .30$) in college students. They argued that this result could be improved by three different features: aggregated both estimates and tests to increase reliability and therefore validity; using a weighting procedure so that items before aggregation are weighted according to their individual diagnosticity; and using indirect rather than direct questions to measure SAI to reduce self-presentational and social desirability effects.

In their study Paulhus et al (1998) used the Wonderlic (1992) test as the dependant measure and two large groups of undergraduates ($Ns = 310, 326$). However, the results using both direct and indirect measures showed correlations in the range of $r = .04$ to $r = .34$ the majority being around $r = .20$. They concluded that the validity of self-report measures of IQ in student samples has a limit of $r = .30$. They found direct items asking for estimates of mental ability more valid than indirect items. They found their aggregation and weighting strategy only offered modest improvements and concluded "as a whole, our verdict is pessimistic about the utility of self-report as proxy measures of IQ in college

samples” (p.551). Recent studies (studies 2 & 3) have found similar correlations between SAI and psychometrically measured intelligence, thus supporting Paulhus et al’s (1998) conclusion.

Furnham (2001b) concluded that some studies have “tried to understand (and improve) the size of the correlation between SAI and test scores by using more tests on bigger populations yet the size of the correlations remains the same around the $r = .30$ mark. Second, these correlations do obscure the fact that whilst some people are clearly accurate estimators of their score others are way out. It may prove very useful to obtain sub-samples of highly accurate vs. inaccurate estimators and see on what other criteria they differ, e.g., self-esteem, experience of IQ tests, etc. Third, there may well be important motivational factors at play in the self-estimation of intelligence, which may lead to serious distortions in the scores. Thus, a close examination of the conditions and instructions under which participants make SAI may give a clue as to how they make their self-estimate” (p. 1400).

Studies 1, 2 and 3 replicated the pattern of results for the relationship between psychometric intelligence and SAI, indicating that participants could accurately predict their test scores before taking an intelligence test. Throughout the three samples, correlations between psychometric intelligence and SAI were found to range from $r = .19$ to $r = .27$ (with a mean of $r = .24$). Further studies 1, 2 and 3 showed that personality traits are more related to estimated than to psychometric intelligence. This study offers the possibility of examining the relationship between self-estimated personality and actual intelligence. The central question is whether self-perception is related to “actual” intelligence, which partly begs the question of the relationship between personality and intelligence. Do intelligent people perceive themselves as more or less neurotic, extraverted, open, agreeable, or conscientious? Further, the question of whether highly and lowly neurotic, extraverted,

open, agreeable and conscientious individuals regard themselves as more or less intelligent (which has been consistently explored in studies 1, 2 & 3) will also be explored.

As noted above there appears to be both hubris and humility associated with SAI: the former most commonly found in males, the latter in females (Furnham, 2001b). Given the nature of the Big Five it is possible that all traits are significantly associated with SAI: that is, personality factors more strongly influence perceived rather than actual intelligence. Neurotics may be expected to under-estimate their score because of their self doubt (Wells & Matthews, 1994); extraverts' assertiveness and optimism may lead them to over estimate their actual IQ score (Furnham, Kidwai & Thomas, 2001; study 2), because Openness to Experience is conceptually related to intelligence it is expected that there is a positive correlation between Openness and SAI. Low Agreeableness ratings (a crude measure of hubris) maybe expected to relate to high IQ ratings, and high Conscientiousness to low IQ ratings, if the trait develops partly out of a need to compensate for average intelligence. There is sufficient evidence in the literature to suggest that personality traits affect people's estimations of their intellectual ability. Thus SAI may be regarded as a variable linked to both personality and actual intelligence (see studies 1, 2 & 3). This study will test several hypotheses:

H1: there will be significant associations between estimated and actual personality scores, with regard to both own and others' estimations. Specifically, it is expected that:

H1a: participants will be able to predict their own and their friends' Conscientiousness scores at the super-trait level. This would confirm that Conscientiousness can be accurately estimated (Furnham, 1997).

H1b: participants will be able to predict their own and their friends' Neuroticism scores at the super-trait level. This would replicate the results of Harrison and McLaughlin (1969) as well as Gray (1972).

H1c: participants will be able to predict their own and their friends' Extraversion scores at the super-trait level. This would be in line with previous results suggesting that psychometric and estimated Extraversion are significantly related (Blaz, 1983; Vingoe, 1966).

H1d: participants will not be able to predict their own and their friends' Agreeableness scores at the super-trait level. This would confirm that Agreeableness is not easily estimated (Goldberg, 1992).

H1e: participants will not be able to predict their own and their friends' Openness scores at the super-trait level. This would confirm that, like Agreeableness (and perhaps due to semantic complexity) it is difficult for individuals to estimate their Openness scores (Goldberg, 1992).

H2a: there will be significant correlations between self-actual and other-actual personality scores; this would be indicative of the similar personalities of friends.

H2b: there will be significant correlations between self-estimated and other-estimated personality scores; this would be indicative of consistent patterns of estimations (moreover it would suggest that people tend to *think* they are similar to their friends)(Furnham, 1997).

H3a: correlations between estimates and actual Openness scores would be significant at the primary trait level. These correlations are expected to the extent that primary traits are easier to interpret than the overall concept/scale of Openness (Goldberg, 1992).

H3b: correlations between estimates and actual Agreeableness scores would be significant at the primary trait level. These correlations are expected to the extent that primary traits are easier to interpret than the overall concept/scale of Agreeableness (Goldberg, 1992).

H4a: there will be no significant associations between actual personality scores and actual intelligence scores. This is expected in line of the results of studies 1, 2, and 3, in which only 8% of the correlations between psychometric intelligence and NEO super-traits were significant. Thus personality traits are not expected to significantly predict psychometric intelligence.

H4b: there will be no significant associations between estimated personality scores and actual intelligence scores. Thus estimated personality traits are not expected to significantly predict psychometric intelligence. This would be consistent with the fact that a) participants can accurately estimate their personality traits, and b) personality and intelligence are not significantly related at the psychometric level.

H4c: there will be significant associations between actual personality scores and estimated intelligence scores. This would replicate the results of Furnham and Thomas (2003) as well as the consistent pattern found in studies 1, 2, and 3 showing that personality traits are significant predictors of SAI. Thus personality traits are expected to significantly predict SAI

H4d: there will be significant associations between estimated personality scores and estimated intelligence scores. Thus estimated personality traits are expected to significantly predict SAI. This would be consistent with the fact that a) participants can accurately estimate their personality traits, and b) personality and SAI are significantly related.

H5: there will be significant correlations between SAI and psychometric intelligence. This would replicate previous papers (Furnham & Rawles, 1995, 1999; Reilly & Mulhern, 1995) as well as the results of studies 1, 2 and 3.

2.14 Method

Participants

Participants were 187 (89 of whom were females) undergraduate students at University College London. Their ages ranged from 17 to 25, with an arithmetic mean of 20.02 (SD = 4.31) years. All the participants were fluent to native English speakers and collaborated in this study as part of their course-work.

Measures

The Wonderlic Personnel Test (Wonderlic, 1992). As in study 1

The NEO Personality Inventory - Revised (NEO-PI-R; Costa & McCrae, 1992). As in study 1

SAI: As in study 1

Self-estimated Personality: Participants were given full descriptions of the NEO super and primary factors as well as population norms (means and SD). They were asked to make 35 estimates (30 primary and 5 super) both for themselves and a friend/acquaintance present in the testing session.

Procedure

Participants were tested simultaneously in a large lecture theatre in the presence of five examiners who ensured the tests were appropriately completed. Participants were first requested to report their SAI. In order to standardize SAI, the normal distribution of intelligence scores (the possible range was 0-155), including labels for “retardation”, “low average”, “average”, “high average” and “gifted”, was presented to the participants. The bell curve showed standard deviation scores each with the appropriate label. After that, they completed the Wonderlic Personnel Test, which had a time limit of 12 minutes. Participants then completed the NEO-PI-R, for which there was no time limit.

2.15 Results

Correlations: Table 2.8 shows the results of the correlational analysis. At the *super-factor* level the results show a pattern partly similar to that of Furnham (1997). They revealed that participants can significantly predict their Conscientiousness (H1a was confirmed), Neuroticism (H1b was confirmed) and Extraversion (H1c was confirmed) scores but not significantly their Agreeableness (H1d was confirmed) and Openness (H1e was confirmed) scores. With regard to intellectual ability, the correlational pattern showed that estimations and actual intelligence scores were significantly related (this confirmed H5).

The estimation of others indicated that participants could significantly predict the Openness, Extraversion and Conscientiousness scores of their friends (this further supported H1c and H1a, respectively). Correlations between participants and their “friends” actual scores showed participants were similar to each other in terms of their Openness, Neuroticism and Extraversion (marginally)(this confirmed H2a). As before all the

correlations between self and other estimation were similar, high and significant, reflecting a rating style issue. This confirmed H2b.

Table 2.8 Correlation between self/other estimated and actual personality and intelligence scores

	Self Estimate Self Actual	Other Estimate Other Actual	Self Actual Other Actual	Self Estimate Other Estimate
Neuroticism	.39** (.51**)	.13 (.26**)	.28** (.15)	.40** (.33**)
anxiety	.54**	.17*	.23**	.29**
angry hostility	.52**	.20*	.02	.65**
depression	.58**	.00	.14	.40**
selfconsciousness	.40**	.04	.18*	.41**
impulsiveness	.06	.07	.09	.72**
vulnerability	.16*	.02	.20*	.64**
Extraversion	.35** (.52**)	.26** (.19*)	.16* (.17)	.48** (.27**)
warmth	.43**	.26**	-.06	.42**
gregariousness	.33**	.34**	.26**	.57**
assertiveness	.51**	.37**	.00	.35**
activity	.51**	.32**	.10	.40**
excitement seek	.26**	.27**	.13	.48**
positive emotions	.37**	.29**	.08	.60**
Openness	.01 (.33**)	.36** (.13)	.34** (.01)	.38** (.48**)
fantasy	.48**	.23**	.10	.44**
aesthetics	.36**	.32**	.17*	.51**
feelings	.14	.02	.16*	.60**
actions	.16*	.19*	.18*	.58**
ideas	.24**	.29**	.26**	.14
values	.23**	.28**	.10	.33**
Agreeableness	.14 (.39**)	.09 (.35**)	.09 (.01)	.46** (.46**)
trust	.28**	.11	.04	.47**
straightforward	.12	-.01	-.14	.78**
altruism	.27**	.17*	.11	.55**
compliance	.26**	.14	.13	.41**
modesty	.17*	-.02	.17*	.55**
tendermindedness	-.09	.09	.25**	.17*
Conscientiousness	.41** (.57**)	.22** (.26*)	.11 (.18*)	.45** (.38**)
competence	.30**	.25**	.05	.46**
order	.46**	.21**	.09	.27**
dutifulness	.20*	.26**	.12	.49**
achievement	.45**	.11	.06	.59**
self-discipline	.54**	.32**	.10	.51**
deliberation	.18*	.16*	-.02	.56**
Wonderlic	.30**	.20 ^φ	.00 ^φ	.67** ^φ

* p < .05, ** p < .01, ^φ N = 87, parentheses: results from Furnham,1997 where N = 227, otherwise N = 184

At the *primary-factor* level, what was particularly interesting was the variation within the six correlations for each super-trait. A second feature was the difference between the results at the super and primary level. Thus whereas the self-estimated/self-actual correlation for Openness to Experience was almost zero for the super-factor, five of the six

correlations were significant at the primary-factor level, two over ($r = .30$). The same was true for Agreeableness. This confirmed H3a and H3b.

When examining the second column: that is, the estimation of the other person's personality and intelligence, the correlation with Openness to Experience at the primary level was higher than all correlations at the primary level, whereas for Extraversion the pattern was reversed. The greatest variability with primary-factor area was perhaps noticeable in the third column. Thus three of the six correlations in the Neuroticism area were significant, four in the Openness and two in Agreeableness when few of the six correlations were significantly positive. None of the correlations exceeded ($r = .26$). The final column shows all but one of the correlations (ideas) were significant.

Hierarchical Regressions: A series of hierarchical regressions were then performed regressing the five personality traits and sex onto the "actual" (Wonderlic) and estimated IQ score. The regressions onto the actual score proved non-significant. That is neither actual trait scores nor estimated trait scores, either alone or with participants sex predicted the actual Wonderlic test scores. This confirmed H4a and H4b.

Four regressions were then calculated with the estimated Wonderlic score as the dependant variable. Regressing the five estimated traits onto the estimated IQ narrowly missed significance ($F(5, 157) = 1.98, p = .07, \text{Adj. } R^2 = .03$) with Openness being a significant predictor ($\text{st.}\beta = .16, t = 1.91, p < .05$). Thus H4d was not supported. Adding sex to the regression made little difference. However the regression of actual trait scores onto the estimated IQ score was highly significant ($F(5, 159) = 4.18, p < .01, \text{Adj. } R^2 = .08$). This confirmed H4c. Neuroticism ($\text{st.}\beta = -.20, t = 2.34, p < .05$) and Agreeableness ($\text{st.}\beta = -.23, t = 3.04, p < .01$) were significant predictors indicating that disagreeable, stable people awarded themselves higher SAI. When the regression was repeated with sex it

remained much the same ($F(6, 158) = 4.03, p < .001, \text{Adj. } R^2 = .10$): Neuroticism ($\text{st.}\beta = -.20, t = 2.33, p < .05$) and Agreeableness ($\text{st.}\beta = -.24, t = 3.18, p < .01$) were significant predictors.

Table 2.9 $\text{St.}\beta$ coefficients for the predictors of estimated and psychometric intelligence

	<i>Estimated</i> Intelligence		<i>Psychometric</i> Intelligence	
	<i>st.}\beta</i>	<i>t</i>	<i>st.}\beta</i>	<i>t</i>
<i>Psychometric</i>				
Neuroticism	-.20	2.34*	.06	.68
Extraversion	.08	.84	.12	1.28
Openness	.08	.93	-.08	.97
Agreeableness	-.23	3.04**	.00	.05
Conscientiousness	.01	.06	.11	1.30
Gender	-.13	1.74	.08	.98
		$F(6, 158) = 4.03^{**}, \text{Adj}R^2 = .10$		$F(6, 157) = .81, \text{Adj}R^2 = -.01$
<i>Estimated</i>				
Neuroticism	.01	.17	.02	.29
Extraversion	.09	1.07	-.06	.79
Openness	.16	1.91*	.05	.54
Agreeableness	-.04	.50	-.05	.51
Conscientiousness	.13	1.56	.10	1.13
Gender	-.07	.85	.10	1.24
		$F(6, 155) = 1.68, \text{Adj}R^2 = .02$		$F(6, 150) = .61, \text{Adj}R^2 = -.02$

** $p < .01$ * $p < .05$

2.16 Discussion

This study examined the relationship between four different (but related) constructs, namely SAI, psychometric intelligence (Wonderlic, 1992), estimated personality and psychometric personality (NEO-PI-R, Costa & McCrae, 1992). In light of the previous literature, the results show that, first, estimated and psychometrically assessed personality are related constructs. At the super-factor level, three of the Big Five personality traits (Neuroticism, Extraversion and Conscientiousness) were moderately related to participants' self-estimations. These results are consistent with initial expectations and the previous literature (Blaz, 1983; Harrison & McLaughlin, 1969; Furnham, 1997; Semin, Rosch & Chassein, 1981). Further, the fact that there were no significant correlations between self-estimated and actual Openness and Agreeableness scores is also in line with the predictions.

It was hypothesised that the relative obscurity and low usage in the definition/label of these factors would enable participants to estimate their scores accurately. However it was found that, at the primary factor level, actual Agreeableness and Openness scores *were* significantly related to participant's self-estimations, yet participants seemed to be able to estimate their friends' Openness at the super-factor level. It is thus necessary to be careful when it comes to interpreting low correlations between self-estimated and self-actual Openness as a consequence of difficulties in understanding the concept described at the more abstract level. This is however still a possible explanation for the Agreeableness factor, which was not accurately estimated for self or other.

The hypotheses that estimations at the primary level would be more accurate than at the super-level were strongly supported by the present results. Participants were best at estimating their own depression, anxiety, self-discipline, angry hostility, assertiveness and activity. Estimations of others' personality scores were generally lower although still significant and the pattern that estimations would be more accurate at the primary level was maintained. Thus it seems the more specific the trait and behaviour described the easier it is for participants to predict their own score. Finally, looking at the relationship between self-actual/other-actual and self-estimated/other-estimated scores indicates that, whereas participants tended to give similar estimations for their own and their friends' personality, their actual personality scores were not significantly related. This suggests that people believe they are like their friends, although they are not (at least in their personality). However no data was selected on either the length or depth of the friendship which could significantly change the pattern of the results.

Second, regarding the relationship between psychometric intelligence and SAI, the present results confirmed the prediction that people would be able to estimate their

intelligence to a moderate degree. In fact the correlation reported between SAI and actual IQ scores (i.e., $r = .30$), is consistent with the most salient literature (Borkenau & Liebler, 1993; De Nisi & Shaw, 1977; Furnham & Rawles, 1999), and with Paulhus, Lysy and Yik's (1998) meta-analysis, in which the authors concluded that SAI and psychometrically measured intelligence typically correlate by $r = .30$ (see also Furnham, 2001b, studies 1, 2 & 3).

Third, assuming that people have some insight into their intellectual ability (see above), the possibility that this insight may have shaped people's conceptions of their personality was considered. However, given that personality and intelligence are only weakly related at the psychometric level, and given that individuals are able to estimate their personality to an accurate extent, no significant correlations between estimated personality and psychometric intelligence were predicted. Results clearly supported this hypothesis; it was shown that self-estimated personality was unrelated to actual IQ scores.

Fourth, considering SAI and psychometric personality: as shown by the regression analyses, personality scores were significantly related to SAI, accounting for about 8% of the variance. Particularly Neuroticism and Agreeableness were (both negatively) significant predictors of SAI. These results confirmed initial predictions and replicate the results of studies 1, 2 and 3, therefore suggesting that personality traits may affect people's estimations of their own intellectual ability, more than their actual scores. In the case of Neuroticism, negative estimations may be a consequence of the low self-esteem and negative self-evaluation that are typical of high Neuroticism scores. On the other hand, modesty, which is a characteristic of Agreeableness, may also have influenced the estimation of participants. As in previous studies then (notably study 1), stable, disagreeable people were the ones who gave the highest SAI.

Like studies 1, 2 and 3 (see also Furnham & Thomas, 2003) the present results show that personality is a significant predictor of SAI, which in turn is a significant predictor of psychometric intelligence. SAI may thus be considered a variable that relates to both personality and intelligence though there is some suggestion that there are also systematic sex differences in SAI (see Furnham, 2001b for a review). Thus neurotics may believe they are not very bright which may give them additional anxiety in IQ testing session, which in turn inhibits their performance. In this sense SAI may have a self-fulfilling effects.

2.17 Conclusions

This chapter has explored the relationship between personality traits, SAI and psychometric intelligence. In addition, other variables such as gender, lay conceptions of intelligence, and estimated personality were also examined with regard to these constructs. Four studies were reported and several conclusions can be drawn.

Results suggest that, at the psychometric level, personality and intelligence are only weakly (and mostly non-significantly) related. A total of 30 correlations between the NEO-PI-R personality super-traits and several ability measures were computed, only 2 of which were significant. Despite the limitations of these four studies, which involved relatively small ($N < 200$) and homogeneous (i.e., participants were students from a competitive university and had higher IQ scores than the population mean) samples, consistent links between established personality traits and measured intelligence seem unlikely.

This is certainly true for Extraversion and Agreeableness, which were virtually unrelated to intelligence scores. With regard to Neuroticism, results are perhaps less

conclusive given the fact that the relationship between psychometric intelligence and this personality trait has been mainly attributed to neurotics' lower capacity to perform in stressful or arousing conditions. Hence the limitations of the present results, which refer to intelligence tests that were administered under no pressure (in the sense that the results were not used for any sort of decision making or stored for further use): all studies involved opportunity samples composed of university students who completed the tests under no pressure.

With regard to the two other traits, namely Openness and Conscientiousness, results are less consistent since these traits were found to be significantly correlated with the Raven Progressive Matrices and Baddeley Reasoning test scores, respectively. Interestingly (and unlike the other three Big Five traits) Openness and Conscientiousness may be theoretically linked to intelligence (rather than merely affect test performance, as has been argued with Neuroticism and Extraversion). These theoretical links appear of great interest for those who attempt to develop a more integrative model to conceptualise non-cognitive and cognitive individual differences (e.g., Ackerman, 1999; Matthews et al, 2000). Specifically, it is the idea that low intellectual ability (Gf) may partly determine the development of a highly conscientious personality, while high Gf may partly determine the development of an open personality.

Nevertheless more evidence in support of these hypotheses is needed. Rather than encouraging the integration of personality and intelligence at a psychometric level, overall the results of chapter 1 seem to indicate that (at least in well-educated and bright samples such as those from competitive universities) well-established personality traits and psychometric intelligence are orthogonal constructs.

On the other hand, studies 1 to 4 all indicated that personality traits (notably Neuroticism and Agreeableness) are significantly related to subjectively (as opposed to psychometrically) assessed intelligence (SAI). In 9/20 correlations computed across chapter 1 there were significant associations between personality and SAI. Although previous research had rarely examined the relationship between SAI and personality traits, the present results show a relatively consistent pattern for SAI to be associated with low Neuroticism and Agreeableness, and reliably high Extraversion and Openness. In addition, and confirming past research (Furnham, 2001b; Furnham & Rawles, 1995, 1999), SAI was systematically linked to psychometric intelligence. Given that personality traits predict SAI (but not to psychometric intelligence), and SAI predict psychometric intelligence, SAI may be regarded as a bridging the link between personality and intelligence.

Thus personality may influence SAI, which in turn can influence performance on ability tests. Further, results showed that SAI is also significantly related to gender (in 75% of the regressions gender was a significant predictor of estimated intelligence). SAI may therefore further explain the relationship between gender and psychometric intelligence: men tend to give higher SAI, and people with higher SAI tend to score higher on psychometric intelligence tests. Moreover, study 2 also suggested that individual differences in SAI can be also understood in terms of lay conceptions of intelligence: specifically whether individuals hold positive or negative attitudes towards IQ testing. Although lay conceptions were only assessed in one of the studies of this chapter (and through a very brief inventory), it seems important that research further examines the possible impact of lay conceptions of intelligence on SAI, since the results of this chapter suggest that SAI may have an impact on performance on psychometric tests.

The limitations of the present results also concern the homogeneity of the samples' SAI, which may be expected to be considerably higher than the normal population: as much as students from selected universities have a higher-than-average intelligence, they are also more likely to regard themselves as more intelligent than the normal population. However, this can only encourage research onto the relationship between SAI, psychometric intelligence and personality traits in a more heterogeneous sample; without the restriction of range of the present samples correlations can be expected to be larger and more significant (Meehl & Rosen, 1955).

Another limitation is perhaps that SAI was assessed in a general way, without looking at lay conceptions of intelligence or estimation of more specific abilities. In that sense, it may be advisable that future studies looking at the relationship between personality, psychometric intelligence and SAI should consider assessing SAI through multiple item inventories/questionnaires. This would provide a more reliable measure of SAI as well as a more specific indicator of the nature and particular lay conceptions of the notions of intelligence underlying SAI. It is however possible that SAI, as assessed in a general way, is a better indicator of participants' *g* and, furthermore, would capture more aspects of people's self-esteem, self-confidence and self-conception.

To conclude, the present chapter has shown that there are no consistent links between personality and intelligence at the psychometric level. However, when intellectual competence is assessed through SAI, personality traits (notably Neuroticism and Agreeableness, but also Extraversion and Openness to Experience) are indeed significant predictors. Since SAI is consistently related to psychometric intelligence, which suggests that it may play a significant role on ability test performance, SAI may expand the

relationship between personality and psychometric intelligence. Furthermore, it is likely that SAI is also related to both psychometric intelligence and gender. Direct effects of gender on psychometric tests are therefore unlikely, and the same can be said with regard to the effects of personality traits on IQ test performance. However in order to fully investigate the relationship between personality traits and intellectual competence (as well as hypothesise and test the direct effects of personality traits), it would be necessary to look not only at psychometric intelligence and SAI, but also at indicators of academic performance. This shall be the topic of the next chapter.

Chapter 3: Personality and Academic Performance

STUDY 5

3.1 Introduction

For over a century psychological and educational researchers have maintained an interest in the effective prediction of academic performance (AP)(e.g., Binet, 1903; Binet & Simon, 1905; Busato, Prins, Elshout & Hamaker, 2000; Ebbinghaus, 1897; Elshout & Veeman, 1992; Galton, 1883; Goh & Moore, 1987; Harris, 1940; Savage, 1962; Terman, 1916; Thurstone, 1919; Willingham, 1974). In fact, it was largely this interest that prompted the development of psychometric theory and, more specifically, modern intelligence tests. Although intelligence tests have consistently been shown to be powerful predictors of AP, it has often been claimed that non-cognitive factors, which are orthogonal to intelligence and thus not assessed by intelligence tests, may also contribute to the prediction of academic success or failure.

Ackerman and Rolfhus (1996, p. 176) have recently argued that abilities are “only one part of the complex causal framework that determines whether a student pursues the acquisition of knowledge and skills within a particular domain. Two other components of the equation are interests and personality traits”. Further, the authors (see also Cronbach, 1949) posit that the performance peaks assessed by intelligence tests (which are measures of *maximal* performance) may be infrequent in everyday life. Thus personality inventories (which refer to *typical* performance) may improve the prediction of performance. Accordingly, Hofstee (2001) proposed that personality traits and cognitive abilities should be considered as separate predictors of AP.

Intelligence and AP: Psychometric intelligence is the strongest predictor of AP in particular and educational level, more generally (Brand, 1994). Not surprisingly, intelligence tests have been widely used both for research as well as for selection purposes across various educational levels, ranging from primary school all the way to university (Brody, 2000; Jensen, 1980; Wolf, 1973; Zeidner & Matthews, 2000). In a meta-analysis of over 3,000 studies, Walberg, Strykowski, Rovai and Hung (1984) reported a correlation between intelligence and AP at school in the order of about $r = .70$. Similar correlations have also been reported in more recent studies (e.g., Gange & St. Pere, 2001).

As noted, intelligence is strongly associated with AP at higher educational levels. In a recent large-scale meta-analysis ($N = 82,659$) that included a total of 1,753 samples, considering several criterion measures and correcting for statistical artifacts, Kuncel, Hezlett and Ones (2001) tested the validity of Graduate Record Examinations (GRE) and undergraduate grade point average (UGPA) as predictors of AP at postgraduate level. It was found that both GRE and UGPA were consistently and significantly related to grade point average in the first postgraduate year of education, to final examination scores.

In spite of the foregoing, there is a small body of research suggesting that the relationship between psychometric intelligence and AP may often be weaker than expected, sometimes even failing to reach statistical significance levels (Metha & Kumar, 1985; Sanders, Osborne & Greene, 1955; Seth & Pratap, 1971; Thompson, 1934). While shortcomings in the operationalisation of the constructs or in the sampling procedures of some studies can account for the presence of anomalous findings, many researchers have emphasised the need to include variables other than psychometric intelligence in investigations designed to predict or account for individual differences in AP (Ackerman &

Heggstad, 1997; Hofstee, 2001; Snow, 1992).

Personality and AP: Personality traits have been among the salient non-cognitive variables that have been examined in relation to AP. Ackerman (1994) suggested that since AP takes place in a typical environment (i.e., students are evaluated on a regular basis and thus required to perform throughout a long-term period), it would make sense to investigate whether it is influenced by typical characteristics, such as those assessed by personality inventories. The logic underlying this argument is straightforward. While cognitive ability tests provide information about a student's intellectual competence (i.e., what she/he *can* do), measures of typical performance may add important information about a student's likelihood to invest time and efforts in his/her studies, strive for achievement, and cope with stress and anxiety (i.e., what she/he *may* do). Burt and Arps (1920) made a similar point after noting that the relationship between intelligence and AP tended to be weaker in high-school samples than in military academy samples.

As already mentioned, there has been a longstanding interest in the influence of personality traits on AP. More than 80 years ago, Whipple (1922, p. 262) concluded that it would be "foolish (...) to suppose that native intelligence is the sole factor in academic success". Webb (1915) put forward a construct that he labeled 'persistence of motives' and which he considered of great relevance to intellectual performance (a modern version of this factor was developed by Digman's, 1990, taxonomy as "conscientiousness", although the author suggested that the label of "achievement-striving" may be more appropriate).

Research into the relationships between personality traits and AP continued throughout the 1950s, but it was not until the establishment of the Eysenckian model of personality (Barrett, Petrides, Eysenck, & Eysenck, 1998; Eysenck, 1947; Eysenck, 1997) that the various studies in the area began to examine with some consistency the same

personality traits. The advantage of a personality paradigm was that it facilitated comparisons across different studies, which was difficult before due to the multitude of personality constructs involved.

The Eysenckian model of personality comprises three basic dimensions, namely Psychoticism, Extraversion, and Neuroticism. The principal measurement vehicles of Eysenckian personality are the Revised version of the Eysenck Personality Questionnaire (EPQ-R; Eysenck, Eysenck, & Barrett, 1985; Barrett et al, 1998) and the Eysenck Personality Profiler (EPP; Eysenck, Barrett, Wilson, & Jackson, 1992; Petrides, Jackson, Furnham, & Levine, 2003). The Eysenckian model provided the basis for a number of similar three-factor models of personality and mood, such those of Cloninger (1987) and Tellegen (1985). Table 3.1 presents some characteristics of high and low scorers on the three personality dimensions of the Eysenckian model.

Table 3.1. Some characteristics of high versus low Neuroticism, Extraversion and Psychoticism scorers.

	Psychoticism	Extraversion	Neuroticism
High (+)	Artistic, careless, creative, disorganized, risk-taking, rude.	Active, assertive, impulsive, sociable.	Anxious, inferior, moody, unstable.
Low (-)	Cautious, conscientious, efficient, sympathetic, systematic.	Quiet, restrained, withdrawn.	Calm, confident, content, relaxed.

Many studies have examined the effects of the Eysenckian three on AP. Neuroticism tends to be negatively associated with AP (Cattell & Kline, 1977; Furnham & Medhurst, 1995; Goh & Moore, 1987; Halamandaris & Powell, 1999; Lathey, 1991; Rindermann & Neubauer, 2001; Sanchez-Marin, Rejano-Infante, & Rodriguez-Troyano,

2001; Weiss, 1998), although it should be noted that this research relies heavily on university samples. This negative association has been explained mostly in terms of anxiety; specifically, it has been argued that test-anxiety and fear of failure, both characteristics of Neuroticism, may impair exam performance (Hembree, 1988; Zeidner, 1995). Furthermore, some authors (notably Muller, 1992) have pointed out that Neuroticism may have long-term consequences in students' self-perceptions, leading to decreased self-efficacy.

Extraversion also seems to be negatively associated with AP, although some of the literature suggests that third variables, such as age, intelligence, and type of academic assessment may moderate this effect in manner that may even change its sign to positive (Anthony, 1973; Eysenck & Eysenck, 1985; Furnham & Medhurst, 1995). Introverts may have an advantage over extraverts in terms of being more focused, more systematic in their study habits, and better able to consolidate their learning (Entwistle & Entwistle, 1970; Sanchez de Marin et al, 2001). Rolfhus and Ackerman (1999)(see also Amelang & Ulwer, 1991; Humphreys & Revelle, 1984) found negative associations between Extraversion and several knowledge tests and suggested that these associations may be related to differences in knowledge acquisition time between introverts and extraverts, suggesting that extraverts are likely to spend less time studying (and more time "socialising") than introverts. In contrast, however, some studies have reported higher AP by extraverts, specifically in primary school (Entwistle, 1972; Anthony, 1973), suggesting that introversion may be an advantage only under high intellectually demanding tasks.

With regard to Psychoticism, the literature indicates that it is a significant negative predictor of AP (Aluja-Fabregat & Torrubia-Beltri, 1998; Furnham & Medhurst, 1995; Goh & Moore, 1987; Maqsud, 1993; Sanchez-Marín et al, 2001). It has been suggested that

Psychoticism may affect responsibility and interests in studies, therefore limiting academic success (Aluja-Fabregat & Torrubia-Beltri, 1998). Moreover, it has also been shown that Psychoticism is related to poor overall adjustment and that the maladaptive nature (e.g., the tendency to be uncaring with others and reject implicit and explicit social norms) of high Psychoticism scorers is counterproductive in academic settings (Halamandaris & Power, 1999; see also Haun, 1965). In addition, many studies have shown Conscientiousness (one of the major personality dimensions in the Five Factor Model that is inversely related to Psychoticism) to be a strong positive predictor of AP across different educational levels (Busato, Prins, Elshout & Hamaker, 2000; De Raad, 1996; Rothstein et al, 1994).

In a succinct summary of the relationships between the Eysenckian traits and AP, it seems that Psychoticism, Extraversion, and Neuroticism tend, to different extents, to be negatively associated with AP. Thus, their effects on AP tend to be in the opposite direction to that of intelligence. In contrast to the majority of extant studies, the present investigation aims to examine the effects of cognitive ability and personality traits on AP concurrently rather than in isolation. Of course, basic individual differences variables like cognitive abilities and basic personality traits have a strong influence on many kinds of behaviour other than achievement.

An interesting question which remains to be addressed is whether these personality traits play any important role in student's behaviour beyond examination performance. Specifically, it would be interesting to examine whether individual differences in personality and intellectual ability are likely to influence academic behavioural variables such as truancy, exclusions and absenteeism.

There is some evidence in the recent literature that links truancy to other, more severe, anti-social behaviours (e.g., juvenile offending, substance abuse). Fergusson,

Lynskey and Horwood (1995) found that truancy was very frequent (almost 40%) in 12-16 year school children. Results also indicated that it was significantly related to dysfunctional (disadvantaged) home environments as well as early conduct problems. Other studies (notably Williamson & Cullingford, 1998) have also provided evidence for the negative association between self-esteem and truancy (as well as exclusions and other disruptive school behaviours). Furthermore, undesirable academic behaviour has been negatively related to empathy (particularly in males)(Cohen & Strayer, 1996; Roberts & Strayer, 1996).

While there appears to be a lack of psychological research on the relationship between undesirable school behaviour and individual differences, the literature on truancy and exclusions suggests that these variables could be positively related to Psychoticism (lack of empathy) and Neuroticism (low self-esteem). Further, to the extent that truancy and exclusions are negatively associated with academic exam performance, these variables could also be expected to be negatively related to intellectual ability.

The present study will examine the predictability of AP (exam grades) in school by personality and psychometric intelligence. Further, the predictability of absences and exclusions by personality traits and psychometric intelligence and the possible effects of gender will also be tested. Analyses of the data will involve a multi-group (males and females) structural equation model. It is predicted that:

H1: Psychometric intelligence (IQ) will be the strongest predictor of AP. This would support the substantial body of empirical evidence for the predictive validity of cognitive ability measures in academic settings (particularly at earlier levels of formal education)(see Brand, 1994; Brody, 2000; Walberg, Strykowski, Rovai & Hung, 1984).

H2: Personality traits will be significant, albeit modest, predictors of AP. Moreover, it is expected that personality traits show some incremental validity (with regard to IQ) in

the prediction of AP. Specifically, it is expected that:

H2a: Neuroticism will be negatively related to AP. This would be in line with the idea that Neuroticism (trait anxiety) impairs performance on examinations, mainly because it is associated with negative self-beliefs and the experience of test-anxiety (see Hembree, 1988; Matthews et al, 2000; Muller, 1992; Wells & Matthews, 1994).

H2b: Extraversion will be negatively related to AP. This would confirm that introverts have an advantage in engaging in more systematic study habits and consolidate learning (Ackerman, 1999; Entwistle & Entwistle, 1970; Sanchez de Marin et al, 2001).

H2c: Psychoticism will be negatively associated with AP. This would replicate previous studies (e.g., Furnham & Medhurst, 1995; Goh & Moore, 1987) in which Psychoticism was found to be a significant predictor of AP, suggesting that Psychoticism may impair AP.

H3: Psychometric intelligence will be a significant and negative predictor of absenteeism (high cognitive ability will be associated with low absenteeism), and exclusions (high cognitive ability will be associated with low exclusions). This would be consistent with the positive relationship between cognitive ability scores and AP on one hand, and the negative relationship between absenteeism/exclusions and AP on the other hand. It is also noteworthy that psychometric intelligence is believed to be an important predictor of educational level in general (Brand, 1994), which would imply negative associations between intelligence and absenteeism/exclusions.

H4: Personality traits will be also associated to absenteeism and exclusions. Specifically, it is expected that:

H4a: Neuroticism will positively predict absenteeism and exclusions (higher Neuroticism scores will be associated with higher absenteeism and exclusion levels).

H4b: Extraversion will positively predict absenteeism and exclusions (extraverts will be more likely to have higher levels of absenteeism and exclusion).

H4c: Psychoticism will be also positively associated with absenteeism and exclusions (hence higher Psychoticism scorers will be more likely to have poorer attendance or be excluded from the courses).

In addition, the effects of gender will also be explored. Further, the possible interactions and combinations to predict AP as well as absenteeism and exclusion levels will also be tested through a series of structural equation models.

3.2. Method

Participants

Questionnaire data were collected from 901 pupils. Complete data were available for about 650 of them, although the actual sample size varies depending on the variables involved in the various analyses. Approximately 52% of participants were males and 48% females. All participants were Year 11 pupils in British secondary education (mean age of approximately 16.5 years).

Measures

Eysenck Personality Questionnaire – Revised (EPQ-R; Eysenck & Eysenck, 1985).

This is a benchmark personality questionnaire representing the best operationalisation of the Eysenckian P-E-N system. It comprises 48 items that are responded to on a dichotomous scale (True/False). On this sample, the internal reliabilities for Psychoticism, Extraversion, and Neuroticism were .65, .85, and .78, respectively.

Verbal Reasoning Test (VRT). This tailor-made test measures primarily crystallised

intelligence and is used by the educational authority that supported this study (see Procedure). The reliability of scores on this test (KR20) is usually in the order of about .97 (National Foundation for Educational Research, personal communication), although this value could not be corroborated in the present case because item-level scores were not available. The test is administered twice to each pupil and the score that the educational authority uses, and was made available to us, represents the average of the best two performances. Henceforth, this variable will be referred to as 'IQ'.

Key Stage 3 Assessment (KS3) results. In the UK, pupils are statutorily assessed at the end of each of the four stages of the National Curriculum, which is followed by all publicly funded schools. Pupils will normally be about 14 years old when national testing occurs. At this stage, attainment in the three core National Curriculum subjects of English, maths, and science is assessed.

General Certificate of Secondary Education (GCSE) A-to-C marks. GCSEs are the principal means of assessing pupil attainment at the end of compulsory secondary education at 16 years. Assessment of GCSEs is usually by external examination and coursework, with the balance towards the former. Assessed subjects include English, maths, science, religion, arts, music, design and technology, etc. Some of these are compulsory, whereas others are optional. GCSEs are graded from A* to G. Attainment at grades A* to C is at level 2 of the UK national qualifications framework, while attainment at grades D to G is at level 1. Progression to further education and training beyond 16 years is closely linked to level 2 attainment, with entry requirements often stipulating a minimum number of GCSEs at grade C or above.

Authorised absences. Information on the number of authorised absences during the school year was available for 363 pupils.

Unauthorised absences. Information on unauthorised absences (truancy) for the same period was available for 391 pupils. Of those, 48 had one or more unauthorised absences.

Exclusions. Information on the number of exclusions was available for 533 pupils. Of those, 15 had been excluded from school for one or more days.

Procedure

The study was conducted under the auspices of the Buckinghamshire County Council Educational Authority (UK). A number of secondary schools in the county were contacted, of which seven participated across all phases of the study. The questionnaire battery was administered by teachers in class according to a detailed protocol and additional data were retrieved from school databases.

3.3 Results

Structural equation model

The data on AP were analysed through a multi-group (males and females) structural equation model. English, mathematics, and science taken at Key Stage 3 level were the indicators of a latent construct labeled KS3, whereas the same subject areas taken at GCSE level were the indicators of a latent construct labeled GCSE. In terms of exogenous variables, in addition to IQ and the three personality factors (Psychoticism, Extraversion, & Neuroticism), the initial model involved three multiplicative terms modeling two-way bilinear interactions between the former and the latter three variables. Several of these variables were related neither to KS3 nor to GCSE and were subsequently removed from the model. The final model, along with dashed lines indicating differential (in terms of whether they reached statistical significance or not) male and female effects is shown in Figure 3.1.

Before specific gender differences in the paths of the model are discussed, a general description of the effects would be useful. As can be seen in Figure 3.1, IQ had a very strong direct effect on KS3 (which confirmed H1), but not on GCSE, which it affected only indirectly through the path from KS3. Thus although cognitive ability appears to be a powerful predictor of AP at stage 1, its predictive power of AP at stage 2 is very weak compared to that of AP at stage 1. With respect to the personality variables, Extraversion and Psychoticism, but not Neuroticism, were related to achievement, although their effects were limited compared to those of IQ. This further confirmed H1, H2b and H2c (but not H2a). There was also a weak significant interaction between IQ and Extraversion for males, but not for females (this interaction will be further analysed and plotted below).

Chi-square change tests

In order to check for gender differences in the model, a series of cumulative constraints were applied. The results of this analysis are reported in Table 3.2.

With respect to the measurement part of the model, it can be seen in Table 3.2 that at least two of the three indicators of KS3 performance (English and science) are non-invariant across genders, with the male loadings being significantly higher than the female loadings, especially in the case of English. The corresponding indicators of GCSE performance were invariant. In terms of the structural part of the model, the path from Extraversion into KS3 was invariant. The test of the path from Psychoticism into GCSE was more complicated. The marginal non-significance of this path in the cumulative $\Delta\chi^2$ test ($p = 0.055$), is likely due to the fact that the χ^2 value is distributed over five degrees of freedom. The contiguous test was clearly significant ($\Delta\chi^2_{(1)} = 6.15, p < .05$) and thus the parameter was allowed to take different values in the two samples. Last, the path from KS3 to GCSE was also non-invariant, being somewhat stronger for females than for males (see Figure 3.1).

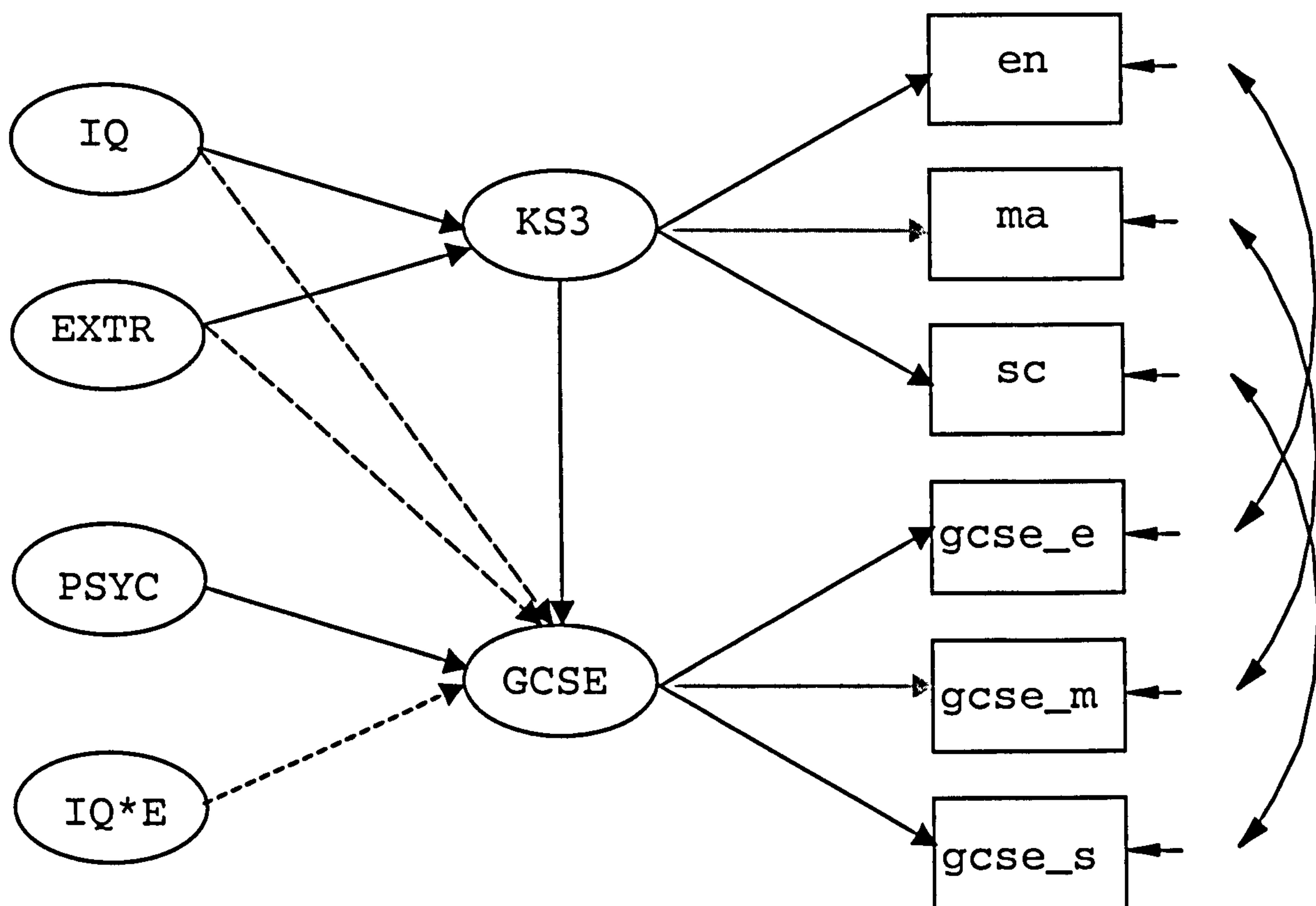


Figure 3.1: Structural equation model (*Note.* Dashed lines indicate that the effect was significant for one sex only)

IQ x extraversion interaction

The results of the model tested above indicate that, on the male sample only, IQ moderates the relationship between Extraversion and GCSE performance. A graphical depiction of this relationship is given in Figure 3.2, where it can be seen that male pupils with low IQ (-2 SD) and low Extraversion (-2 SD) scores tend to do considerably better than their high Extraversion (+ 2SD) counterparts.

As IQ scores increase, however, the influence of Extraversion begins to diminish until it reaches a point ($IQ \cong +2 SD$) where it does not have any impact on GCSE performance. Thus, the β weight of Extraversion on GCSE at $IQ = -2 SD$ is -0.19 , whereas

the β at IQ = +2 SD is 0.01. For male pupils with mean IQ scores, the corresponding β is -0.09.

Table 3.2 Cumulative constraints testing for gender differences in the model

Models	χ^2	χ^2_{df}	$\Delta\chi^2$	Δdf	p
1. Baseline	106.76	53	-	-	< .01
2. KS3 -> English	129.09	54	22.33	1	<.01
3. KS3 -> Science	110.80	54	4.04	1	<.05
4. GCSE -> English	107.72	54	0.96	1	ns
5. GCSE -> Science	108.68	55	1.92	2	ns
6. IQ -> KS3	109.46	56	2.70	3	ns
7. Extraversion -> KS3	109.50	57	2.74	4	ns
8. Psychoticism -> GCSE	115.65	58	8.89	5	= 0.055
9. KS3 -> GCSE	114.30	58	13.56	6	<.05

Absenteeism

Females had significantly higher attendance levels than males ($F(1, 351) = 11.16, p < 0.1$; $Mean_{fem} = 92.67, SD_{fem} = 8.14$; $Mean_{male} = 89.41, SD_{male} = 9.43$). After adjustments for IQ and trait scores, however, the gender difference was no longer significant ($F(1, 283) = 1.47, p = ns$; $Mean_{fem} = 92.51, SE_{fem} = 5.78$; $Mean_{male} = 91.12, SE_{male} = 9.21$). This further confirmed H3.

To investigate the extent to which cognitive ability and traits influence attendance patterns at school, a standard multiple regression was carried out, whereby attendance percentages were regressed on IQ, Psychoticism, Extraversion, and Neuroticism. The regression was significant, after the removal of four outliers (standardised residuals > 3.5 SD), the regression was significant ($F(4, 286) = 12.28, p <.01$) and accounted for 13.5% of the variance. IQ was a significant positive predictor ($\beta = 0.325, t = 5.91, p <.01$), whereas Extraversion and Psychoticism were significant negative predictors ($\beta = -.128, t = 2.16, p <.05$ and $\beta = -.117, t = 2.13, p <.05$, respectively) in the equation. This confirmed H3, H4b and H4c, respectively.

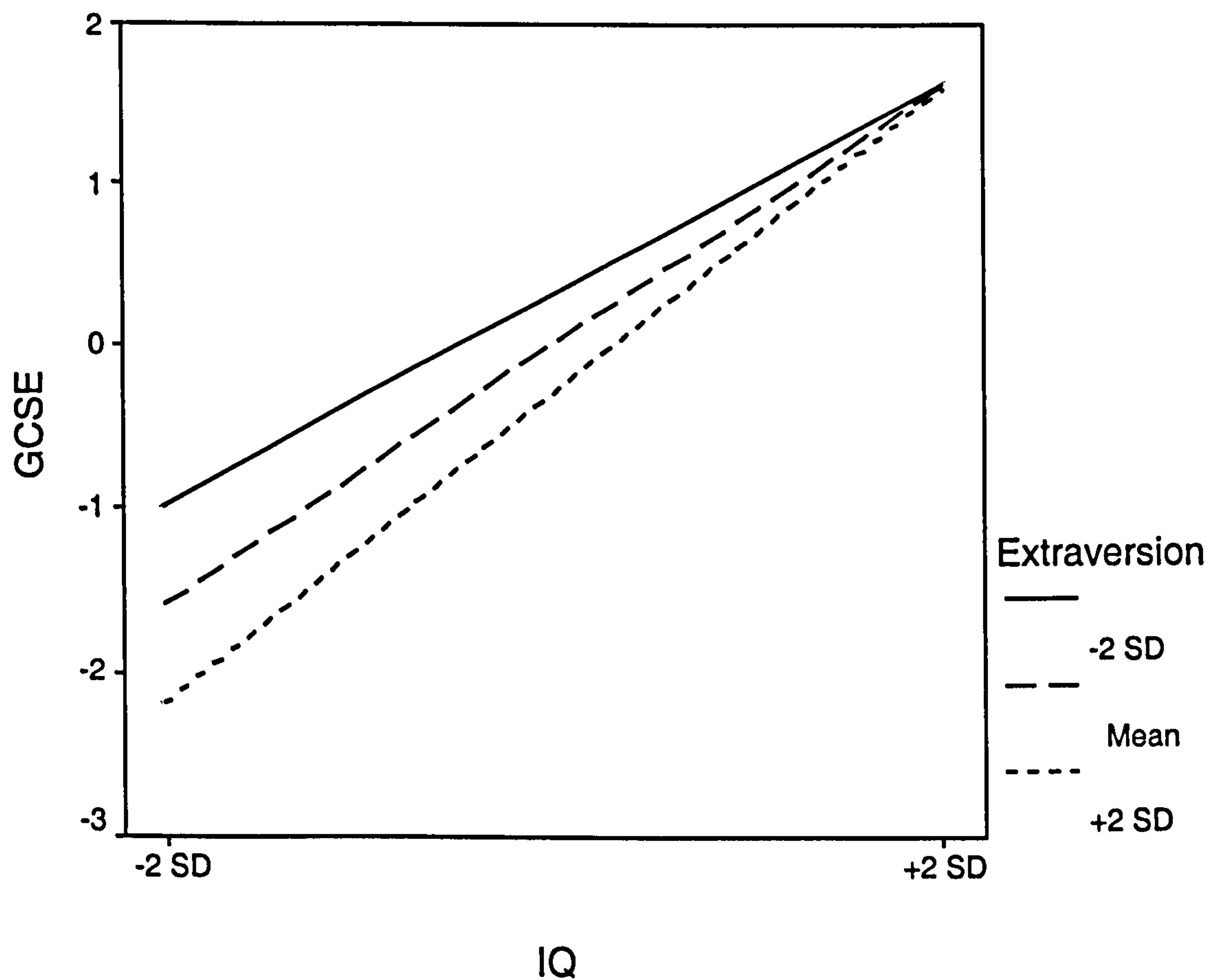


Figure 3.2 Interaction

A more detailed picture emerged, when the data were analysed separately for males and females. For the male pupil data, neither the overall regression nor any of the individual predictors reached significance ($F_{(4, 83)} = 1.19$, $p = ns$; $\beta_{IQ} = .15$, $\beta_P = -.06$; $\beta_E = -.17$, and $\beta_N = -.01$). In contrast, for the female data, after the removal of four outliers (standardised residuals > 3.5 SD), the regression was significant ($F(4, 192) = 9.17$, $p < .01$) and accounted for 14.3% of the variance. IQ was a strong positive predictor ($\beta = .35$, $t = 5.23$, $p < .01$), whereas Psychoticism was a negative predictor ($\beta = -.13$, $t = 1.99$, $p < .05$) in the equation (this further confirmed H3 and H4c). Extraversion also approached significance levels ($\beta = -.13$, $t = 1.88$, $p = 0.06$), while Neuroticism did not ($\beta = -.07$, $t = 0.99$, $p = ns$)(this did not support H4a).

Due to the size difference between the male and female samples, the results from the regressions above, especially the significance levels, should be interpreted with some caution. In particular, it should be noted that both IQ and Extraversion are likely to influence school attendance levels in male pupils, with positive and negative effects, respectively. A larger sample size may reveal effects that are not only statistically significant, but also stronger than those observed on the female sample above, especially as regards Extraversion.

Truancy and exclusions

For truant pupils, the number of unauthorized absences was regressed only on the three traits, as for many of them IQ scores were not available. This regression was not statistically significant ($F_{(3, 40)} = 1.89, p = ns$). There were only a small number of pupils who had been excluded for one or more days from school due to antisocial behavior. The investigation of the relationship between exclusions, traits, and IQ was handled through a series of chi-square analyses based on residualised scores in order to avoid reanalyzing any overlapping variance. Low IQ pupils were significantly more likely to have been excluded than their high IQ counterparts ($\chi^2_{(1)} = 7.54, p < .01$). In addition, pupils with high Psychoticism scores were significantly more likely to have been excluded than those with low scores ($\chi^2_{(1)} = 5.10, p < .05$)(this confirmed H3c). Extraversion and Neuroticism were not related to exclusions ($\chi^2_{(1)} = 2.02, p = ns$ and $\chi^2_{(1)} = .52, p = ns$, respectively).

Absenteeism, truancy, exclusions, and AP

To examine the extent to which absenteeism, truancy, and exclusions are related to AP over and above the influence of traits and cognitive ability, a series of partial correlations were computed. The correlation between attendance level and KS3, controlling for gender, IQ, and the three traits was significant ($r_{(267)} = .17, p < .01$). The corresponding correlation

for GCSE was also significant ($r_{(275)} = .28, p < .01$)

Analogous correlations, i.e., with gender, IQ, and the three traits partialled out, were computed for truancy and exclusions. Dichotomized truancy scores were not related to KS3 performance, but they were marginally related to GCSE performance ($r(294) = -.11, p = 0.68$). Raw truancy scores were significantly related to GCSE performance only ($r(294) = -.14, p < .05$). Similarly, dichotomized exclusion scores were not related to KS3 performance, but they were significantly related to GCSE performance ($r(415) = -.15, p < .01$).

3.4 Discussion

The present study has examined the joint influence of cognitive ability and personality traits on AP and behaviour at school. In addition, it briefly looked at the effects of truancy, absenteeism, and exclusions on achievement.

As expected, psychometric intelligence was found to be a powerful predictor of AP, a result that accords well with a large body of existing empirical evidence (Brody, 2000; Jensen, 1980, 1998; Zeidner & Matthews, 2000). More specifically, the use of SEM, which allows for a much more detailed decomposition of effects compared to standard multiple regression, indicated that the effect of IQ on AP at GCSE level (i.e., when the pupils are about 16 years old) is entirely mediated via AP at KS3 level (i.e., when the pupils are about 14 years old). That is to say, IQ does not add anything over and above KS3 in the prediction of GCSE performance. In yet different words, a high IQ does not seem to confer incremental advantages in AP over the years. Rather, AP remains relatively stable, over the time span examined in this study, with its initial level being a function of one's IQ. This is consistent with the current individual differences approaches that emphasise the importance

of acquired knowledge over other, more abstract and less content-dependant, aspects of intellectual competence (see Ackerman, 1996, 1999; Ackerman, Beier & Bowen, 2000; Snow, 1992, 1995).

With regard to personality, two of the three Gigantic 3 personality traits of the Eysenckian model were significantly, albeit moderately related to AP. These factors were Extraversion and Psychoticism (both negatively). The negative effects of Extraversion on AP are supportive of several previous studies such as Anthony (1973), Eysenck and Eysenck (1985), and Rolfhus and Ackerman (1999). Thus they reflect the idea that introverts have an advantage in specific tasks (e.g., learning, intellectual engagement, study habits) that improve performance in academic settings. With regard to Psychoticism, the present results are also in line with previous findings (notably Furnham & Medhurst, 1995; Goh & Moore, 1987; Sanche-Marín et al, 2001) suggesting that this personality trait may impair AP.

A general interpretation of the present findings seems to indicate that both personality *and* intelligence may play a significant role in the processes underlying AP (see Snow, 1992, 1995). Moreover, there are several specific findings in this study that may help to understand the relationship between personality and psychometric intelligence with AP and its related behavioural aspects. Further, the mediational and moderational effects of gender, personality and intelligence have also been explored.

The relationship between Extraversion and AP seems to be mediated by gender and cognitive ability. Specifically, it was found that, among male students, introversion, as opposed to Extraversion, is associated with higher grades. However this is true only at lower levels of psychometric intelligence. That is, among male students with higher IQ, there are no significant Extraversion differences in AP. Another interesting finding

concerns the relationship between gender and the academic behavioural variable of absenteeism (attendance). It was found that this relationship is moderated by personality and IQ. Specifically, female students tended to have better attendance than males, but only when IQ, Extraversion and Psychoticism were not taken into account. Hence it was found that Extraversion and Psychoticism (both negatively) and IQ (positively) were significant predictors of absenteeism.

The influence of personality and ability on AP was also evidenced by a small number of truancies and exclusions. It was found that low IQ and higher Psychoticism scorers were more frequent among excluded students than those with high IQ and low Psychoticism scores. Given that truancies and exclusions are modestly but significantly related to AP (gender), over and above IQ and personality, these findings are important: low IQ and high Psychoticism may lead to truancies and exclusions, which may consequently lead to lower examination grades.

To conclude, the results of this study are supportive of an integrative approach for conceptualising individual differences underlying performance in academic settings: they show that the prediction of AP is a complex issue in which both cognitive (intellectual ability) as well as non-cognitive (personality traits, gender, absenteeism) variables play an important role. Further, considering the relative independence of personality from cognitive ability (evidenced not only in the present result but also in the results of studies 1 to 4), it seems important to examine in more detail how other well-established personality traits (such as the Big Five) may predict AP, particularly at more advanced levels of education.

STUDY 6

3.5 Introduction

Although past research has explored the relationship between personality and AP (Cattell & Butcher, 1968; Kline & Gale, 1977), academic achievement has been typically associated with intelligence rather than personality (e.g., Elshout & Veenman, 1992; Harris, 1940; Neisser, Boodoo, Bouchard, Wade, Brody, Ceci, Halpern, Loehlin, Perloff, Sternberg & Urbina, 1996; Sternberg & Kaufman, 1998). Furthermore, several researchers (Allik & Realo, 1997; Dollinger & Orf, 1991; Green, Peters & Webster, 1991; Mehta & Kumar, 1985; Rothstein, Paunonen, Rush & King, 1994) concluded that personality is not significantly related to academic achievement to be of real significance in educational settings.

There is however longstanding empirical evidence indicating that both personality and intelligence are important predictors of AP as both have been known to be related to learning (Busato, Prins, Elshout & Hamaker, 1999; Eysenck, 1981; Furnham, 1992). Accordingly, study 5 showed that well-established personality traits (specifically Extraversion and Psychoticism) are of modest but significant importance in the prediction of AP; even when IQ is used as a predictor. This is in line with the belief that performance in general may be a multiplicative function of intelligence and motivation, where motivation can be conceptualized in terms of personality characteristics (Mayer, 1955; Rinderman & Neubauer, 2001; Vroom, 1960). As early as 1933, Stanger (1933) had already suggested that “the energy output of the individual student (...) varies independently of ability” (pp. 648). This interactive model suggests that both intelligence *and* personality comprise salient

individual differences which influence performance: intelligence (what a person *can* do) through specific abilities which facilitate understanding and learning, personality (*whether* a person will do it) through certain traits which enhance or handicap the use of these abilities. Using personality traits as predictors may therefore account for additional variance in performance, as it was indeed shown in study 5.

It has been recently claimed that personality measures on their own are powerful enough to explain a moderate percentage of the variance in AP (Blickle, 1996; Cacioppo, Petty, Feinstein & Jarvis, 1996; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Rindermann & Neubauer, 2001; Wolfe & Johnson, 1995) - although a few earlier studies (notably Chorro, 1981; Hamilton & Freeman, 1971) had claimed this before. Both Blickle (1996) and Geisler-Brenstein, Schmeck and Hetherington (1996) found Openness to Experience to be associated with AP. This association has often been interpreted in terms of the fact that this particular personality factor seems correlated with intelligence in the range of $r = .20$ to $r = .40$. Johnson (1994) and Saucier (1994) have noted that Openness to Experience, particularly its so-called "Aesthetics" and "Ideas" scales, is related to lexical intellect. Further, McCrae (1993) and Holland, Dollinger, Holland, and MacDonald (1995) reported significant correlations ($r = .33$, and $r = .42$) between the Openness to Experience factor and the Wechsler Adult Intelligence Scale (see also Ackerman, 1996; Ackerman & Heggestad, 1997; McCrae & Costa, 1985; Rolfhus & Ackerman, 1996). However studies 1, 2 and 4 showed no significant associations between Openness and several measures of intelligence.

Eysenck (1967b) argued that Extraversion and Neuroticism are theoretically and empirically associated with ability, mainly as a consequence of similarities in mental speed

(i.e., high Extraversion, low Neuroticism, and high intelligence are all related to high mental speed). Stable, as opposed to neurotic, individuals tend to score higher on ability tests – possibly because they tend to be less affected by anxiety (Furnham & Mitchell, 1991; Zeidner, 1995; Zeidner & Matthews, 2000) and perform better in university classes (Cattell & Kline, 1977; Goh & Moore, 1987; Lathey, 1991; Sanchez-Marin, Rejano-Infante & Rodriguez-Troyano, 2001; Savage, 1962). Nevertheless it seems to be difficult to find a consistent pattern for the relationship between intelligence and Extraversion, which is either weaker or more context/task specific than Neuroticism. Rolfhus and Ackerman (1999) found negative relationships between Extraversion and several knowledge tests, and suggested that these relationships may be related to differences in knowledge acquisition time between introverts (spend more time studying) and extraverts (spend more time socializing). Furthermore, study 5 reported significant, albeit moderated, associations between Extraversion and AP. However in a systematic series of studies examining the psychometric relationship between personality traits and intellectual ability, Extraversion was shown to be virtually unrelated to psychometric intelligence (see studies 1, 2, 3 and 4).

Perhaps the personality factor more consistently associated with AP is Conscientiousness (Blickle, 1996; Busato, Prins, Elshout & Hamaker, 2000; Costa & McCrae, 1992; De Raad, 1996; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Kling, 2001). Several studies have also evidenced personality differences in work performance (Mount & Barrick, 1995; Salgado, 1997). Early studies (notably Smith, 1969) had attributed the relationship between Conscientiousness and performance to the so-called “strength of character” factor. Another explanation has been that Conscientiousness is closely related to motivation, a variable of considerable importance with regard to all types

of performance (Andersson & Keith, 1997; Boekaerts, 1996; Hamilton & Freeman, 1971; Heaven, 1990; Furnham, 1995; Pelechano, 1972). According to Campbell (1990), motivation can be understood as the choice of a) expending effort, b) the level of effort, and c) persisting at that level of effort. It has been therefore suggested that Conscientiousness and performance are related through motivation – particularly when extrinsic determinants of motivation are held constant (Sackett et al, 1998).

Another personality factor which has been frequently associated with (poor) AP is Psychoticism. Goh and Moore (1987) found that Psychoticism was a significant (negative) predictor of academic success. Maqsud (1993) showed negative relationships between Psychoticism and academic attainment, and positive correlations between academic attainment and academic self-concept. These correlations suggest that Psychoticism could affect students' self-conceptions of AP. Furnham and Medhurst (1995) reported significant and negative correlations between Psychoticism and AP (as measured by seminar reports and final grade). These results were replicated by Aluja Fabregat and Torrubia-Beltri (1998), who also suggested that Psychoticism affects responsibility and interest in studies, and by Sanchez-Marin et al (2001), who argued that Psychoticism can limit academic success. Accordingly, in study 5 Psychoticism was found to be a negative and significant predictor of AP in secondary school.

This study will investigate the predictability of general AP in two longitudinal studies of British university students. Personality will be assessed by two widely used and well-established inventories, i.e., the NEO-FFI (Costa & McCrae, 1992), and the EPQ-R (Eysenck & Eysenck, 1985). These inventories assess the Big Five and Gigantic Three dimensions of personality, respectively, and are considered the state of the art in personality assessment (Matthews & Deary, 1998). Further using two related questionnaires provides

some evidence of generalisability across instruments. Hence the possibility of examining how the major personality dimensions relate to AP. AP will be assessed through examination grades (corresponding to several exams at the end of each academic year) and a 6-month supervised final-year project. In addition, academic behavioural indicators (ABI)(obtained by continuous assessment) such as absenteeism, essay-writing, seminar behaviour, will be also examined with regard to personality traits and AP.

It is noteworthy that only examination marks and the final-year project (and not ABI) are relevant in determining a student's final/overall grade. Accordingly AP will be conceptualised in terms of exams and the final-year project only. Whereas ABI have essentially no incidence on a student's final mark, they are used to monitor his/her progress. It is thus interesting to examine the predictive validity of personality traits with regard to ABI, that is, whether personality inventories may account for any additional variance in AP when ABI are controlled. This would provide a robust comparative indicator of the predictive power of personality inventories

In addition, the incremental validity of personality traits will be also tested against tutors' predictions (six different tutors, the same members of staff who judged students' ABI through essays and seminar behaviour in approximately eight weekly seminar meetings lasting 1 to 2 hours per two year term over three years). Teacher's ratings have been shown to predict AP (Sneed, Carlson & Little, 1994). Further they provide "observational" data to complement and test self-report data. On the other hand, it has been argued that personality dimensions affect teacher's perceptions of students (Aluja-Fabregat et al, 1999; Furnham & Medhurst, 1995). It is therefore important to examine whether personality traits are significantly correlated with tutors' ratings of students. Further, since tutors' predictions are taken into account by the university in the prediction of AP, it would be interesting to

examine whether a) there are any significant personality correlates of tutors' predictions (which would imply that tutors ratings of the students are, to some extent, influenced by the personality of the student), and b) whether personality inventories are more or less effective predictors of AP than tutors' predictions.¹

Given the longitudinal nature of the dependent variables in the present data sets, this study is important both from a theoretical as well as an applied perspective. Theoretically, it is set to test whether stable personality traits may relate to real-life outcomes, specifically AP in university settings. From an applied point of view, the successful prediction of AP throughout three years would provide important empirical evidence to support the inclusion of well-established personality inventories as predictors of performance in university settings. Predicting academic achievement from the results of a personality inventory (which is administered only once and three years prior to the final results) would have important consequences for any educational admissions system. The longitudinal data collected for this study is particularly relevant to test the anticipatory effect of personality inventories. Moreover, as Rolfhus and Ackerman (1999) have indicated, grades may represent a better predictor of future knowledge acquisition than any ability test, and they should be therefore considered a reliable and valid measure of potential achievement. This could apply to personality inventories as well.

The first aim of the present study will be to examine the relationship between the Big Five (i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness) and the Gigantic Three (Neuroticism, Extraversion and Psychoticism) personality traits with exam grades (as measured during three academic years and the end of the year when timed written essay-based exams are done), and final-project performance (a

single mark corresponding to a 6-months supervised final year project). Secondly, the Big Five and Gigantic Three will be examined with regard to a series of ABI such as students' behaviour in class, essay writing, absenteeism, and tutors' predictions of students' final grades. Finally, in order to examine the predictability of AP by personality, the incremental validity of the Big Five and Gigantic Three will be tested against ABI and tutors' predictions. In addition, creativity (Welsh, 1963) will be also examined as a possible correlate and predictor of AP. Thus, this study will also test whether a measure of creativity can be useful to predict AP. Based on the above reviewed literature, several sets of hypotheses can be stated:

H1: There will be significant personality trait correlates/predictors of AP. This will support a diversity of recent empirical studies that found significant associations between established personality dimensions and several indicators of academic attainment (Blickle, 1996; Cacioppo, Petty, Feinstein & Jarvis, 1996; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Rindermann & Neubauer, 2001; Wolfe & Johnson, 1995; see also study 5). Specifically, it is expected that:

H1a: Neuroticism will be negatively and significantly related to AP, particularly with examination marks. This would support the idea that stable individuals tend to perform better in university classes (Cattell & Kline, 1977; Goh & Moore, 1987; Lathey, 1991; Sanchez-Marin, Rejano-Infante & Rodriguez-Troyano, 2001; Savage, 1962).

H1b: Conscientiousness will be positively and significantly related to AP, particularly with final-year project marks. This would be consistent with the literature conceptualising Conscientiousness as a positive correlate of performance, not only in academic, but also in occupational, settings (see Blickle, 1996; Busato, Prins, Elshout &

¹ Note: the seminar leaders can never know candidates in exam as they are marked blind and double-marked

Hamaker, 2000; Costa & McCrae, 1992; De Raad, 1996; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Kling, 2001; Salgado, 1997)(see also study 5, where Psychoticism, a negative correlate of Conscientiousness, was found to be a negative predictor of AP).

H1c: Extraversion will be negatively and significantly associated with AP, particularly with exam marks. This would be consistent with studies reporting a negative relationship between Extraversion and knowledge tests (e.g., Rolfhus & Ackerman, 1999). This association is usually explained in terms of differences in knowledge acquisition time between introverts (spend more time studying) and extraverts (spend more time socializing)(see also Sanchez-Marin et al, 2001). Hence it is also expected to replicate the results of study 5.

H1d: Openness to Experience will be positively and significantly associated with AP. This association will be interpreted in terms of the significant correlation between Openness and intellectual ability, particularly vocabulary and general knowledge (Ashton, Lee, Vernon & Jang, 2000; Goff & Ackerman, 1992).

H1e: Psychoticism will be negatively and significantly related to AP. This would support previous findings (Aluja Fabregat et al, 1998; Furnham & Medhurst, 1995; Goh & Moore, 1987; Maqsd, 1993; Sanchez-Marin et al, 2001; study 5), as well as the conception of Psychoticism as a maladaptive trait which is detrimental for real-life outcomes (such as academic attainment). Further, the prediction that Psychoticism will be negatively associated to AP would also replicate H1b and H1d, since it is claimed (Eysenck, 1991; 1992ab) that Psychoticism comprises negative aspects of Conscientiousness, but positive of Openness to Experience.

hence there is no possibility of self-fulfilling prophesies occurring. It is also noteworthy that neither exam

H2: There will be modest but significant personality differences in ABI. These differences would confirm Furnham and Medhurst's (1995) findings on personality traits as significant correlates of behaviour in class. It is expected that:

H2a: Neuroticism will be significantly related to ABI. Specifically, there will be negatively associations between Neuroticism and essay grades. Although essay writing is not considered a significant aspect of a student's AP, essays are evaluated and marked by a seminar leader. Hence it is expected that anxious individuals may experience a greater degree of test anxiety (fear to be evaluated) than stable ones; these differences are expected to lead to performance difference in essay writing.

H2b: Extraversion will be positively associated with some, but negatively with other, ABI. Specifically, it is expected that Extraversion will be positively related to seminar behaviour and absenteeism (i.e., extraverts will miss more seminar classes)(this will confirm the findings by Furnham & Medhurst, 1995), and negatively associated with essay grades; since essay writing requires long-term concentration and intellectual investment rather, both characteristics that may be associated with introverts rather than extraverts.

H2c: Openness to Experience will be significantly related to ABI. Specifically, it is expected that Openness will be positively associated with seminar behaviour and essay grades, and negatively with absenteeism. These associations are expected in terms of the higher degree of creativity and intellectual curiosity that characterises open personalities (see McCrae & Costa, 1997).

H2d: Conscientiousness will be significantly related to ABI; specifically with seminar behaviour (positively) and absenteeism (negatively, i.e., conscientious participants

would miss less seminar meetings). These associations would reflect the hard-working, organised and ambitious nature of conscientious students.

H2e: Psychoticism will be negatively related to essay marks and seminar behaviour. These associations would be interpreted in terms of the lower responsibility and interest that has been attributed to high Psychoticism scorers. Furthermore, Furnham and Medhurst (1995) reported significant and negative correlations between Psychoticism and seminar ratings. (see also Aluja Fabregat & Torrubia-Beltri, 1998).

H3: Creativity will be significantly related to ABI (particularly seminar behaviour and essay marks) and AP. These associations would also be expected in terms of the conceptual similarities between creativity and Openness as well as intellectual ability (see McCrae & Costa, 1997a; see also Eysenck, 1995b). Accordingly it would be suggested that individual differences in creativity (like the Big Five Openness trait and intellectual ability) are beneficial in academic or intellectual settings.

H4: Tutors' predictions and ABI will correlate significantly with – and significantly predict - AP. This hypothesis is based on the fact that both tutors' predictions and ABI are based upon students' production across a 3 years period. During this period of time, tutors have the possibility of assessing a student's verbal as well of written skills, understanding of the subject matter, and attendance. Further, ABI and tutors' predictions are actually used as predictor variables by the department.

H5: Personality traits will show incremental validity in the prediction of AP over and above the predictive power of ABI and tutors' predictions. That is, additional variance will be accounted for by the personality factors assessed. This would provide a clear indication of the extent to which personality measures can improve the prediction of AP.

3.6 Method

Participants

Sample 1 was composed of 70 (49 females and 21 males) undergraduate students from University College London. All students were native English speakers. Initial age ranged from 17 to 21, with an arithmetic mean of 19.8 (SD = 1.04) years. Data for each participant were collected throughout three academic years (1998/2001). Sample 2 was composed of 75 (54 females and 21 males) undergraduate students from University College London. All students were native English speakers. Initial age ranged from 17 to 40, with an arithmetic mean of 20.8 (SD = 3.64) years. Data for each participant were collected throughout three academic years (1996/1999).

Measures

AP, tutors' predictions, ABI, personality and creativity data were collected from the University College London archive by the author.

ABI: Every week (throughout three academic years) participants attended a compulsory one to two hours (one hour in 1st and 2nd years, two hours in the 3rd year) tutorial or seminar as part of their Psychology degree. Six different seminar leaders (i.e., staff members) evaluated each student's presentation and discussion of diverse subjects and wrote a final report upon conclusion of each seminar. Thus there were two seminar leaders per year for three years. ABI were given by three variables, namely seminar behaviour, absenteeism, and overall essay marks, all of which were aggregated scores across all semesters. Seminar behaviour was a measure on the six 7-point scales in which students

were rated by their tutors. These scales were demonstrated to be longitudinally reliable. For sample 1: grasp of subject matter ($\alpha = .63$), work habits ($\alpha = .67$), motivation ($\alpha = .71$), written expression ($\alpha = .59$), oral expression ($\alpha = .68$), and amount of participation ($\alpha = .77$). For sample 2: grasp of subject matter ($\alpha = .68$), work habits ($\alpha = .72$), motivation ($\alpha = .61$), written expression ($\alpha = .60$), oral expression ($\alpha = .70$), and amount of participation ($\alpha = .79$). Absenteeism was calculated in percentages for each participant [total number of seminar meetings / seminar meetings missed * 100], and was also found to have sufficient internal and longitudinal reliability ($\alpha = .69$ for sample 1 and $\alpha = .65$ for sample 2). Overall essay marks were obtained by calculating the arithmetic mean for each participant (number of essays submitted was held constant, i.e., three per seminar). The reliability of the overall essay marks was $\alpha = .70$ for sample 1 and $\alpha = .71$.² for sample 2.

Tutors' predictions: At the end of the seminar reports, tutors also included their predictions of final marks for each student, i.e., a probabilistic estimation of how likely it was for each student to receive each possible final mark (i.e., over 70%, 60-70%, 50-59%, 40-59%, under 40%). Although each of the six predictions for each student was given by a different tutor, tutors' predictions were found to be reliable ($\alpha = .62$ for sample 1 and $\alpha = .69$ for sample 2) and factor analysis resulted in a main tutors' predictions factor.

AP: AP was measured by overall exam marks based on five three hour written exams (on a 1-100% scale where 32% is a pass and 70% is a first or distinction) and final-year project performance, i.e., a single mark (same scale than exam marks) for a six months final research project, elaborated under the supervision of a member of staff and double marked by the supervisor and a second member of the staff (and moderated by an external

² It could be argued that the alphas are on the "borderline" acceptability category. On the other hand, given that they represent the ratings of six observers over a three-year period with young people it may be argued that they are more than satisfactory.

examiner). Unlike overall exam marks, the final-year project addresses AP under no exam conditions and may therefore be considered a less stressful measure of AP (students are assessed for their production over a 6-month period rather than for their performance in a 2 to 3 hour exam session).

Creativity: *The Barron-Welsh Art Scale* (Welsh, 1963). This scale is believed to be one of the most reliable and valid psychometric measures of creativity (Furnham, 1999). Creativity data was available for sample 1 only.

Personality:

Sample 1: *The NEO Five-Factor Inventory - Revised* (NEO-FFI; Costa & McCrae, 1992). This well-established 60-item questionnaire measures the “Big Five” personality factors, i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Items involve questions about typical behaviours or reactions which are answered on a five-point Likert scale, ranging from “strongly disagree” to “strongly agree”. There is a great deal of empirical literature over the past decade providing evidence of its concurrent, construct, convergent, divergent, incremental, and predictive validity (see Costa & McCrae, 1992).

Sample 2: *The EPQ-R* (Eysenck & Eysenck, 1985). As in study 5.

3.7 Results

Sample 1

Correlations: Correlations between AP, tutors’ predictions, ABI, personality, and creativity are presented in Table 3.3. As can be observed, seminar behaviour, essay marks, Neuroticism and Conscientiousness were the most significant correlates of AP, whereas creativity, Openness to Experience, and Extraversion were not significantly correlated with

AP. The correlations confirmed H1 and H4. The significant correlations between AP and Neuroticism confirmed H1a, while the significant correlations between AP and Conscientiousness confirmed H1b. H1c and H1d were not confirmed by the correlational analysis, as neither Extraversion nor Openness were significantly correlated with AP. There was also a significant correlation between Agreeableness and 1st year exam marks, although performance difference in Agreeableness were not predicted. Further, the relationship between Agreeableness and AP beyond 1st year exam marks was not significant and in the near-zero order. The hypothesis of a significant relationship between creativity and AP (H3) was not confirmed by the results.

Table 3.3: Correlations between AP, tutors' predictions, ABI, Big Five and creativity

	Exams 1 st year	Exams 2 nd year	Exams 3 rd year	Exams total	Final Project
Tutors' predictions	.36**	.14	.42**	.27*	.26*
<u>ABI</u>					
Seminar behaviour	.54**	.37**	.58**	.52**	.41**
Absenteeism	-.30*	-.04	-.14	-.18	-.05
Essay marks	.56**	.50**	.61**	.61**	.45**
<u>Personality (NEO-FFI)</u>					
Neuroticism	-.28**	-.31**	-.32**	-.35**	-.25*
Extraversion	.05	.06	-.02	.07	-.01
Agreeableness	.34**	.06	.03	.22	.13
Openness	-.06	.06	.15	.00	-.03
Conscientiousness	.33**	.34**	.34**	.39**	.36**
Creativity	.07	.13	.04	.12	.01

** p < .01, * p < .05

N = 70

Table 3.4 presents the correlations between ABI, personality and creativity. As can be observed, the only significant correlations were between Openness to Experience and absenteeism, and Conscientiousness and absenteeism. These correlations only partly confirmed H2. The negative correlation between absenteeism and Conscientiousness confirmed H2d. Several correlations, e.g., Agreeableness and absenteeism,

Conscientiousness and seminar behaviour, Conscientiousness and essay marks, approached significance levels. With exception of the correlation between Openness to Experience and abstentism (i.e., participants higher in Openness to Experience tended to miss more seminar classes), the direction of the correlations confirmed the initial predictions.

Table 3.4: Correlations between ABI, Big Five and creativity

	Absenteeism	Seminar behaviour	Essay marks
<u>Personality (NEO-FFI)</u>			
Neuroticism	.07	-.14	-.03
Extraversion	.04	.02	.02
Openness to Experience	.25*	.08	.10
Agreeableness	-.20	.15	.17
Conscientiousness	-.24*	.20	.23
Creativity	-.08	.23	.21

** p < .01, * p < .05 N = 70

Regressions: Several hierarchical regressions were performed on the data in order to test the predictability of AP by Big Five factors, creativity, ABI, and tutors' predictions. In addition, the Big Five and creativity were also tested as predictor of tutors' predictions and ABI. The results of the hierarchical regressions are summarised in Table 3.5. As can be seen, tutors' prediction significantly accounted for 6% of the variance in overall exam marks and 5% in final project marks. This confirmed H4. When ABI were added as predictors, the amount of variance accounted for in overall exam and final project marks increased by 32% and 15%, respectively (which further confirmed H4). When Big Five were included as predictors, the model accounted for an additional 10% of the variance in both overall exam marks and final-project marks. This confirmed that (H5) personality traits would show some incremental validity in the prediction of AP with regard to ABI and tutors' predictions. Further, Neuroticism and Conscientiousness were significant predictors in the model, which further confirmed H1a and H1b, respectively. A final hierarchical regression on sample 1 showed that tutors' predictions were significantly predicted by ABI, accounting for 37% of

the variance. When Big Five factors and creativity were added as predictors, the variance accounted for by the model only increased by 1% (and none of the predictors were significant).

Table 3.5: St. β coefficients for predictors of tutors' predictions and AP

Dependant Variables: Predictors	Tutors' predictions		Exams total		Final-project	
	st. β	t	st. β	t	st. β	t
Tutors' predictions	-	-	.27	2.36*	.26	2.18*
<i>F</i>			(1, 68)	5.57*	(1, 68)	4.74*
<i>Adj. R2</i>				.06		.05
<i>ABI</i>						
Seminar behaviour	.36	2.40**	.23	1.43	.31	.58
Absenteeism	-.08	.21	-.04	.30	-.13	1.96*
Essays	.33	2.40**	.56	3.94**	.32	1.72
<i>F</i>	(3, 66)	14.46**	(4, 65)	11.53**	(4, 65)	5.15**
<i>Adj. R2</i>	.37		.38		.20	
<i>Personality (NEO-FFI)</i>						
Neuroticism	-.06	.56	-.36	3.36**	-.28	2.15*
Extraversion	-.11	.91	-.12	1.03	-.15	1.10
Openness to Experience	-.09	.88	-.09	.91	-.17	1.52
Agreeableness	.15	1.23	-.02	.15	-.03	.23
Conscientiousness	.16	1.15	.22	2.10*	.29	2.50**
<i>F</i>	(8, 61)	6.59**	(9, 60)	8.21**	(9, 60)	4.30**
<i>Adj. R2</i>	.39		.48		.30	
<i>Creativity</i>						
	.02	.15	.09	.91	.00	.04
<i>F</i>	(9, 60)	5.77**	(10, 59)	7.47**	(10, 59)	3.80**
<i>Adj. R2</i>	.38		.48		.22	

** p < .01, * p < .05

N = 70

Sample 2

Correlations: Correlations between AP, tutors' predictions, ABI, personality (EPQ-R) are presented in Table 3.6. As can be seen, seminar behaviour, absenteeism, essay marks, Neuroticism, Extraversion and Psychoticism were all significantly correlated with AP, whereas the Lie scale was not (it should be noted that, albeit included as a scale in the EPQ-R, no predictions were made for the Lie factor, which was not strictly considered as a personality dimension). Thus H1 and H4 were confirmed by the correlations. The significant correlations between overall exam marks and Neuroticism further confirmed H1a, while the

significant correlations between final-year project and Extraversion (which has not been found in sample 1) did not confirm H1c, since a negative, rather than a positive, relationship had been predicted between these variables. The significant and negative correlation between AP (both overall exam and final-project marks) and Psychoticism confirmed H1e. There were no significant correlations between AP and tutors' predictions. However significant correlations between ABI and overall exam marks partly confirmed H4.

Table 3.6: Correlations between AP, tutors' predictions, ABI and personality

	Exams total ³	Course-work
Tutors' predictions	.06	.05
<u>ABI</u>		
Seminar behaviour	.35**	-.11
Absenteeism	-.25*	.06
Essays	.28*	-.04
<u>Personality (EPQ-R)</u>		
Neuroticism	-.37**	-.09
Extraversion	.13	.27*
Psychoticism	-.29*	-.27*
Lie	.15	.09

** p < .01, * p < .05, N = 75

Table 3.7 presents the correlations between ABI and EPQ-R personality traits. There were no significant correlations were between ABI and personality traits. Hence H2 was not supported by the correlations of sample 2.

Table 3.7: Correlations between ABI variables and EPQ-R traits

	Absenteeism	Seminar behaviour	Essay marks
<u>Personality (EPQ-R)</u>			
Neuroticism	.12	-.06	-.06
Extraversion	-.05	.07	-.18
Psychoticism	.11	.03	-.06
Lie	-.05	.13	.17

** p < .01, * p < .05 N = 75

³ Unlike in study 1, only overall (rather than 1st, 2nd, and 3rd) exam marks were available for this study. However it should be noted that exam marks tend to be internally and longitudinally reliable.

Regressions: Several hierarchical regressions were performed on the data in order to test the predictability of AP by EPQ-R factors, ABI, and tutors' predictions. In addition, the EPQ-R personality traits were also tested as predictor of tutors' predictions. The results of the hierarchical regressions are presented in Table 3.8. Tutors' predictions did not significantly predict AP, accounting for only 2% and 1% of overall exam and final-year project marks, respectively. When ABI were added as predictors, the amount of variance accounted for in overall exam and final project marks increased to 18% and 5%, respectively. Thus H4 was also partly confirmed in sample 2. When the EPQ-R personality traits were included as predictors, the model accounted for an additional 16% of the variance in overall exam marks and an additional 2% of the variance in final-project marks. This confirmed H5.

Table 3.8: St. β coefficients for predictors of tutors' predictions and AP

Dependant Variables:	Tutors' predictions		Exams total		Course-work	
	st. β	t	st. β	t	st. β	t
Tutors' predictions	-	-	.05	.41	.04	.36
F	-	-	(1, 71) 1.65	(1, 71) .13		
Adj. R ²	-	-	.02		.01	
<u>ABI</u>						
Seminar behaviour	.09	.62	.31	2.18*	-.11	.73
Absenteeism	-.31	2.60*	-.23	1.93*	.04	.26
Essays	.24	1.68	.07	.52	.01	.10
F	(3, 69) 4.05**	(4, 68) 4.84**	(4, 68) .19			
Adj. R ²	.11		.18		.05	
<u>Personality (EPQ-R)</u>						
Neuroticism	.21	1.75	-.35	3.54**	.02	.13
Extraversion	.08	.66	-.03	.36	.30	2.44*
Psychoticism	.13	1.06	-.19	1.72	-.33	2.58**
Lie	.19	1.50	.06	.52	-.08	.60
F	(7, 65) 2.63*	(8, 64) 5.61**	(8, 64) 1.54			
Adj. R ²	.14		.34		.07	

** p < .01, * p < .05

N = 75

Further, Neuroticism was a significant predictor of overall exam marks (which confirmed H1a), whereas Extraversion and Psychoticism were both significant predictors of final project marks (this confirmed H1d). A final hierarchical regression on sample 2

showed that tutors' predictions were significantly predicted by ABI, accounting for 11% of the variance. When the EPQ-R personality factors were added as predictors, the variance accounted for by the model increased by 3% (and none of the predictors were significant). Results are summarised in Table 3.8.

3.8 Discussion

The present study has attempted to explore the predictability of AP in university by two well-established personality measures, i.e., the NEO-FFI (Costa & McCrae, 1992) and the EPQ-R (Eysenck & Eysenck, 1985). The correlations and regressions of the two longitudinal studies involving university students provided robust psychometrical evidence for the predictive and incremental validity of both personality inventories.

The results of this study support the hypothesis that personality is significantly related to AP (Blickle, 1996; Cacioppo, Petty, Feinstein & Jarvis, 1996; Chorro, 1981; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Hamilton & Freeman, 1971; Rindermann & Neubauer, 2001; Wolfe & Johnson, 1995; study 5). As expected, Neuroticism was found to be a negative correlate and predictor of academic achievement. This is consistent with previous research (Cattell & Kline, 1977; Goh & Moore, 1987; Lathey, 1991; Sanchez-Marin, Rejano-Infante & Rodriguez-Troyano, 2001; Savage, 1962). Further, as Furnham and Mitchell (1991), Zeidner (1995), and Zeidner and Matthews (2000) have suggested, this correlation may be associated with anxiety characteristics of neurotic personalities. It should be noted that anxiety may be associated with exam rather than final project results – since, unlike an exam situation, final project involves a long-term and less stressful performance. However in sample 1, Neuroticism was not only a

significant correlate and predictor of exam, but also of final-year project, results. This suggests that Neuroticism may affect AP not only in exam (i.e., stressful) conditions.

Consistent with the previous literature (Blickle, 1996; Busato, Prins, Elshout & Hamaker, 2000; Costa & McCrae, 1992; De Raad, 1996; De Raad & Schouwenburg, 1996; Goff & Ackerman, 1992; Kling, 2001; Smith, 1969), Conscientiousness was found to be the most important correlate and predictor of AP. The positive association between AP and Conscientiousness may be simply attributed to the hard-working, organised and ambitious nature of highly conscientious individuals. Further, each of the sub-scales of Conscientiousness (i.e., competence, order, dutifulness, achievement striving, self-discipline, and deliberation) can be theoretically related to performance, not only in academic but also in occupational, settings (see Mount & Barrick, 1995; Salgado, 1997).

Extraversion was only partly related to AP, that is to final-year project marks (and only in sample 2). It is also noteworthy that this relationship was positive rather than negative. This positive association is perhaps best interpreted in terms of the interpersonal skills (i.e., getting along with the supervisor during a 6-month period). However there were no significant relations between Extraversion and exam marks. Following Anthony (1973), Savage (1962), Entwistle and Entwistle (1970), and Sanchez-Marin et al (2001), it had been predicted that introverts would achieve higher grades than extroverts. Since there were no significant Extraversion differences in AP, the present results, like Kline and Gale's (1971), Cowell and Entwistle's (1971), and Furnham and Medhurst's (1995), suggest that Extraversion is not clearly related to academic achievement.

With regard to Openness to Experience, results are perhaps more surprising. Due to the fact that Openness to Experience has been associated with vocabulary and general

knowledge (Ashton, Lee, Vernon & Jang, 2000; Goff & Ackerman, 1992), it could have been expected to find some significant relationships between this personality factor and academic achievement. One possibility is that the homogeneity of the sample (psychology students only) may have restricted individual differences in Openness to Experience. Students of different disciplines would be expected to differ in aesthetics, ideas, and values, to a greater extent. Another explanation for the low correlation between Openness and AP is that the characteristics of Openness would be more beneficial for “humanistic” (as opposed to “scientific”) degrees (see McCrae & Costa, 1997a). This would explain why type of degree – and perhaps even the type of assessment – involved in the present samples is not positively associated with Openness to Experience.

The third clear personality correlate and predictor of AP was Psychoticism. This is consistent with past research (Aluja Fabregat et al, 1998; Furnham & Medhurst, 1995; Goh & Moore, 1987; Maqsud, 1993; Sanchez-Marin et al, 2001; study 5), and the initial predictions. Furthermore, the negative association between Psychoticism and AP is in line with the positive relationship between AP and Conscientiousness (see Eysenck, 1991), since both low Conscientiousness and high Psychoticism refer to maladaptive behaviour such as poor co-operation and organisation, as well as low achievement-striving and bad discipline.

With regard to the relationship between personality and ABI as well as tutors' predictions, results suggest that the link between these variables is weak. With exception of Extraversion, personality (notably Conscientiousness and Openness to Experience) was only modestly related to ABI. This association was especially weak with the EPQ-R traits (sample 2). These results run counter to those of Furnham and Medhurst (1995), and suggest that personality traits are related to AP rather than behaviour in class. Further,

personality did not significantly predict tutors' predictions in sample 2, suggesting that tutors do not account for individual differences in students' personality when predicting their final grades. This may suggest that, according to the tutors, personality has no effect on AP. Bearing in mind that ABI are employed as predictors of exam and final-project performance, the weak relationship between personality and ABI asks the question of whether ABI or personality traits are better predictors of actual AP: that precisely was the central and final question of this study.

The results of the hierarchical regressions indicate that personality traits (both EPQ-R and NEO-FFI) show an important incremental validity as predictors of AP. This validity can be mainly attributed to the Neuroticism, Conscientiousness, and Psychoticism factors, which were found to be more significant predictors of overall and final-year project grades than ABI and tutors' predictions. Although Neuroticism and Conscientiousness have been repeatedly associated with AP (Blickle, 1996; Busato, Prins, Elshout & Hamaker, 2000; Cattell & Kline, 1977; Costa & McCrae, 1992; De Raad, 1996; De Raad & Schouwenburg, 1996; Goh & Moore, 1987; Goff & Ackerman, 1992; Kling, 2001; Lathey, 1991; Sanchez-Marín, Rejano-Infante & Rodríguez-Troyano, 2001; Savage, 1962; Smith, 1969), the implications of the present results go beyond those of the previous literature, in the sense of providing a robust criterion to evaluate the predictive validity of well-established personality traits. If knowing students' Neuroticism, Psychoticism and Conscientiousness scores can predict AP better than knowing students' oral and written skills and academic production during a 3-year time period and their tutors' predictions, it can be certainly argued that personality measures such as the Big Five and the Gigantic Three should be considered when attempting to predict AP in student selection.

Limitations of the present study can be attributed to the homogeneous sample, which was limited to a (highly ranked) university population in the first place, and to psychology students in the second. In addition, measures of intelligent and motivation, previously associated with the criterion (Anderson & Keith, 1997; Boekaerts, 1996; Elshout & Veenman, 1992; Furnham, 1995; Hamilton & Freeman, 1971; Harris, 1940; Heaven, 1990; Neisser, Boodoo, Bouchard, Wade, Brody, Ceci, Halpern, Loehlin, Perloff, Sternberg & Urbina, 1996; Pelechano, 1972; Sternberg & Kaufman, 1998) were not included in the present studies. Nevertheless, it should be noted that in highly selected university samples intelligence is likely to be high and rather homogeneous ($IQ > 115$), and that these samples do not represent the distribution of intelligence across the general population. Further, it is likely that intelligence measures would have overlapped with ABI rather than with personality measures. However measures of intelligence/ability (frequently used in competitive university selection processes) would still provide additional data to test the incremental validity of personality inventories in the prediction of AP, as it was indeed tested and shown in study 5. One should bear in mind that the relationship between personality traits and psychometric intelligence is a rather modest one (see studies 1 to 4). It is thus likely that the prediction of AP (and maybe performance in general) will be improved with the inclusion of sound personality inventories, which does not, to any extent, imply that personality inventories should *replace* ability tests. Given the increase interest that competitive universities are showing in standardised tests for the selection of their students, it is believed that personality inventories should not be neglected in any academic selection process, for individual differences in personality are probably of educational relevance in higher learning programs.

STUDY 7

3.9 Introduction

For nearly a century differential psychologists have consistently attempted to understand the major predictors of individual AP (Binet & Simon, 1905; Busato, Prins, Elshout & Hamaker, 2000; Elshout & Veehman, 1992; Harris, 1940; Thorndike, 1920). Recent research by Ackerman and Heggestad (1997) has suggested that individual differences like personality, intelligence, and vocational interests can be used, not only to explain variance in AP, but also the processes by which traits influence examination outcomes. Accordingly, Ackerman's (1996) PPKI theory (intelligence as processes, personality, knowledge and interests) represents an attempt to develop an integrative conceptual framework for understanding the relationship between non-cognitive and cognitive individual differences underlying the acquisition of knowledge and adult intellect. This theory posits that personality traits play an important role in the development of knowledge, in that they direct an individual's choice and level of persistence to engage in intellectually stimulating activities and settings. The theory of PPKI thus implies that individual differences in personality may influence AP (which is essentially a measure of field-specific knowledge) and, indeed, studies have shown that "non-intellectual" factors such as personality traits and learning styles are significantly involved in AP (Busato, Prins, Elshout & Hamaker, 2000; De Fruyt & Mervielde, 1996; see also studies 5 & 6).

There are several personality traits that have been shown to relate to AP. Openness to Experience (also known as Intellect) has been associated with academic success in school (Schuerger & Kuma, 1987) and university, both at an undergraduate (De Fruyt & Mervielde,

1996) and postgraduate (Hirschberg & Itkin, 1978) level. Some have argued that this association can be explained in terms of the correlation between crystallised intelligence and the Openness to Experience trait (Brand, 1994). Others (perhaps more appropriately) have explained this association in terms of *typical* rather than *maximal* performance (Goff & Ackerman, 1992; Hofstee, 2001), since Openness has also been shown to be highly correlated with Typical Intellectual Engagement (Goff and Ackerman, 1992), a trait that refers to one's typical efforts to invest in intellectual activities. However both Openness to Experience and Typical Intellectual Engagement have not always demonstrated predictive validity with regard to academic achievement (Goff & Ackerman, 1992; Busato et al, 2000; Wolfe & Johnson, 1995). Further, studies 1, 2 and 4 found no significant correlations between Openness and psychometric intelligence.

The more traditional orthogonal trait variables of Extraversion and Neuroticism have been also associated with AP after nearly 40 years of investigation. Early studies have attributed the relationship between Extraversion and AP to introverts' greater ability to consolidate learning, less distractibility and better study habits (Entwistle & Entwistle, 1970). Recent studies (notably Sanchez-Marin, Rejano-Infante & Rodriguez-Troyano, 2001) have also suggested that extraverts under-perform in academic settings because of their distractibility, sociability and impulsiveness. Study 5 showed that Extraversion is counterproductive with regard to academic exam performance, while study 6 showed that this personality trait is beneficial when AP is assessed through a long-term supervised project (which involves interaction with academic staff).

The negative relationship between academic achievement and Neuroticism (Furnham & Medhurst, 1995) has usually been explained in terms of stress and anxiety

under test (i.e., exam) conditions (Zeidner & Matthews, 2000), although such traits may affect AP in a more general way, i.e., not just through exam performance (Halamandaris & Power, 1999). Furthermore, earlier research has suggested a possible ambiguity in the relationship between Neuroticism (particularly anxiety) and academic achievement. Specifically, Eysenck and Eysenck (1985) have suggested that the motivational effects of anxiety may be greater in highly intelligent students because they encounter little difficulties in their studying. In this sense Neuroticism is a positive predictor in bright participants but a negative predictor in less talented participants. Nevertheless study 6 reported a significant (linear) relationship between Neuroticism and AP.

Perhaps the personality factor more consistently associated with AP is Conscientiousness (Blickle, 1996; Busato, Prins, Elshout & Hamaker, 2000; Costa & McCrae, 1992; De Raad & Schouwenburg, 1996). Studies have replicated this association in school (Wolfe & Johnson, 1995) as well as undergraduate (Goff & Ackerman, 1992) and postgraduate (Hirschberg & Itkin, 1978) education. Some authors have argued that Conscientiousness may affect AP beyond (and even compensate for poor) intellectual. This would explain why females usually obtain higher grades albeit scoring lower on IQ tests than males (see Kling, 2001). Accordingly study 6 showed that Conscientiousness is a significant predictor of AP (exam grades). Further, study 5 reported negative associations between AP and Psychoticism (in a sense the opposite of Conscientiousness).

Although research seems to be approaching a consensus on the identification of the personality factors that may account for a significant proportion of variance in AP, such identification has focussed on super-traits (e.g., Neuroticism, Extraversion) rather than

primary traits ⁴ (e.g., anxiety, activity, dutifulness). However, an examination of the primary traits would provide important information about the specific non-cognitive variables that may affect an individual's AP, as people with identical superfactors scores may have very different primary trait factors scores. Identification of the specific personality traits associated with AP would therefore reduce speculative interpretations about the predictive nature of super-traits, that is, which *aspects* of Neuroticism, Extraversion, Openness and Conscientiousness are actually related to AP.

Further, it is important to examine whether the use of primary traits may improve the prediction of AP by super-traits. As Hough (1992) noted, it is still necessary to clarify whether broad personality dimensions (such as Conscientiousness) are to be preferred to more specific and narrow dimensions (like achievement striving). This question brings up the debate on Bandwidth-fidelity, i.e., whether specific or general personality characteristics have more predictive validity with regard to human performance (see Barrick & Mount, 1994; Ones & Viswesvaran, 1996). Although recent reviews on this subject seem to suggest that broad traits are better predictors of performance than primary traits, it has also been argued that examining specific personality traits have important exploratory advantages for the understanding of the processes underlying the relationship between personality and performance (Ones & Viswesvaran, 1996). Furthermore, since most of the Bandwidth-fidelity debate has focussed on job-performance (with very few published papers, notably De Fruyt & Mervielde, 1996, reporting correlations between AP and personality at the primary trait level), it would be interesting to compare general and specific personality traits in relation to AP.

⁴ From now on this study will reserve the use of "primary traits" for the sub-components (sub-facets) of the Big Five "super-traits" (i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness, Conscientiousness).

So far, only few studies have examined the relationship between AP and personality at the primary trait level. Most of these studies have focussed on the anxiety trait (Darke, 1988; M. Eysenck, 1997; Matthews, Davies, Westerman & Stammers, 2000). Among the first ones to examine performance difference at the trait level were Morris and Liebert (1970). The authors suggested that only the worry (as opposed to the emotionality) components of anxiety are related to performance impairment. According to Spielberger (1972), trait anxious individuals would be more likely to suffer from information-processing disruption and performance impairment (state anxiety). M. Eysenck (1997) has argued that anxiety may specially affect performance on difficult, short-term or working memory, and secondary (i.e., dual) tasks. Likewise Matthews et al (2000) suggested that, due to interference with attention, working memory and retrieval, anxiety is likely to impair learning and academic achievement. Further, Wells and Matthews (1994) concluded that anxious individuals tend irrationally to lack confidence in their abilities, and would therefore adopt coping strategies, such as worry (emotion-focused coping), that are likely to impair performance.

With regard to the primary facets of the other four super-traits (i.e., Extraversion, Openness, Agreeableness and Conscientiousness), research has yet to provide psychometric evidence for their relationship with AP.

Hence the importance of this study, which will examine a) whether and to what extent the Big Five can predict AP in university, b) which, among the super and primary traits, are the most significant correlates and predictors of AP, and c) whether the prediction of AP by personality can be more accurate at the super or primary trait level. This study will therefore attempt to replicate previous findings on the relationship between AP and

personality at the super-trait level (particularly studies 5 & 6), as well as explore the relationship between AP and personality at the primary trait level. Several hypotheses will be tested:

H1: Neuroticism will be negatively and significantly related to AP. This would confirm previous findings (Furnham & Medhurst, 1995; study 6) as well as reflect the modest but consistent positive association between Neuroticism and test anxiety (see Zeidner & Matthews, 2000). Further, to the extent that Neuroticism is associated with low SAI (see chapter 1), it would be expected to correlate negatively with AP.

H2: Extraversion will be negatively and significantly related to AP as measured by written exams. Although the negative relationship between Extraversion and AP has not been as consistently supported as that of Neuroticism and AP, one may expect that the more active social life of extraverts are counter-productive with regard to their study habits (Entwistle & Entwistle, 1970; Sanchez-Marin et al, 2001). Thus it is expected to replicate the results of study 5.

H3: Openness will be positively and significantly related to AP. This is predicted on the basis of the significant correlation between Openness and intelligence (up to $r = .40$ with crystallised intelligence)(see Zeidner & Matthews, 2000). However some studies (notably studies 1, 2 and 4) have failed to replicate this correlation. Further, study 6 found no significant association between Openness and AP, suggesting that the creative and imaginative nature of open individuals may not be of great advantage in academic settings, particularly when individuals are required to reproduce curricular content rather than produce novel responses or creative problem-solving (see also Blickle, 1996; De Fruyt &

Mervielde, 1996).

H4: Agreeableness will not be significantly related to AP. This prediction is based on the lack of existing evidence for the significant relationship between Agreeableness and AP on one hand, and Agreeableness and intelligence on the other (Zeidner & Matthews, 2000).

H5: Conscientiousness will be positively and significantly related to AP. This would confirm the results of several recent studies that reported significant associations between these variables (Blickle, 1996; Busato et al, 2000; De Raad et al, 1996; study 6).

H6: The Big Five super-traits will significantly predict AP. This hypothesis is stated in terms of the previous predictions that refer to the significant associations between AP and four of the five main personality traits (see H1, H2, H3, and H5). Hence it is expected to replicate study 6.

H7: Primary traits will account for more of the variance than super-traits. Given that the five super-traits represent equally weighted (added) components of their underlying primary-factors, one can expect that the sub-facets of the NEO-PI-R will encapsulate more (“purer”) personality variance. Hence if one assumes individual differences in personality to be relevant (i.e., account for a significant amount of the variance) with regard to AP, one may expect primary traits to comprise the “full” variance of personality and thus increase the amount of explained variance in AP (in comparison to super-traits).

Given the exploratory nature of the psychometric examination of the relationship between AP and personality at the primary-trait level, no specific hypotheses are stated with regard to the significant primary-trait correlates of AP. One may however expect that all the

Conscientiousness sub-facets will be positively and significantly related to AP, whereas most of the Neuroticism sub-facets will be negatively and significantly related to AP. On the other hand one may also expect that the sub-facets of Extraversion and Openness will be differentially correlated with AP (some may be positively, some negatively, some significantly and some not significantly related to AP). With regard to Agreeableness none of the sub-facets are expected to correlate significantly with AP.

3.10 Method

Participants

Participants were 247 (179 females and 68 males) undergraduate students from University College London. Most students were native English speakers, but those who were not were fully bi or tri-lingual. Initial age ranged from 17 to 23, with an arithmetic mean of 20.1 (SD = 2.04) years. Data for each participant were collected throughout three academic years. Students are highly selected with an application acceptance ratio of 1:12. School grades played a major role as well as an interview. Selection decision was not based on any psychological test data. The department has been rated one of the best in the country and students school grades are among the highest.

Measures

AP and personality data were collected from the University College London archive by the author.

a) AP: AP was measured by overall exam marks based on five three hour written exam sessions (on a 1-100% scale where 32% is a pass and 70% is a first or distinction).

There are two exams in the first two years (one at the end of the 1st and one at the end of the 2nd year) and three more exams at the end of the 3rd year. Exam questions are chosen by course convenors, i.e., senior lecturers or professors of the department. Each of the final examination sessions corresponds to one of the three academic years. During each of these years, students undertake a number of courses, such as “Introduction to the Science of Psychology”, “Memory and Decision Making” (1st year course-units), “Design and Analysis of Psychological Experiments”, “Cognition and Language” (2nd year course-units), “Psychology and Education” and “Social Psychology” (3rd course-units). In total, each student completes 20 units (including forced and open choices). Although the choice of the course-units may vary, the number of course-units is the same for all students. Furthermore, AP in all course-units is assessed via written (essay-based type) examinations. Exams are double marked blindly and re-examined by an external examiner. Exam marks ranged from 39.0 to 74.2, with an arithmetic mean of 62.2 (SD = 6.29). Typically a three-hour exam requires written answers to three questions selected by the candidate out of nine on three exam papers.

b) Personality: The *NEO Personality Inventory - Revised* (Costa & McCrae, 1992).

As in study 1.

Procedure

As described above, this is an archival study. Data from student files was matched to personality data collected in their first month.

3.11 Results

Table 3.9 presents the correlations between the Big Five super-traits (i.e., Neuroticism, Extraversion, Openness to Experience, Agreeableness, and

Conscientiousness), yearly as well as totaled overall examination marks. Due to the large number of statistical tests performed, ALPHA levels were adjusted from $p < .05$ to $p < .01$. This would reduce the probability of obtaining significant results by chance (i.e., Type I error rate).

Table 3.9: Correlations between Big Five super and primary traits and Exam marks

	Exams 1	Exams 2	Exams 3	Exams t
<u>Neuroticism</u>	-.01	-.22**	-.21**	-.16*
anxiety	-.20**	-.28**	-.32**	-.29**
angry hostility	-.05	-.19**	-.18**	-.15*
depression	.06	-.11	-.06	-.04
self-consciousness	.20**	.09	.08	.13*
impulsiveness	-.17**	-.28**	-.28**	-.26**
vulnerability	.09	-.13*	-.08	-.04
<u>Extraversion</u>	-.17**	-.02	-.13*	-.11
warmth	-.02	.08	.01	.03
gregariousness	-.21**	-.14*	-.22**	-.20**
assertiveness	-.15*	.09	.00	-.01
activity	-.27**	-.16*	-.23**	-.24**
excitement	-.06	-.04	-.09	-.07
positive Emotions	-.02	.08	.01	.03
<u>Openness to Experience</u>	-.03	.06	.02	.02
fantasy	-.07	-.02	-.05	-.05
aesthetics	.02	.09	.06	.06
feelings	.01	.01	-.01	.01
actions	-.03	.06	.02	.02
ideas	-.00	.04	.03	.02
values	-.06	.04	.01	-.01
<u>Agreeableness</u>	.07	.04	.08	.07
trust	.02	.03	.02	.03
straightforwardness	.05	.03	.09	.06
altruism	-.09	-.03	-.05	-.06
compliance	.11	.06	.11	.10
modesty	.14*	.06	.09	.10
tender-mindedness	-.01	-.02	.01	.01
<u>Conscientiousness</u>	.25**	.36**	.39**	.36**
competence	-.05	.04	.01	.00
order	.05	.12	.15*	.11
dutifulness	.34**	.37**	.37**	.38**
achievement striving	.25**	.36**	.37**	.35**
self-discipline	.13*	.22**	.27**	.22**
deliberation	.12	.14*	.19*	.16*

** $p < .01$ * $p < .05$

N = 247

As expected, (H1) Neuroticism was significantly correlated with AP (although the

correlation between Neuroticism and totaled exam marks was only significant at $p < .05$). Extraversion only correlated significantly (and negatively) with 1st year exam marks (H2 was only partly confirmed). Openness was not significantly correlated with AP (H3 was not confirmed). As predicted, (H4) Agreeableness was not significantly correlated with exam grades, and (H5) Conscientiousness was moderately, positively and significantly related to AP (in the three years and overall).

In order to test the contribution of each of the personality super-traits in the prediction of AP, examination marks were then regressed onto the Big Five. It should be noted that due to the low variation between yearly examination marks, only the totaled (average) grade was discussed as the outcome variable and indicator of AP in the regressions. It was believed that this would both further reduce Type I error rate as well as represent the most reliable measure of AP. Table 3.10 presents the standardised β coefficients and t values for the multiple regression. As expected, (H5) Conscientiousness was the most significant predictors of exam marks. However Neuroticism and Openness were not significant predictors of totaled exams (H1 and H3 not confirmed), whereas Extraversion was significant only at $p < .05$. Personality accounted for 13% of the variance in overall totaled examination results, which confirmed H6.

Table 3.10: St. β and t values for the Big Five super-traits as predictors of exam marks after Regressions.

	Exams 1			Exams 2			Exams 3			Exams T		
Intercept	56.34			56.63			61.03			58.00		
	St. β	β	t	St. β	β	t	St. β	β	t	St. β	β	t
N	-.01	-.00	.15	-.16	-.05	2.26*	-.20	-.06	2.85**	-.13	-.04	1.83
E	-.17	-.06	2.29*	-.09	-.03	1.23	-.21	-.07	3.01**	-.17	-.05	2.32*
O	.01	.04	.15	.03	.01	.51	.03	.01	.49	.03	.00	.41
A	.06	.02	.93	.00	-.00	.07	.04	.01	.64	.03	.01	.55
C	.23	.09	3.48**	.31	.12	4.84**	.32	.12	5.15**	.31	.11	4.80**
F(5, 241)	4.79**			8.57**			11.89**			8.64**		
R ²	.09			.15			.20			.15		
Adj. R ²	.07			.13			.18			.13		

* $p < .05$, ** $p < .01$ N=Neuroticism, E=Extroversion, A=Agreeableness, O=Openness, C=Conscientiousness N=247

Correlations between AP and primary (as opposed to super) personality traits were also performed on the data (see Table 3.9).

Table 3.11: St. β and t values for the Big Five super-traits as predictors of exam marks after Regressions.

	Exams 1			Exams 2			Exams 3			Exams totaled		
	St. β	β	t	St. β	β	t	St. β	β	t	St. β	β	t
Intercept		61.25			62.71			65.97			63.31	
anxiety	-.11	-.12	1.45	-.04	-.04	.56	-.13	-.13	1.82	-.10	-.10	1.38
angry hostility	-.02	-.03	.24	-.16	-.21	1.69	-.15	-.20	1.68	-.12	-.15	1.29
depression	-.05	-.06	.49	-.02	-.02	.20	-.06	-.06	.58	-.04	-.05	.46
self-conscious	-.02	-.02	.21	.02	.02	.29	-.09	-.11	1.23	-.03	-.03	.39
impulsiveness	-.01	-.01	.09	-.08	-.11	1.08	-.04	-.06	.65	-.05	-.06	.66
vulnerability	.22	.32	2.27*	.07	.10	.73	.15	.21	1.63	.16	.21	1.69
warmth	.13	.22	1.12	.09	.15	.78	.07	.12	.69	.10	.16	.95
gregariousness	-.05	-.06	.56	-.01	-.20	.18	-.08	-.09	.98	-.05	-.06	.61
assertiveness	-.10	-.13	1.19	.05	.06	.64	.01	.01	.13	-.01	-.02	.17
activity	-.22	-.32	3.05**	-.16	-.23	2.25*	-.19	-.26	2.78**	-.21	-.27	2.94**
excitement	.04	-.05	.47	-.08	-.11	1.01	-.05	-.07	.70	-.03	-.04	.43
pos. emotions	.08	.10	.77	.09	.12	.92	.05	-.06	.51	.08	.09	.81
fantasy	-.10	-.15	1.46	-.03	-.05	.51	-.02	-.02	.26	-.06	-.07	.83
aesthetics	-.00	-.00	.06	.05	.07	.65	-.01	-.00	.09	.01	.02	.18
feelings	.08	.15	1.12	.01	.02	.19	.05	.08	.69	.05	.08	.73
actions	-.03	-.04	.40	.01	.01	.11	-.03	-.04	.42	-.02	-.03	.24
ideas	.01	.01	.10	-.06	-.07	.69	-.04	-.04	.47	-.03	-.04	.38
values	.04	.00	.52	.09	.17	1.21	.10	.16	1.26	.08	.13	1.08
trust	-.09	-.10	1.06	-.14	-.18	1.78	-.16	-.19	2.07*	-.14	-.16	1.77
straightforward	-.00	-.00	.02	-.04	-.05	.50	.02	.00	.32	-.01	-.07	.08
altruism	-.14	-.28	1.69	-.10	-.20	1.28	-.12	-.23	1.55	-.13	-.24	1.65
compliance	.01	.02	.15	-.03	-.05	.33	.01	.02	.18	.00	-.04	.00
modesty	.05	.06	.65	.02	.03	.34	.03	.03	.40	.04	.04	.51
tender-mind	-.10	-.15	1.35	-.07	-.10	.90	-.00	-.00	.07	-.06	-.09	.87
competence	-.09	-.14	1.24	-.10	-.16	1.42	-.13	-.19	1.85	-.11	-.16	1.61
order	-.15	-.20	2.12*	-.07	-.09	1.05	-.08	-.10	1.20	-.11	-.14	1.61
dutifulness	.40	.49	4.98**	.36	.43	4.51**	.34	.39	4.47**	.39	.43	5.09**
achievement	.20	.27	2.54* ¹	.28	.37	3.54**	.25	.31	3.22**	.26	.32	3.38**
self-discipline	.07	.10	.96	.05	.07	.68	.12	.16	1.65	.09	.11	1.18
deliberation	-.03	-.03	.38	-.03	-.04	.43	.01	.01	.17	-.02	-.02	.25
F (30, 216)		3.52**			3.75**			4.42**			4.26**	
R ²		.33			.34			.38			.37	
Adj. R ²		.23			.25			.29			.28	

** p < .01, * p < .05

The most significant trait correlates of AP at the primary level were two Conscientiousness sub-facets, namely dutifulness and achievement striving, which correlated moderately with overall exam marks. Anxiety and impulsiveness from Neuroticism, and gregariousness and activity from Extraversion, were negatively and significantly correlated with overall exam marks. Finally another Conscientiousness trait, i.e., self-discipline, was modestly but significantly correlated with overall examination results.

Finally, another multiple regression was carried out to test the predictability of exam grades by personality traits at the primary level. It was found that NEO-PI-R sub-facets were significant predictors of AP, accounting for 28% of the variance in overall exam grades. Thus the prediction that primary traits would account for more variance in AP than super-traits (H7) was also confirmed. The three significant predictors were dutifulness, achievement striving, and activity. Furthermore, these three variables alone were found to account for more than 28% of the variance in overall exam grades ($F(3, 243) = 33.45, p < .01$). Regression coefficients for the multiple regression including all 30 sub-facets are presented in Table 3.11.

3.12 Discussion

The present study has examined which and to what extent personality (super and primary) traits as measured by the NEO-PI-R (Costa & McCrae, 1992) predict university exam marks. Consistently with recent studies (Blickle, 1996; Busato et al, 2000; study 6) there were modest but significant correlations between Conscientiousness and AP. Also in accordance with previous investigations (Furnham & Medhurst, 1995; study 6) were the

significant negative correlations between AP and Neuroticism. Furthermore, the present results also replicated earlier findings on the negative correlation between academic achievement and Extraversion (see Entwistle & Entwistle, 1970; study 5). These results therefore indicate that conscientious, stable and introverted individuals would be more likely to succeed in university-based academic settings, and that these variables may account for around 15% of the variance in academic exam performance.

In order to identify the more specific personality characteristics associated with academic achievement the correlational analysis was also carried out at the primary level. Results showed that the Conscientiousness primary traits dutifulness and achievement-striving were the highest AP correlates of exam scores. Self-discipline (also Conscientiousness traits) was also significantly correlated with AP albeit more modestly. On the other hand, primary scales from the Neuroticism factor were differentially correlated with AP. Only anxiety and impulsiveness were negatively and significantly ($p < .01$) correlated with AP. This would indicate that the negative association between academic success and Neuroticism is mainly a consequence of the anxiety and impulsiveness traits. Whereas the negative relationship between academic achievement and anxiety is supported by previous literature (both correlational and experimental, see Zeidner, 1998, see also Matthews et al, 2000 for a review), AP has not yet been explicitly related to impulsiveness. Looking at the checklist items of the impulsiveness scale from the NEO (see Costa & McCrae, 1992), it may be suggested that the moody, irritable and excitable nature of impulsive individuals may be counterproductive for a student's study habits. Thus neurotic students may be less able to control certain impulses and moodiness that may be detrimentally associated with learning discipline. It is however noticeable that these

characteristics are better encompassed by the Conscientiousness sub-facets (e.g., dutifulness, deliberation). This may explain why the predictive effect of AP by impulsiveness disappears in the multiple regression (when Conscientiousness facets are also included as predictors).

In the case of Extraversion primary traits, correlations are even more heterogeneous. Two facets, namely activity and gregariousness were both significantly and negatively related to exam grades. Further, these two sub-facets were the only significant Extraversion correlates of AP, suggesting that introverts would benefit from being less active (perhaps socially) and gregarious than extraverts. However, warmth and excitement (two primary traits which may also be associated with poorer study habits) were not significantly correlated with exam grades. It is therefore necessary that research further explores the relationship between AP and Extraversion at the primary level.

Openness to Experience and Agreeableness were not significantly related to exam grades, neither at the super, nor at the primary, level. In the case of Agreeableness, results support initial hypothesis, since none of the primary traits of this personality factor seem to be relevant in learning processes or examination performance. Furthermore, Agreeableness has been shown to be unrelated to intellectual ability (Ackerman & Heggestad, 1997; Zeidner & Matthews, 2000). In the case of Openness to Experience however, results run counter to initial predictions. Once again (as in study 6), it seems surprising that none of the Openness primary traits were (even modestly) related to AP. Nevertheless, recent studies (e.g., Busato et al, 2000; Wolfe & Johnson, 1995) have equally failed to replicate significant relations between Openness to Experience and academic achievement. It may be possible that the rather simple and practical personality characteristics of low Openness to

Experience scorers (Matthews et al, 2000) may be also beneficial for AP. Further, it is possible that Openness may have a positive effect in AP when artistic, imaginative and creative intervention of students is highly regarded, but not in other degrees in which systematic, organised and dutiful performance is required.

Finally, the regressions carried out in the present study indicate that personality traits as measured by a reliable and well-established inventory like the NEO-PI-R (Costa & McCrae, 1992) can be very useful in the prediction of academic success and failure. Specifically, the present findings replicate the results of previous studies (e.g., Entwistle & Entwistle, 1970; Furnham & Medhurst, 1995; Kling, 2001; Sanchez-Marín et al, 2001) and confirm that Conscientiousness (positively) and Extraversion and Neuroticism (both negatively) can be modest but significant predictors of academic achievement. Furthermore, the present results suggest that the accuracy in the prediction of AP by personality could be increased significantly by employing primary rather than super-traits. In particular dutifulness, achievement striving and activity seem to be moderately and consistently related to AP, accounting for most of the variance in exam grades. However it is worth noticing that the increase in the amount of explained variance by primary traits may not be proportionally significant to the number of predictors employed. That is, relatively to the number of predictor variables, primary traits are less powerful than the super factors: five factors account for approximately 15%, while thirty factors account for less than 30% of the variance. This means an average of 3% of the variance accounted by each super-trait, and an average of less than 1% accounted by each primary trait. These results may therefore re-open the debate on the Bandwidth-fidelity dilemma (i.e., whether specific or more general traits are to be preferred to maximise the prediction of human performance (particularly in

academic settings)(see Barrick & Mount, 1994; Ones & Viswesvaran, 1996). Whereas the results of the present study may support the theoretical argument that favours the use of super-traits, at the same time (at least for exploratory purposes), research at the primary level should also be encouraged.

There are of course some limitations to the present study, which must be addressed. These limitations are mainly referred to the employed data set, which only included personality and AP information. Furthermore, only *specific* data on personality and AP was available to this study: personality was assessed via the NEO-PI-R, which may undoubtedly be considered one of the most widely-used and validated personality scales, but certainly *not* the only one (as there are a number of leading researchers in the field of personality who prefer to employ other scales such as the 16PF and the Gigantic Three)(see Matthews & Deary, 1998). However studies 5 and 6 have also evidenced the predicted validity of the EPQ-R (Eysenck & Eysenck, 1985), undoubtedly the other most prestigious inventory to assess personality. On the other hand, the only measure of AP was provided by examination grades. Hence one may only speculate about the extent to which other assessment methods (participation in class, absenteeism, course-work) may be differentially related to the examined personality traits. At the same time however, examination marks remain (at least in Great Britain) the ultimate indicator of AP and measuring AP through examination marks becomes thus a rather pragmatic approach (this is certainly justifiable from an applied perspective). Further, the relationship between personality traits and AP as conceptualised by behavioural (continuous/class assessment) variables has been examined in study 6.

Another limitation refers to the fact that the present study did not employ any measure of intelligence (note that this was entirely due to the archival nature of the data).

Thus there remains the question of whether the NEO-PI-R would have shown some incremental validity with regard to ability measures (e.g., IQ test). In that sense it could be argued that the sample was highly selected with regard to their educational background and intellectual ability (although no standardised psychometric tests were employed), which allows us to assume that participants' IQ scores would have been rather high and the total sample fairly homogeneous. However this has implications for the generalisability of the findings and, moreover, to a conceptual reconsideration of what sort-of AP this study has examined: is personality important only when intelligence is leveled (or placed as covariate)? Having said this, one should also remind that, after a decade of intense research on the personality-intelligence interface, consistent links between personality and psychometric intelligence are perhaps unlikely (as it has been shown by the results of the studies in chapter 1; see also Hofstee, 2001). Thus there would be little reason to expect an overlap between personality inventories and IQ tests in the prediction of academic achievement, and indeed study 5 has shown that personality traits are significant predictors of AP even when IQ measures are included as predictors.

On the other hand, this study would have certainly benefited from the inclusion of other scales, such as questionnaires on interest, study-habits or learning-styles and, furthermore, Goff and Ackerman's (1992) Typical Intellectual Engagement scale. It is argued (especially when taking into account Ackerman's, 1996, PPKI theory), that the relationship between personality (and intelligence) and AP may be mediated by other variables like motivation and interests, which would also play an important role in determining students' knowledge acquisition – a key feature in exam performance. However researchers within this framework (notably Wittman & Suess, 1999) have also

found a direct effect of personality traits on performance (even when it is controlled for knowledge and intellectual ability). Furthermore, considering all the variables that could not be examined and contributed to the limitations of the present study, it is rather impressive that a 40 minutes personality inventory like the NEO-PI-R can predict up to almost 30% of the variance in AP three years later. Non-intellectual variables like personality traits seem to play an important role in the processes underlying academic success and failure, particularly in highly selected and competitive settings.

STUDY 8

3.13 Introduction

Interest in personality correlates of education variables waxes and wanes (Furnham & Heaven, 1990). The prediction of academic attainment has almost exclusively relied on the use of ability (i.e., IQ) tests (Eysenck, 1971; Anastasi, 1998). Although these tests have been generally proven effective (Gottfredson, 1997), research in the last ten years has emphasized the importance of non-cognitive variables such as personality traits in the processes that determine long-term performance (occupational and academic). Non-cognitive factors may have a differential impact on performance depending on their interaction with specific types of environments, tasks, time of the day, etc (Furnham, 1995).

Running counter to some previous hypotheses (notably Eysenck & Eysenck, 1985), recent studies have suggested that Neuroticism is generally associated with low academic attainment. Whereas cognitive theories provide explanations in terms of the worry components (e.g., fear of failure, tension, negative self-evaluation) associated with this personality trait (Morris & Liebert, 1969; Matthews, 1986; Wells & Matthews, 1994), correlational studies have tended to overlook specific differences in the performance of neurotic students. Rather, these studies have focussed on the final outcomes, namely examination performance or GPA (Busato, Prins, Elshout & Hamaker, 2000). Such is the case of studies 6 and 7, in which negative correlations between Neuroticism and AP were conceptualised in terms of exam grades only.

This study looks at the relationship between Neuroticism and special exam treatment, that is, writing examinations under “special circumstances”. British University students still mostly have their final degree mark assessed in final year exams. These are

stressful and there are various mechanisms in place to deal with that stress, hopefully to ensure that it does not disguise ability and effort. To the extent that Neuroticism is associated with higher test-anxiety, and test anxiety may lead to exam avoidance, neurotic students are expected to be more likely to want to receive special examination treatment. Furthermore, Neuroticism may have physical consequences such as racing heart, perspiration, gastric disturbances and muscle tension)(Matthews, Davies, Westerman & Stammers, 2000), which genuinely leads to psychosomatic illness which can affect exam performance. This hypothesis will be tested in two samples of British university students.

3.14 Method

Participants

Sample 1 was composed of fifty-four students, aged 17 to 22 yrs. (SD = 1.89). Sample 2 was composed of sixty students, aged 18 to 23 yrs. (SD = 2.01). In both samples, participants were first year university students from the University of London who completed a personality inventory at the beginning of the academic year as part of their course work. Exact information on participants' gender was not available but approximately 70% of the participants in both samples can be estimated to be female.

Neuroticism

Neuroticism was assessed by the EPQ-R (Eysenck & Eysenck, 1985), designed to assess Psychoticism, Extraversion, and Neuroticism. The EPQ-R comprises a total of 106 items (79 measure exclusively Psychoticism, Extraversion, and Neuroticism).

Special Examination Treatment

At University College London students can by special arrangement take all or some

of their exams in the health center with medically trained staff present. Though they are given no additional time for exams they may be given tea, water, etc, during the exam. Occasionally, students sit an exam under normal conditions but produce a doctor's letter afterwards explaining that they were not well at the time. Information on this is recorded and taken into consideration only after examinations have been blind marked by two examiners who were unaware both of students' name and where or how they completed the exam. A committee then considers if any results are significantly different from other results sat under "normal" circumstances and data files on the students' performance over three years, and whether results should be changed accordingly.

3.15 Results

Table 3.12 presents the mean Neuroticism scores for healthy and sick (special treatment) participants. In both samples, an independent t-test was computed and revealed significant differences in the Neuroticism scores between participants who received special examination treatment (sick) and those who completed their exams under normal conditions (healthy). Differences between the means were significant at the $p < .01$ level.

Table 3.12: EPQ-R Means and SD for healthy vs. sick students

			Neuroticism	Extraversion	Psychoticism	Lie
Sample 1	Healthy	43	11.27 (5.09)	14.37 (4.76)	3.40 (2.36)	5.07 (3.22)
	Sick	11	16.72 (3.55)	15.64 (2.91)	2.54 (3.17)	4.72 (2.87)
			$t(52) = 3.34^{**}$	$t(52) = .84$	$t(52) = .99$	$t(52) = .32$
Sample 2	Healthy	53	11.66 (5.44)	15.00 (4.33)	3.94 (3.27)	5.53 (3.33)
	Sick	7	16.71 (3.09)	14.57 (4.93)	3.29 (1.50)	3.55 (1.34)
			$t(58) 2.40^{**}$	$t(58) = .24$	$t(58) = .52$	$t(58) = 1.41$

** $p < .01$

In addition, ANOVA indicated there were no significant differences under different examination conditions ($F(1, 104) = .20, p = .65$). For the normal treatment, the mean grade was 61.17 (SD = 6.60), whereas for the special treatment it was 60.47 (SD = 4.79).

3.16 Discussion

The present results show that neurotic students (as assessed three years earlier when entering University) were more likely to be ill at the time they should have taken their final exams three year later. Since examination treatment was based on the health conditions of the students (only sick participants received special treatment), special treatment is an indicator of participants' health on the day of the pre-established examination date. Thus the present results show that Neurotic students (as assessed three years earlier when entering University) were more likely to be ill at the time they should have taken their final exams three years later.

Although the association between Neuroticism and illness during examination period has not been directly explored in the past, a number of studies may contribute to its understanding. Neuroticism has been associated with higher test-anxiety, and test anxiety may lead to exam avoidance/reluctance.

An interesting issue that remains to be addressed is to what extent neurotic students may or not be aware of the possibility that, for instance fear of failure or test-anxiety, may lead to illness during the examination period. Furthermore, it would be interesting to investigate whether other (non-written or continuous assessment) forms of examinations may reduce anxiety in Neurotic individuals. Bearing in mind that Neuroticism is mainly related to performance impairment because it predisposes to state anxiety (Spielberger, 1972; Eysenck, 1982; study 7), and that state anxiety is likely to emerge during examinations (see test-anxiety), considering alternative approaches for assessing students, particularly Neurotic ones, may improve the accuracy in evaluating what has been learned

(i.e., content) rather than what can be retrieved.

3.17 Conclusions

This chapter has examined cognitive and non-cognitive individual differences in AP. As such, it has dealt with a longstanding issue in educational psychology, namely the prediction of success and failure in academic settings (e.g., Binet, 1903; Binet & Simon, 1905; Busato, Prins, Elshout & Hamaker, 2000; Ebbinghaus, 1897; Elshout & Veeman, 1992; Galton, 1883; Goh & Moore, 1987; Harris, 1940; Savage, 1962; Terman, 1916; Thurstone, 1919; Willingham, 1974). Nevertheless practically no recent studies have examined the impact of modern and well-established cognitive and non-cognitive measures in the prediction of AP.

The results in this chapter (see study 5) indicate that, at least in secondary school, psychometric intelligence is by far the best predictor of AP. This is consistent with previous evidence (Brody, 2000; Jensen, 1980, 1998; Zeidner & Matthews, 2000). Moreover, it is likely that the predictive power of cognitive ability is even higher in primary school, but lower in university programs. This can be suggested on the basis of the mediational role of previous knowledge (or AP at stage 1) in the prediction of later AP, as well as the increased amount of variance accounted for by personality inventories in university as compared to school samples. Thus the fact that cognitive ability is the strongest predictor of AP should not undermine the importance of other, non-cognitive traits, which seem to increase in predictive power as individuals progress through the formal educational system (see Ackerman, 1996, 1999). Further, even when IQ measures are employed as predictors of AP, personality traits show some incremental, albeit modest, predictive validity (as it was shown in study 5).

Another interesting issue is that of the prediction of AP in more advanced settings such as undergraduate university programs (see studies 6, 7 & 8). Given that university students (particularly in competitive settings) have been previously selected on the bases of their previous AP or, in broad terms, intellectual competence, predicting academic success and failure in these programs becomes a rather challenging task: there is a restriction of range in the samples' intelligence. Throughout this chapter, longitudinal evidence was reported in support of the predictive validity of personality inventories (EPQ-R, NEO-FFI, and NEO-PI-R) for the prediction of AP in competitive university settings. Several personality traits such as Neuroticism (negatively), Extraversion (negatively), Psychoticism (negatively) and Conscientiousness (positively) were found to be significantly related to academic exam grades. This is in line with initial predictions and the previous literature (see section 1.3.2).

Whilst there were some specific variations between studies (particularly with regard to which of these traits was the most significant predictor among all personality traits assessed), the significant prediction of AP by personality traits was replicated in all samples, and the amount of variance accounted for was found to range from 10% to 30%. The prediction is maximised when primary traits (e.g., anxiety, activity, achievement-striving) are included, although from a bandwidth-fidelity perspective it may be difficult to justify the inclusion of as many predictors (up to thirty) per outcome variable (see study 7). Hence personality traits assessed at the super trait level seem more reliable and methodologically sound to predict AP.

It is necessary to comment on the limitations of the studies reported in this chapter. As mentioned above, the fact that university students (particularly in competitive institutions) have been previously selected on the basis of their intellectual competence or

past educational achievement may certainly affect the generalisability of the present results. This fact raises the question of to what extent personality traits may successfully predict AP in more heterogeneous samples, specifically when intelligence differences between students are larger. Moreover, it is likely that in less competitive settings and less advanced stages of formal education, there would also be a larger range of individual differences in non-cognitive traits (such as personality). Examining samples from competitive university programs may thus restrict not only the range in intellectual ability but also in specific personality traits that are expected to play a significant role in a student's AP (e.g., Conscientiousness, Neuroticism, Extraversion). Nevertheless, study 5 has offered the opportunity to examine AP at earlier stages of formal education. In that sample, students were not primarily pre-selected on the basis of their intellectual competence and accordingly the sample may be considered more heterogeneous with regard to individual differences in both personality and intellectual ability.

A perhaps more important limitation of this chapter is that, with exception of study 5, none of the studies included a measure of intelligence as predictor of AP. Thus the predictability of AP by personality could not be directly compared to that of psychometric intelligence. This means that it is not possible to find out how much of the variance in AP accounted for by personality traits is unique, at least with regard to intelligence. Nevertheless, studies 1 to 4 have shown that there is no consistent significant overlap between personality and psychometric intelligence. Rather, the data in chapter 2 suggested that personality and intellectual ability may be considered orthogonal constructs (this idea is consistent with the latest review on the area, namely Zeidner & Matthews, 2000). Accordingly, it may be expected that personality traits would have accounted for more or less the same variance in AP, even if data on intelligence had been available and hence

included in the analyses of studies 6 to 8. This hypothesis can be supported by the findings of study 5, in which personality traits were shown to account for additional variance in AP than psychometric intelligence. However it would have certainly been interesting to compare the predictive power of personality against psychometric intelligence in university students. Considering that these samples have a higher than average (and less variable) IQ, and that the predictive power of psychometric intelligence has been reported to decline at more advanced levels of formal education, it can be hypothesised that the predictive power of personality traits may approach that of psychometric intelligence (unlike it was shown in secondary school).

A final limitation concerns the omission of SAI in the studies of this chapter. In chapter 2, it was shown that SAI is an important variable in the relationship between personality traits and intellectual competence, mainly for being significantly correlated with both personality (e.g., Neuroticism, Agreeableness, Openness) as well as psychometric intelligence. Furthermore, it was suggested that SAI may be a mediating variable between personality and intelligence, therefore affecting performance on psychometric tests (see also Furnham & Thomas, 2003). It thus seems impossible to neglect that the assessment of SAI would have provided important additional information on the relationship between cognitive and non-cognitive individual differences underlying AP. Specifically, it would have provided the opportunity to test the incremental validity of SAI in the prediction of AP, as well as replicate the findings of studies 1 to 4. Since most of the data in this chapter is archival in nature, it was not possible to collect information on participants' SAI. Nevertheless, considering the initial aims of this chapter, that is, examining the relationship between personality traits and AP, it is also true that the omission of SAI in the samples of this chapter has no major implications for the main hypotheses tested.

Despite the limitations discussed above, the results of this chapter have several interesting implications with regard to the relationship between personality traits and intellectual competence, as well as important implications for the use of cognitive and non-cognitive measures in the prediction of AP. In brief, they indicate that most of the well-established personality traits (e.g., Neuroticism, Psychoticism, Conscientiousness) are significantly related to AP. Although the prediction of AP may be more accurate from the scores of an intelligent test than from the results of a personality inventory (this is certainly true in primary and secondary school), it seems clear that the best way to predict AP is to include both intelligence *and* personality measures. Further, it is likely that the inclusion of personality inventories as predictors of AP is particularly important at higher levels of formal education, such as competitive university programs. This suggests that personality traits have a significant role in the processes underlying academic achievement: a student's personality may determine, among other things, his/her study habits, achievement striving, responsibility, organisation, and ability to manage stress under examination conditions, all aspects that may be considered independent of the student's intellectual ability.

Chapter 4: Individual differences and art judgement

STUDY 9

5.1 Introduction

As noted earlier, there has been an unprecedented increase in the last decade in research on the relationship between non-cognitive and cognitive traits underlying individual differences. A paradigmatic example is that of the relation between personality traits and intellectual ability (Goff & Ackerman, 1992; Eysenck, 1994a; Matthews & Deary, 1998; Zeidner & Matthews, 2000; chapter 2). In addition, psychometric studies have also been concerned with the relation between personality traits and AP (Busato et al, 1999, 2000; De Fruyt & Mervielde, 1996; chapter 3).

Although there have been different approaches to the study of personality and intellectual ability (e.g., cognitive, biological), the predominant method has been the psychometric approach (Boyle, 1991; Ackerman & Heggestad, 1997). This is almost inevitable since personality and intelligence are both psychometric constructs *per se*; that is, both variables are part of a longstanding and well-established psychological tradition that employs psychometric tests or inventories to identify and quantify latent constructs (Spearman, 1927; Cronbach, 1949; Wechsler, 1950; Eysenck & Eysenck, 1985; Costa & McCrae, 1992). However, within the psychometric tradition there have been different alternatives to investigate the relation between personality and intelligence.

In most cases, researchers have looked at correlations between personality inventories and intelligence tests (psychometric intelligence)(e.g., Ashton, Lee, Vernon, Jang, 2000; studies 1 to 4). Thus significant correlations between, say, Neuroticism (trait anxiety), and the Raven Progressive Matrices (Raven, Court, Raven, 1980) may be

indicative of the fact that personality traits and intellectual ability are, to some extent, related. Furthermore, meta-analytical studies can provide evidence for the relationship between different personality traits (e.g., Neuroticism, Extraversion, Conscientiousness) and the general intelligence factor (g)(which results from the positive manifold between different ability tests)(see Ackerman & Heggestad, 1997). This approach has been extensively employed in the studies of chapter 2.

Mixed constructs:

Another psychometric approach to the study of the relationship between personality and intelligence (or non-cognitive and cognitive traits in general) consists in identifying mixed constructs (novel or existent); that is, psychometric identification and validation of latent variables that are a mix of both cognitive and non-cognitive traits (see Zeidner & Matthews, 2000; Hofstee, 2001). In most cases, these variables have involved new types of intelligence, such as the so-called “hot” intelligences (e.g., emotional intelligence, spiritual intelligence, practical intelligence, interpersonal intelligence)(Goleman, 1996; Sternberg, 1997; Gardner, 1999; Mayer & Salovey, 1997). These constructs may differ with regard to the specific type of ability they refer to, but they all confound non-cognitive characteristics such as motivation, emotional stability, or Extraversion (see Goleman, 1995; Petrides & Furnham, 2001). Indeed there seems no end to the “discovery” of new intelligences. Thus Gardner (1999) added “naturalistic intelligence” to his initial list of seven intelligences. There is now also a considerable interest in “spiritual intelligence”, though no clear agreement about what it is (Emmon, 2000; Mayer, 2000).

However it is often the case that researchers have attempted to validate these novel types of intelligence as ability measures rather than a mix of cognitive and non-cognitive

traits (for a detailed discussion on this topic see Petrides & Furnham, 2001). Despite this, practically none of the “hot” intelligences have been exempted from criticisms with regard to their specific assessment or measurement approaches as well as providing satisfactory evidence of incremental validity (see Davies, Stankov & Roberts, 1998).

There are other constructs that deliberately confound non-cognitive and cognitive traits from a *typical* (rather than a *maximal*) performance perspective (Cronbach, 1949). Three salient cases are learning styles (and the related concept of cognitive styles)(see Messick, 1994; Furnham, 1995), competencies (McClelland, 1973; Dulewicz & Herbert, 1999), and typical intellectual engagement (Goff & Ackerman, 1992).

The construct of learning style has its roots in the more general concept of “styles” (Wolf, 1972), and refers to broad cognitive and affective preferences with regard to the learning environment (Messick, 1994). Thus learning styles comprise both cognitive and non-cognitive individual differences that are relatively stable predictors of perceived learning, interactions and responses with regard to a given learning situation (see Furnham, 2002). Although, conceptually, learning styles may be a valid example of a mixed construct between non-cognitive and cognitive traits, the fact that they have been assessed through self-report inventories is indicative of their “proximity” to personality, rather than cognitive ability (Furnham & Steele, 1993). In fact, learning styles have been found to correlate moderately (up to $r = 0.40$) with established personality traits such as Neuroticism and Extraversion (Furnham, 1996). Furthermore, critics have argued that there is little evidence for the etiology and incremental validity of learning styles over accepted personality traits (Messick, 1994; Furnham, 1995).

A very fashionable mixed construct in the business world is that of competency. McClelland (1973) expressed dissatisfaction with the fact that together or alone ability and

personality tests could not adequately predict job success. He used the term “competence” to replace that of skill, which he believed too narrow. Thus one may have the *skill* to drive a bus, but not the *competency* to deal with passengers. Boyatzis (1982), the father of competency movement, said a competency (i.e., problem-solving, conceptualisation) was an “underlying characteristic” of a person which could be a “motive, trait, skill, aspect of one’s self-image or social role, or a body of knowledge which he or she uses”. Nearly all the researchers in the field see competencies as a useful super-ordinate category that combined (among other things) ability and personality. Despite the popularity of the concept in the business world and specifically within the Human Resources community, it has come under fire conceptually for lack of conceptual clarity (Furnham, 2000).

Perhaps the most explicit recent attempt of bridging the gap between personality and intelligence is that of typical intellectual engagement (TIE), a conceptualisation of the *typical* (as opposed to *maximal*) manifestation of intelligence. TIE was put forward to operationalise the influence of personality on the development of adult intelligence and knowledge. Although the idea that personality traits may affect the development of intellectual ability is not new (see Cattell’s, 1971/1987, “investment” theory), it was not until the development of Ackerman’s (1996) PPKI (i.e., intelligence as processes, personality, knowledge and interests) theory, and the central concept of TIE (Goff & Ackerman, 1992), that the integration of non-cognitive and cognitive individual differences occurred at an empirical as well as a theoretical level. Like Openness (factor V in the Big Five taxonomy), TIE assesses aspects of typical intelligence. Specifically the conceptualisation of TIE refers to the processes of crystallized intelligence investment. Studies have indicated that TIE (a self-report scale) is highly correlated ($r = .6$) with Openness (Goff & Ackerman, 1992; Ackerman & Goff, 1994). Furthermore, Rocklin

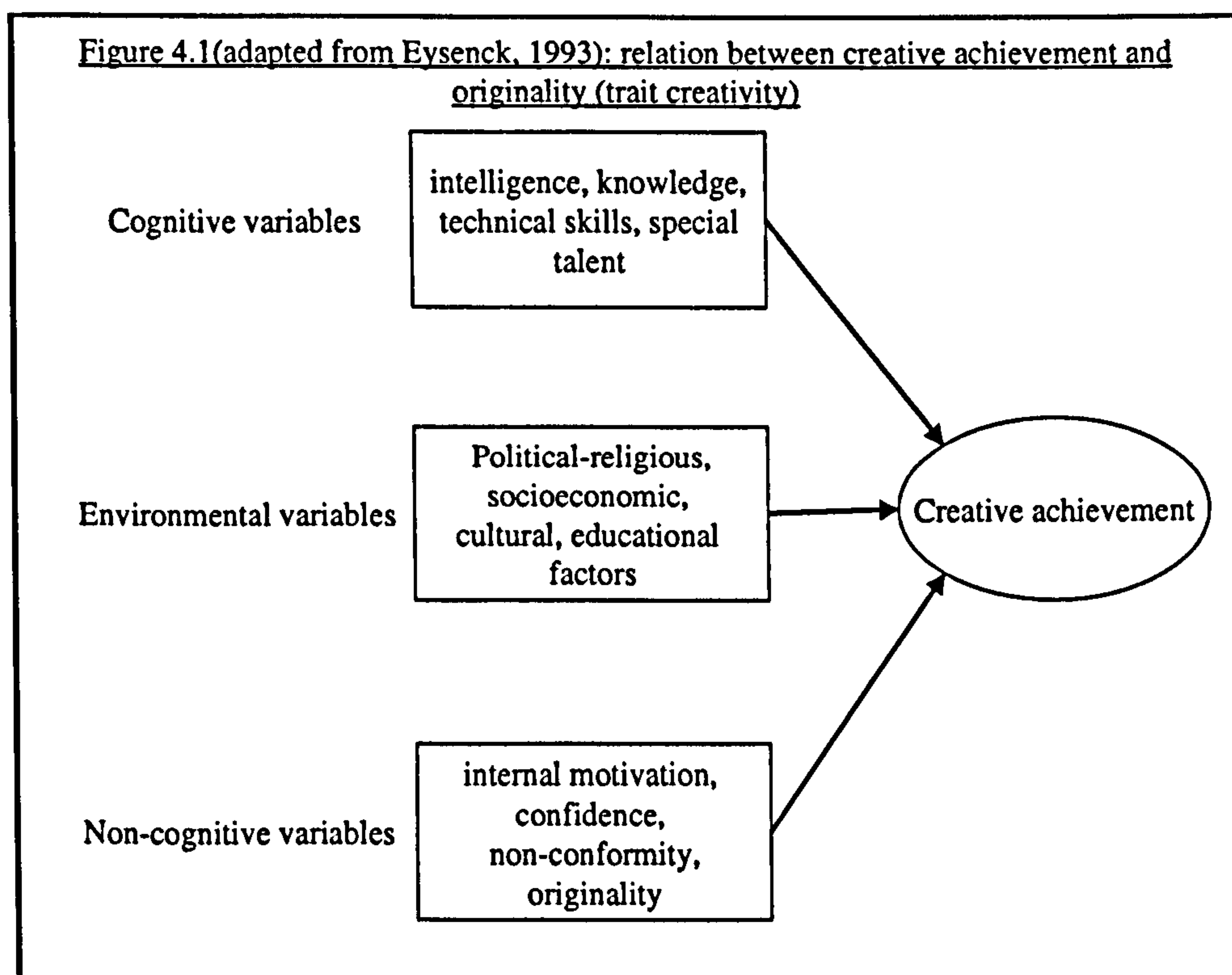
(1994) has argued that TIE and Openness are interchangeable in terms of their relations with intellectual ability. It should however be said that most researchers in the field of individual differences have seemed to agree on the conceptualisation of Openness and TIE as personality rather than intelligence (Costa & McCrae, 1992; Ackerman & Heggestad, 1997; Zeidner & Matthews, 2000; Hofstee, 2001). Thus they should be considered non-cognitive traits even when they are believed to affect the development of skills, crystallised intellect and knowledge.

Creativity:

Although several constructs that may comprise a mix of non-cognitive and cognitive traits have been examined above, it seems that some of these constructs may be rather cognitive (e.g., “hot” intelligences), other non-cognitive (e.g., learning styles, competency, TIE) in nature. Such distinction is consistent with Cronbach’s (1949) proposition that psychology should approach the measurement of cognitive traits by using *maximal* performance tests, while non-cognitive traits may be assessed by *typical* performance measures (e.g., personality inventories). Further, it may be argued that none of the above reviewed constructs has been linked to a theory that explicitly clarifies and justifies its status as a strict mix between personality and intelligence. Nevertheless, there is in the psychological literature on individual differences a longstanding construct that may be conceptualised as a product of both personality and intelligence, as well as supported by a testable theory, namely creativity (Eysenck, 1993, 1995ab).

Eysenck (1995) noted that there are two major definitions of creativity: achievement creativity, which refers to the invention of novel and socially praised products, and trait creativity/originality, the latent trait underlying creative behaviour. Individuals may be high on trait creativity and low on achievement creativity, but not vice-versa. Further,

correlations between trait and achievement creativity are usually modest in size (Eysenck, 1993). This is because achievement creativity is affected by a number of cognitive and non-cognitive factors (see Figure 4.1).



Earlier, Glover, Ronning and Reynolds (1989) noted that creativity correlated significantly with intellectual ability, but it was also *something else* than intellectual ability. Further, creativity was also significantly correlated with personality traits. Specifically, creativity correlated positively with Extraversion (notably gregariousness and cheerfulness), although several previous papers had also emphasised the link between creativity and genius with psychopathology (Lange-Eichbaum, 1931; Lombroso, 1901; Prentky, 1980). Moreover, it was suggested that (only) a certain level of Psychoticism¹ is beneficial for creativity (Eysenck, 1992b, 1993, 1995b; see also Karlsson, 1970). Statistically, the relation

between creativity and Psychoticism may range from $r = .24$ (fluency) to $r = .74$ (originality)(See Farmer, 1974; Kidner, 1978). On the other hand, the correlation between creativity and intelligence has been interpreted in terms of “the amount of intelligence needed to lay a foundation in knowledge that enables trait creativity to make a genuine contribution – to understand the fundamental problem, interpret the rules, and give solutions that are socially acceptable” (Eysenck, 1995, p. 233).

It would therefore appear that creativity does indeed fulfill the conditions to represent a mixed construct, which is a product of personality and intelligence. There are however specific psychometric problems with this concept, notably the modest correlations between trait and achievement creativity, but also the more general issue concerning the lack of reliable and valid psychometric instruments to measure creativity (particularly objective tests). Hence there is still little agreement on the notion of creativity; further, its relation to personality and intelligence has not been clarified either at a conceptual or psychometric level. Is creativity a subordinate of intelligence, or rather a component? Is it given by a combination of personality traits, or is it a distinct and orthogonal personality factor? As much as creativity has represented a challenge to psychometricians and psychologists in the last century, these questions remain largely debatable (for recent reviews and discussions see Eysenck, 1995b; Sternberg & O’Hara, 2000).

Art judgement:

Along with creativity, over the years psychologists attempted to construct and validate several tests of artistic judgement (Burt, 1933; Bryan, 1942; Burkhart, 1958; Child, 1965, Furnham & Walker, 2001ab). Whereas creativity is associated with the production of original responses, art judgement refers to appreciative skills or the ability to discern

¹ Note that in the Five Factor Model Psychoticism is represented as a combination of low Agreeableness and

between better and worse artistic works. To the extent that there is some consensus, among experts, on the quality of artistic productions (particularly the discrimination between original art products and their imitations), the assessment of art judgement may be based on correct and incorrect responses. These would present the advantage of being measures of maximal performance, and thus more reliable.

The psychometrics of art judgement date back more than seven decades, when Meier and Seashore (1929; see also Seashore, 1929), after six years of research, published an “objective measure of art talent”. This measure was designed to facilitate the identification of “promising art talents”. Although Meier and Seashore conceived art as a general ability complex (comprising more than 20 different but related traits), they regarded aesthetic or artistic judgement as a basic and indispensable component, which all gifted artists should possess in highly developed manner. The test consists of pairs of pictures that differ in one feature. This feature is indicated to the participant in the instructions. One of the pictures is “real” (corresponds to an original work of art and has been rated as such by experts of the arts), the other represents a simple variation of the original. Participants are given the task to identify the “better” (original) design.

Although early studies have reported on the predictive (Eurich & Carroll, 1931) and cross-cultural (Stolz & Manuel, 1931) validity of Meier and Seashore’s (1929) test, researchers expressed concern about its poor relationship to psychometric intelligence (see Carroll, 1932; see also Stolz & Manuel, 1931). Naturally, if art judgement is to be conceived as an objective measure of ability, it must bear a certain degree of association with well-established psychometric intelligence tests. This led Carroll (1932, 1933) to question the nature and meaning of the construct of art judgement.

However Meier presented a modification of this test, the Meier art judgement test (Meier, 1940). This version was believed more reliable and valid than its antecessor, the Meier-Seashore (1929). The Meier art test kept the 100 most discriminating of the 125 original items of the Meier-Seashore. Of these, 25 have been assigned double weight in scoring. Thus the Meier art judgement also allows for a shorter administration time. Nevertheless, research on the Meier art judgement test has been limited (e.g., Furnham & Rao, 2002). In a recent study, Furnham and Rao (2002) found that art judgement as measured by the Meier test was not significantly related to aesthetic judgements of Mondrians or Hirst (which the authors presented alongside facsimiles). It was suggested that art judgement as measured by the Meier test may only apply to representational art. Interestingly, however, scores on the Meier test were significantly predicted by personality (specifically the Big Five traits of Openness and Conscientiousness).

The present study will examine the relationship between the Maitland Graves Art test (JDT) with personality traits (Big Five), psychometric intelligence (Wonderlic Personnel Test), and previous art experience. In one of the few studies to explore the relationship between personality and artistic judgement, Eysenck (1972) found no correlation between the JDT and the Gigantic Three (Neuroticism, Extraversion and Psychoticism) personality dimensions. In the present study, personality will be assessed in terms of the Big Five (Costa & McCrae, 1992), which include the Openness to Experience and Conscientiousness traits. Several hypotheses can be stated:

H1: There will be significant associations between personality traits and JDT scores. Specifically, it is expected that:

H1a: There will be significant associations between JDT and Openness to Experience. This would be consistent with McCrae and Costa's (1997a) conceptualisation

of high Openness as a characteristic of artists: “As neurotics can be used as exemplars of high scores on the dimension of Neuroticism, so artists can be considered primer examples of individuals high in Openness to Experience” (p. 825). One may thus expect that Openness would be positively related with JDT because, over time, interests in art (which are manifest in high Openness scorers) would increase knowledge, “taste” and discriminability in art.

H1b: Conscientiousness will be significantly related to JDT scores. The negative relationship between Conscientiousness and JDT scores is predicted in terms of the “conservative” taste of highly conscientious individuals. In a recent study by Furnham and Walker (2001b), Conscientiousness was linked to liking of representational rather than modern) art. Given the modern nature of the JDT, it could be expected that less conscientious participants would be more likely to prefer the slides in the employed tests and thus be more likely to distinguish between correct and incorrect figures. Further, Furnham and Walker’s (2001a) study showed “sensation-seeking” to be a powerful predictor of art judgement. Given that Conscientiousness is negatively related to sensation seeking (as well as a number of other constructs that may be conceptualised as positive correlates of art judgement ability, such as Psychoticism and creativity)(see Eysenck, 1992c), negative associations between JDT scores and Conscientiousness are predicted. Finally another reason to expect Conscientiousness to be negatively related to the JDT is that several recent studies reported negative correlations between Conscientiousness and ability tests (see for instance study 1; Moutafi, Furnham & Patiel, 2003). Hence the prediction that JDT scores (which reflect the ability to discern between correct and incorrect artistic designs) would be negatively related to Conscientiousness.

H2: There will be a significant positive correlation between scores in an intelligence

test and scores on the JDT. Burkhart (1958) noted that there is a significant link between intelligence test scores and scores in art ability. Further, if art judgement is to be conceived as a mixed construct, comprising both cognitive and non-cognitive individual differences, it is ought to relate to personality traits (see H1) as well as cognitive ability.

H3: Recent studies have demonstrated the perhaps self-evident point that aesthetic preference is related to art education and experience. It was therefore anticipated that art education, knowledge and interest would be directly correlated with art judgement. To measure the former, three sets of questions will be asked: nine questions on art interest/education; three questions on art activities; and one on the extent to which participants know about a dozen specific art styles (e.g., Cubism, Surrealism).

5.2 Method

Participants: In all there were 74 participants, of which 28 were male and 46 were female. Age ranged from 18 to 24 (SD = 2.23) years. Demographic variables (e.g., annual income, political ideas, and religiousness) were dismissed from the analysis for the sample was very homogeneous on these variables. Participants were first year students of the University of London, and took part in this study as part of their course-work.

Measures: Each participant completed four measures.

1. Personality. NEO Five-Factor Inventory (FFI) Form S (Costa & McCrae, 1992).

As in study 6.

2. Intelligence. The Wonderlic Personnel Test (WPT) (Wonderlic, 1992). *As in study 1.*

3. Art Judgement. The Maitland Graves Design Judgement Test (Graves, 1948).

This test involves showing participants 90 slides, mostly but not exclusively in pairs and

asking them to indicate their preference. For each pair of slides, there was always a correct answer that corresponded to the “better” design in the slide. Thus there is always a correct response for each slide. Each slide was shown for approximately 45-60 seconds. All slides are in black, white, and green and contain regular and abstract figures. The validity of the test is discussed in the introduction. The reliability of the scale was $\alpha = .78$.

4. Art experience. This was a one-page questionnaire drawn up specifically for this study. The three parts are described in the ‘results’ section.

Procedure:

Soon after arriving at university, students participated in an assessment afternoon at which they completed personality and intelligence tests. Approximately eight weeks later, they completed the Graves Maitland Judgement Design Test (Graves, 1948), as well as the one page questionnaire on previous art experience. Students were tested simultaneously in a large lecture theatre in the presence of several test administrators were present to ensure a proper test administration.

5.3 Results

a) Art interests: A total of 9 items were subjected to Principal Components Analysis and yielded a single factor that was labeled *Art interests*. Extraction of this factor was based on the results of a scree tests of Eigenvalues. Factor scoring was computed via the Anderson-Rubin Method. Table 4.1 exhibits the items, affirmative response frequencies, and component matrix for this solution. As can be observed, all factor loadings were larger than .44, suggesting all items were significantly positively related.

b) Art activities: for the second part of the questionnaire, a second factor (Principal

Components) analysis was carried out and a single factor was extracted which we labeled *Art activities*. This factor comprised the three items: “how often do you visit art galleries?”, “how often do you visit art shops?”, and “how often do you buy pictures?”. Table 4.2 presents the component matrix and frequency of responses for this factor. It should be noted that all loadings were rather high and positive, but still below multicollinearity levels.

Table 4.1 Items, affirmative response frequency, and Component Matrix for Art interests

Items (Questions)	Eigenvalue	Yes	Factor loading
1. Would you say you were an artistic person?	3.42	42%	.78
2. Would you say you had an eye for paintings?		48%	.68
3. Have you ever formally studied art?		62%	.66
4. Do you believe you can draw better than the average person?		43%	.64
5. Do you have Art GCSE (O level) (= 10 th grade) ?		33%	.63
6. Do you have Art A level (= 12 th grade) ?		8%	.59
7. Would you say you were a creative person?		64%	.57
8. Do you currently paint at all?		20%	.52
9. Do you ever read art books?		31%	.45

Reliability analysis of the scale $\alpha = .79$

Table 4.2 Component Matrix and response frequencies for Art activities

How often do you:	Practical ly never	Every few years	Once a year	Once every 6 months	Once a month	Eigenvalue	Factor loading
Visit Art Shops?	10%	34%	16%	25%	12%	2.00	.89
Visit Art Galleries?	18%	25%	22%	10%	23%		.79
Buy pictures?	7%	22%	14%	26%	29%		.76

Reliability analysis of the scale $\alpha = .75$

c) Art knowledge: A total of 12 ratings from the knowledge of art styles were subjected to Principal Components Analysis. The question they were asked was whether they knew a dozen different art styles. Based on the results of a scree test of Eigenvalues, a single factor was obtained. This factor was labeled *Art knowledge* and scored via the Andersson-Rubin method. Table 4.3 exhibits frequencies of affirmative responses and the component matrix for this solution.

Table 4.3 Factor Component Matrix and affirmative response frequencies for Art knowledge

	Do you know?	Eigenvalue	Factor loading
Pop-art	40%	4.56	.70
Cubism	35%		.62
Modernism	34%		.60
Abstract	41%		.55
Art nouveau	20%		.53
Surrealism	53%		.51
Post impressionism	19%		.51
Pre-Raphaelite	13%		.49
Post-modern	16%		.49
Expressionism	47%		.48
Impressionism	30%		.43
Dada	15%		.41

Reliability analysis of the scale $\alpha = .77$

Table 4.4 presents the intercorrelations for the Big Five personality traits, intelligence (as measured by the WPT), art background, activities, and knowledge, and scores on the Judgement Design test (JDT). Openness to Experience was significantly correlated with art background ($r = .40, p < .01$), activities ($r = .48, p < .01$), and knowledge ($r = .47, p < .01$). However, the correlation between Openness to Experience and JDT was not significant. Further, correlations between JDT and Conscientiousness were not significant. H1a and H1b were thus not confirmed. On the other hand, Conscientiousness was negatively correlated with art recognition ($r = -.23, p < .05$), art activities ($r = -.18$), and JDT ($r = -.18$), though the last two correlations did not reach significance levels. Finally, JDT was significantly correlated with intelligence ($r = .28, p < .05$) (which confirmed H2), and Extraversion ($r = .31, p < .01$) (which partly confirmed H1). Art background, activities, and knowledge were not significantly related to JDT. This did not support H3. However, these three scales were highly intercorrelated ($r = .46$ to $r = .55$). Hence, a fourth factor analysis was carried out on these scales.

Table 4.4: Intercorrelations between Big Five, WPT, art background, activities, and knowledge, and JDT.

	N	E	O	A	C	WPT	Art interests	Art activities	Art knowledge
Extraversion	-.57**								
Openness	-.11	.40*							
Agreeableness	.06	-.03	.00						
Conscientiousness	-.12	.13	-.07	-.01					
WPT	-.13	.19	.06	-.05	-.10				
Art interests	.06	.01	.40**	-.03	-.09	-.02			
Art activities	.10	.06	.48**	-.12	-.18	.03	.55**		
Art knowledge	.06	.09	.47**	.01	-.23*	.06	.51**	.46**	
JDT	-.11	.31**	.11	-.03	-.18	.28*	.05	.12	.01

**p < .01, *p < .05 N = Neuroticism, E = Extraversion O = Openness A = Agreeableness C = Conscientiousness

d) Art experience: Art interests, activities, and knowledge were factor-analysed via Principal Components Analyses and the simplified solution yielded a single factor which was labeled *Art experience*. Table 4.5 presents the component matrix for this solution.

Table 4.5 Component Matrix for Art-trait

	Eigenvalue	Art experience
Art interests	2.03	.84
Art activities		.82
Art knowledge		.79

Reliability analysis of the scale $\alpha = .75$

Finally, a series of hierarchical regressions were performed to investigate how personality (NEO-FFI), intelligence (WPT), art judgement (JDT) and gender predict art interests, activities, knowledge, and the more general factor art experience (these four variables were used as dependent variables). Furthermore, it was also tested whether personality, intelligence, and gender could predict JDT scores.

The first regression showed that Big Five accounted for 15.5% of the variance in art interests ($F(5, 65) = 3.56, p < .01, \text{Adj. } R^2 = .15$). Openness to Experience was the only significant predictor in the model ($\text{st.}\beta = .50, t = 4.07, p < .01$).

The second regression showed that the Big Five accounted for 25.7% of the variance in art activities ($F(5, 65) = 5.84, p < .01, \text{Adj. } R^2 = .26$). Openness to Experience was again the only significant predictor in the model ($\text{st.}\beta = .55, t = 4.73, p < .01$).

Table 4.6 St. β coefficients and t values for the predictors of the Hierarchical Regressions

	Art interests		Art activities		Art knowledge		Art experience		JDT	
	st. β	t	st. β	t	st. β	t	st. β	t	st. β	t
N	-.02	.17	.07	.52	.08	.61	.05	.40	.07	.50
E	-.24	1.47	-.20	1.27	-.02	.14	-.19	1.30	.31	1.89*
O	.51	4.03**	.55	4.63**	.48	3.89**	.63	5.54**	-.04	.37
A	-.06	.50	-.13	1.23	-.00	.00	-.08	.76	-.04	.33
C	-.06	.52	-.10	.89	-.19	1.62	-.14	1.32	-.23	1.86*
F (5, 64)	3.56**		5.84**		4.73**		7.90**		1.95	
Adj. R^2	.15		.26		.21		.33		.06	
WPT	-.01	.08	-.02	.17	.04	.38	.01	.05	.20	1.74
F (6, 63)										2.15*
Adj. R^2										.09
JDT	-.09	.73	.07	.65	-.08	.70	-.04	.37		
F (7, 62)	2.55*		4.13**		3.40**		5.04**			
Adj. R^2	.13		.24		.19		.29			
Gender	.10	.82	.00	.02	-.03	.23	.03	.29	.11	.90
F (8, 61)	2.31*		3.56**		2.93**		4.35**		1.95	
Adj. R^2	.13		.23		.18		.28		.09	

** $p < .01$, * $p < .05$, N=Neuroticism, E=Extraversion, O=Openness, A=Agreeableness, C=Conscientiousness

5.4 Discussion

This study had three sets of hypotheses. The first examined the relationship between personality traits (NEO-FFI) and art judgement (JDT). Contrary to expectations, art judgement was significantly (positively) related to Extraversion rather than Openness to

Experience. Previous studies on art preference, as opposed to judgement, have identified Extraversion as a relevant variable (Furnham & Avison, 1997; Furnham & Walker, 2001a). On the other hand, as predicted, Conscientiousness was (negatively) related to art judgement. This is in line with the idea that conscientious individuals have a “conservative” (rather than a modern) taste for art (Furnham & Walker, 2001b). Given the modern nature of the JDT, it was expected that less conscientious participants would be more likely to distinguish between correct and incorrect figures. Further, the present studies are also in line with Furnham and Walker’s (2001a) finding regarding “sensation-seeking” as a positive predictor of art judgement. Moreover, the fact that Conscientiousness was a negative predictor of JDT scores is also consistent with recent studies reporting negative correlations between Conscientiousness and ability tests (see for instance study 1; Moutafi, Furnham & Patiel, 2003).

The second set of hypotheses concerned the relationship between psychometric intelligence and art judgement. Correlational data (Table 4.4) confirmed the hypothesis of a significant positive correlation ($r = .28$) between these two variables. However, when the predictability of art judgement by intelligence was tested, regression analysis (see Table 4.6) narrowly missed significance ($p = .06$). This indicates that personality traits are better predictors of art judgement than cognitive ability.

Perhaps the most robust finding concerns the relationship between personality traits (notably Openness to Experience) and the three art variables: interests, activities, and knowledge, but notably art experience in general. Three things are important with respect to these results. First the factor analytic results showed the three areas internally coherent. People who study and practice art got high scores for art interest; those who visited art shops and galleries regularly and bought pictures got high scores for art activities; while those who

claimed to be able to recognize a dozen art styles (from abstract and dada to Pre-Raphaelite) obtained high scores in art knowledge. Predictably these three variables were closely inter-related ($r = .46$ to $r = .55$) and loaded onto a general factor which was labeled art experience. However the regression showed that neither gender, intelligence, nor art judgement predicted any of the three scores. Further, only one of the five personality variables was a significant predictor though it was a major one. In all the regression analyses (see Table 4.6) Openness to Experience was the most significant predictor. Whilst this is consistent with many previous studies that found that this was the major Big Five predictor of art preference (Furnham & Avison, 1997; Furnham & Walker, 2001ab; Rawlings, Twomey, Burns & Morris, 1998; Rawlings, Barrantes & Furnham, 2000), in the present study the size of the correlations, particularly that between Openness to Experience and art experience, was roughly twice the size of those in previous studies. In this study Openness to Experience accounted for more than 33% of the variance in art experience. Previous studies examining Openness to Experience at the super (Furnham & Walker, 2001a) or primary (Rawlings et al, 2000) factor level, have indicated clear relationships but where the amount of common variance was considerably less than in these studies. Studies in this area fall into three categories: individual difference correlates of art preferences, art judgement, and art interests. Nearly all of the studies done over the last decade have concerned art preference where it has been demonstrated that factors associated with Openness to Experience and sensation seeking are related to art preference. The present study provided additional evidence for the relation of personality with previous art experience. It should however be noted that the relatively higher correlations found in the present sample (as compared to previous studies that examined art *preference* rather than *experience*) may be an artifact of the common psychometric properties of the NEO-FFI and

the art experience questionnaire, both of which are self-report instruments. There has been much less work in art judgement and art interests. This study has clearly shown that whereas Openness to Experience is a good predictor of art interests it does not predict art judgement.

STUDY 10

5.5. Introduction

The beginnings of research in art judgement date back seven decades, when Meier and Seashore (1929; see also Seashore, 1929) published their “objective measure of art talent”. This measure was designed to facilitate the identification of “promising art talents”. Although Meier and Seashore conceived art as a general *ability* complex (comprising more than 20 different but related traits), studies and paradigms on creativity (notably Eysenck, 1993, 1995ab) suggested that personality traits may also be significantly related to art judgement (for a detailed discussion see study 9). Given the current interest in identifying links between cognitive and non-cognitive constructs (see chapter 1; see also Ackerman, 1996, 1999; Ackerman & Heggestad, 1997), an investigation of art judgement, a possible mixed construct comprising both individual differences in personality *and* intelligence, seems important.

Study 9 showed that intelligence was a significant predictor of art judgement, as measured by the Graves-Maitland art judgement test. Like the Meier-Seashore, this test is based on participants’ discrimination/identification of the better designs. The Maitland Graves test has attracted wide attention to determine its validity (Eysenck, 1967; 1970; 1972; Pichot, Volmat & Wiart, 1960; Uduehi, 1996). Further, Gotz and Gotz (1974) found that 22 different arts experts (designers, painters, sculptors) had .92 agreement on choice of preferred design, albeit being critical of them.

In study 9 it was found that intelligence (as measured by the Wonderlic Personnel Test: Wonderlic, 1992) was significantly associated with art judgement, but not with art experience (as defined by the responses of a self-report scale of artistic background designed by the authors). Further, the authors also looked at the relation between art judgement and personality (Big Five: Costa & McCrae, 1992). Results showed that two personality traits, namely Conscientiousness (negatively) and Extraversion (positively) were significant predictors of art judgement. The clearest finding in study 9 concerned the relationship between personality traits (notably Openness to Experience) and art experience. In several regressions, Openness was found to account for up to 33% of the variance in art experience.

Although in study 9 the correlations between personality traits and art experience (background) seem to suggest, that personality traits (notably Openness) may be relevant to the processes of artistic engagement, it remains questionable whether art judgement should be considered a measure of intelligence or personality. Perhaps the significant correlation of art judgement with both personality and intelligence may be indicative that art judgement is a measure of both non-cognitive and cognitive traits.

Given the current interest on the relationship between personality and intelligence (particularly in identifying mixed constructs that comprise both cognitive and non-cognitive individual differences), the present study will attempt to replicate the relationship between personality traits, psychometric intelligence, and art judgement. Furthermore, these variables will also be examined with regard to art interests and TIE. In this study the Meier art judgement test will be employed (Meier, 1940). This test contains 100 slides, each of which comprises a pair of art figures that differ in only one feature. Like in Graves' art judgement test, one of the figure corresponds to an original model (or "better" design, as

determined by experts' consensus), and participants must try to identify it (see Method section for details, e.g., validity and reliability, on this test).

Another addition to this study is the inclusion of the TIE scale (Goff & Ackerman, 1992). Considering that personality-intelligence interactions may be also understood in terms of typical, as opposed to maximal, performance, the TIE scale may provide additional information about the relation between art judgement and investment aspects of personality. Further, given the close association between TIE and Openness, it would be interesting to test whether these traits are interchangeable with regard to their relation to art interests and art judgement. Hence several hypotheses will be tested:

H1: there will be significant and positive correlations between Openness to Experience and the three indicators of art interests. Openness would be positively associated with art education, galleries visited and art recognition. These correlations would replicate the results of study 9 as well as confirm McCrae and Costa's (1997a) conceptualisation of Openness as a measure of the artistic aspects of personality (see also Costa & McCrae, 1992).

H2: TIE will be significantly and positively correlated with art interests. This would be consistent with the high correlation between TIE and Openness to Experience (Rocklin, 1994). Nevertheless, it is particularly interesting to test whether art interests are significantly related to TIE, which a) also includes aspects of Conscientiousness, b) does not comprise items referring specifically to engagement in artistic activities (see Goff & Ackerman, 1992).

H3: art interests will be significantly and positively related to art judgement. This

would confirm the results of study 9. Further, the significant relation between art judgement and self-report art interests may be indicative of the construct validity of the former. To the extent that the Meier test distinguishes between potential artists and other respondents (Seashore, 1929), higher art judgement scores are expected to report more interests in arts.

H4: art judgement scores will be significantly and positively correlated with psychometric intelligence (both Wonderlic and Raven). These correlations would replicate the significant relation between psychometric intelligence and art judgement found in study 9. Moreover, since art judgement is measured through objective performance (correct and incorrect items), and is considered a test of ability, it would be expected to correlate with the Wonderlic and Raven tests, two well-established measures of maximal performance and intellectual ability.

H5: psychometric intelligence will not be significantly related to art interests. This hypothesis is based on the results of study 9 as well as Cronbach's (1949) distinction that intelligence is related to maximal performance, while personality would be more associated with typical performance (see also Goff & Ackerman, 1992).

H6: art judgement will be also significantly related to personality traits. Specifically, it is expected to find (H6a) positive correlations between art judgement and Extraversion, and (H6b) negative correlations between art judgement and Conscientiousness. These correlations would replicate those found of study 9. Further, negative associations between art judgement and Conscientiousness would also be in line with the negative relation between this personality trait and psychometric intelligence on one hand (study 1), and

creativity on the other (Furnham, 1999; see also Eysenck, 1993, 1994b, 1995b, where creativity is positively associated with Psychoticism, a negative correlate of Conscientiousness). Although Openness and TIE are expected to be significantly correlated with art interests (H1 & H2), these personality traits are not expected to be significantly related to art judgement: this is based on the findings of study 9, who showed that Openness was significantly related to art interests, but not to art judgement.

H7: art judgement will be significantly predicted by psychometric intelligence (both Wonderlic and Raven). This will be tested through several regression models in order to further confirm H4 and replicate the results of study 9.

H8: personality will show (non-trivial) incremental validity in predicting art judgement. This will be tested through hierarchical regressions, in that personality traits will be added to psychometric intelligence in the predictive block as predictors of art judgement. Again, this would be replicative of the findings in study 9.

H9: personality will show predictive validity with regard to art interests. This is expected mainly in terms of the significant and positive relation between Openness and TIE with art interests (see H1 and H2). Thus Openness and TIE will be significant predictors of art interests.

5.6 Method

Participants

Participants were 102 (78 females and 24 males) 1st year Psychology students from University College London. Age ranged from 18 to 24 (SD = 1.31) years. Students participated in this study as part of their course-work and received individual feedback on

their test results.

Procedure

Soon after arriving at university, students participated in an assessment afternoon at which they completed several psychometric tests including the NEO-PI-R (Costa & McCrae, 1992), the Wonderlic Personnel Test (Wonderlic, 1992) and the Raven Progressive Matrices (Raven, Raven & Court, 1998). Approximately eight weeks later, they completed the Meier art judgement test (Meier, 1940), as well as a one-page questionnaire on art interests, art activities and art preferences. Students were tested simultaneously in a large lecture theatre where they were shown a total of 100 slides, each containing at least a pair of figures (designs). For each pair of slides, there was always a correct answer that corresponded to the “better” (correct or real) design in the slide. Each slide was shown for approximately 45-60 seconds. Six demonstrators were present to ensure a proper test administration.

Measures

a) NEO-PI-R (Costa & McCrae, 1992). As in study 1.

b) Typical Intellectual Engagement (TIE)(Goff & Ackerman, 1992). This construct was assessed through the 59-item inventory developed by Goff and Ackerman (1992). Participants respond on a 6 point Likert scale and high scores represent their desire to engage in intellectual activities (e.g., arts, music, philosophical discussions, problem solving).

c) The Meier art judgement test (Meier, 1940). This test involves showing participants 100 slides, mostly but not exclusively in pairs and asking them to indicate

which of the figures the “better” (real) one is. Figures always differ in one feature and an original figure is presented against a copy (or sometimes two). All slides are in black, white, and green and contain regular and abstract figures. The validity of the test is acceptable and has been thoroughly discussed elsewhere (Meier, 1940; see also Seashore, 1929; Hevner, 1933). Reliability coefficients in this study were high ($\alpha = .88$).

d) Art interests. This was a one-page questionnaire drawn up specifically for this study. The three sections of the questionnaire are described in the Results section. Data reduction was performed on the questionnaire responses via three Principal Components analyses (one per section) and a total of four factors were obtained, namely art experience, music experience, art activities and art recognition (details of the factor analyses are shown in the Results section). These four variables were further factor-analysed to obtain a general art interests factor.

e) Raven’s Standard Progressive Matrices. (Raven, Raven & Court, 1998). As in study 3.

f) The Wonderlic Personnel Test (WPT) (Wonderlic, 1992). As in study 1.

5.7 Results

Factor analyses:

Art and music experience: A total of 12 items were subjected to Principal Components Analysis and yielded a two-factor solution that accounted for 48% of the variance. Extraction of the two factors was based on the Eigenvalues and the results of a scree test. Oblimin rotation with Kaiser Normalisation was performed to obtain two oblique

factors. Factors were labeled “art experience” (accounted for 32% of the variance) and “music experience” (accounted for 16% of the variance). Factor scoring was computed via simple addition. Table 4.7 exhibits the items, affirmative response frequencies, reliability coefficients, and pattern matrix for this solution. As can be observed, all factor loadings were larger than .54, indicating high and positive loadings onto the factors. The correlation between art experience and music experience was $r = .29, p < .05$.

Table 4.7 Items, affirmative response frequency, and Factor Pattern Matrix for art and music experience

Items (Questions)	Item #	Yes	Factor Loadings	
			Art experience	Music experience
Do you have an Art A level?	4	18%	.78	
Do you have an Art GCSE (O level)?	3	41%	.76	
Do you ever read Art books?	9	29%	.66	
Would you say you have an eye for paintings?	7	42%	.65	
Do you currently paint at all?	10	22%	.63	
Have you ever formally studied art?	1	50%	.63	
Would you say you are an artistic person?	6	51%	.58	
Do you believe you can draw better than the average person?	11	39%	.57	
Do you more about ballet than the average person?	5	33%		.71
Do you play any musical instrument?	2	25%		.62
Are you keen on opera?	12	17%		.58
Do you often listen to classical music?	8	20%		.54
Eigenvalues			3.84	1.87
Percentage of variance accounted for by each factor			32%	16%
<i>Reliability analysis of the scales (Cronbach's α)</i>			.81	.76

Art activities: for the second part of the questionnaire, a second factor analysis (Principal Components) was performed on the data resulting in the extraction of a single factor. As in study 9, this factor comprised the three items “how often do you visit art galleries?”, “how often do you visit art shops?”, and “how often do you buy pictures?”, and was labeled “art activities”. This factor was found to account for 70% of the variance and was scored by simple addition of the three items (reliability analysis of the scale showed an acceptable Cronbach's α of .78). Table 4.8 presents the pattern matrix and frequency of

responses for this factor.

Table 4.8 Factor Pattern Matrix and response frequencies for art activities

How often do you:	Practically never	Every few years	Once a year	Once every 6 months	Once a month	Art activities
						Factor Loadings
Visit Art Shops?	10%	34%	16%	25%	12%	.89
Visit Art Galleries?	33%	21%	18%	20%	9%	.81
Buy pictures?	35%	22%	19%	20%	5%	.76

Reliability analysis of the total scale $\alpha = .78$

Art recognition: A total of 14 ratings from the recognition of art styles questionnaire were subjected to Principal Components Analysis. The question they were asked was whether they would be able to recognise (yes/no response scale) each of the 14 listed different art styles (e.g., cubism, pop art). Based on the results of a scree test and the Eigenvalues, a single factor was obtained. This factor was labeled “art recognition” and scored by simple addition. The factor was found to account for 50% of the variance and the reliability of the scale was $\alpha = .74$. Essentially a high score indicates self-confidence in art knowledge. Table 4.9 exhibits frequencies of affirmative responses and the pattern matrix for this solution.

Table 4.9 Factor Pattern Matrix and affirmative response frequencies for art recognition

	Would recognise	Art recognition
		Loadings
Baroque	25%	.76
Pop art	28%	.76
Expressionism	20%	.75
Cubism	39%	.74
Post-impressionist	47%	.73
Impressionism	63%	.73
Modernism	29%	.72
Art Nouveau	34%	.70
Realism	22%	.70
Dada	27%	.68
Post-modernist	47%	.68
Pre-Raphaelite	16%	.67
Surrealist	45%	.67
Rococo	30%	.65

Reliability analysis of the total scale $\alpha = .77$

Art interests: Finally, the four obtained factors from the questionnaire on art interests (i.e., art experience, music experience, art activities, and art recognition) were factor-analysed and a single factor was obtained via Principal Components Analysis. This factor was labeled “art interests”, and accounted for 50% of the variance. High scores thus indicate training and self-reported knowledge of fine art. Art interests scores were computed via the Regression method. Table 4.10 presents the factor correlation matrix and loadings for this solution.

Table 4.10 Factor Pattern Matrix for art interests

	Art interests
	Loadings
Art activities	.84
Art experience	.81
Art recognition	.59
Music experience	.50

Reliability analysis of the total scale $\alpha = .74$

Correlations:

Table 4.11 presents the correlations between the personality traits (Big Five and TIE), intelligence (Wonderlic and Raven scores) and the four indicators of art interests (art experience, music experience, art activities, and art recognition). As expected (H1), there were significant correlations between Openness to Experience and art experience ($r = .28, p < .01$), music experience ($r = .26, p < .01$), art activities ($r = .43, p < .01$), and art recognition ($r = .34, p < .01$). The correlation between Openness and the general factor of art interests was $r = .46, p < .01$. Also predicted (H2) were the significant correlations between TIE and art experience ($r = .21, p < .01$), music experience ($r = .35, p < .01$), art activities ($r = .35, p < .01$), and art recognition ($r = .20, p < .01$). TIE and art interests correlated by $r = .39, p <$

.01. Thus Openness and TIE were both positively and consistently correlated with indicators of art interests.

Table 4.11 Correlations between intelligence, personality traits and indicators of art interests.

	Art experience	Music experience	Art activities	Art recognition	Art judgement
Wonderlic	-.24*	-.01	.00	.02	.30**
Raven	.03	.23*	-.09	.09	.34**
Neuroticism	.10	.06	.06	.08	.24*
Extraversion	-.05	.02	.08	-.07	-.26**
Openness	.28**	.26**	.43**	.34**	.14
Agreeableness	-.17	-.12	-.13	.04	-.11
Conscientiousness	-.07	-.10	-.08	-.07	-.26**
TIE	.22*	.35**	.35**	.20*	.08

* $p < .05$, ** $p < .01$

N = 102

Regarding the relationship between indicators of art interests and art judgement scores, results partly confirmed that (H3) there would be significant correlations between art judgement and indicators of art interests. Specifically, this was confirmed by the significant correlations between the art judgement test and art activities ($r = .26$, $p < .01$), and art recognition ($r = .25$, $p < .05$), but not by the non-significant correlations between art judgement scores and art experience ($r = .15$, $p = .13$) on one hand, and music experience ($r = .03$, $p = .75$) on the other. However the correlation between art judgement scores and art interests was highly significantly ($r = .26$, $p < .01$). H3 was therefore confirmed.

With regard to the relation between art judgement and intelligence, correlations confirmed the initial prediction (H4) that art judgement test scores would correlate significantly and moderately with Wonderlic ($r = .30$, $p < .01$) and Raven ($r = .34$, $p < .01$) scores. Thus art judgement was significantly related to both general and fluid intelligence.

There were also significant correlations between art experience and Wonderlic scores ($r = -.24, p < .01$), and between music experience and Raven scores ($r = .23, p < .01$). The correlation between intelligence scores and the general factor of art interests was $r = .14, p = .16$ for Raven, and $r = -.11, p = .27$ for Wonderlic scores. Thus art interests were not significantly related to psychometric intelligence. These results confirmed H5.

Concerning the relation between art judgement and personality traits (Big Five and TIE), these results showed that art judgement scores were significantly correlated with Neuroticism ($r = .24, p < .05$), Extraversion ($r = -.26, p < .01$), and Conscientiousness ($r = -.26, p < .01$). This did not confirm that (H6a) extraverts would out-perform introverts on the art judgement test (on the contrary, it was found that introverts were significantly better in art judgement than extraverts); however correlations did confirm that (H6b) less conscientious participants would perform better in the test than conscientious participants. Although Neuroticism was positively and significantly related to art judgement, no predictions had been made with regards to this relationship. On the other hand the predictions that (H6c) Openness and (H6d) TIE would not be significantly related to art judgement were also confirmed by the present results. The correlation between art judgement scores and Openness was $r = .14, p = .15$, and that between art judgement and TIE was $r = .08, p = .42$.

In order to further explore the significant correlates of art judgement, correlations between art judgement scores and the sub-facets of Neuroticism, Extraversion and Conscientiousness (i.e., the three main personality factors that were significantly correlated with art judgement) were also computed. Results are presented in Table 4.12.

Partial correlations were also computed to test whether personality traits would be significantly correlated with art judgement even when controlling for psychometric intelligence. Further, correlations between psychometric intelligence and art judgement partialing out personality traits were also calculated (in order to test whether psychometric intelligence would still be significantly related to art judgement when controlled for personality). Results showed that Neuroticism ($r = .29, p < .01$), Extraversion ($r = -.32, p < .01$), and Conscientiousness ($r = -.30, p < .01$) were still significantly correlated with art judgement scores when Raven and Wonderlic scores were partialled out. Thus personality and intelligence were both found to account for a significant amount of unique variance in art judgement.

Table 4.12 Correlations between the sub-facets of the significant Big Five correlates of art judgement.

N sub-facets Art judgement		E sub-facets art judgement		C sub-facets art judgement	
anxiety	.19	warmth	-.19	competence	-.33**
anger-hostility	.19	gregariousness	-.28**	order	-.08
depression	.24*	assertiveness	-.24*	dutifulness	-.21*
self-conscious.	.14	activity	-.09	achiev.-striv.	-.11
impulsiveness	.09	excitement	-.03	self discipline	-.23*
vulnerability	.25*	posit. emotions	-.18	deliberation	-.23*

* $p < .05$, ** $p < .01$ N = 102

A final series of partial correlations was calculated to test whether personality traits and psychometric intelligence would be significantly correlated with art judgement when controlling for art interests. It was found that Neuroticism ($r = .23, p < .05$), Extraversion ($r = -.26, p < .01$), Conscientiousness ($r = -.25, p < .05$), Wonderlic ($r = .33, p < .01$) and Raven ($r = .34, p < .01$) were all still significantly related to art judgement when controlling for art interests.

Regressions:

A total of four hierarchical regressions (see table 4.13) were performed on the data to test the predictability of art judgement, art experience, art activities, and art recognition by personality (Big Five and TIE) and intelligence (Wonderlic and Raven scores).

In the first regression, Model 1 included Wonderlic and Raven scores as predictors of art judgement scores, and accounted for 12% of the variance ($F(2, 99) = 7.89, p < .01, \text{ADR}^2 = .12$). This confirmed H7. Raven scores were the only significant predictor in the model ($\text{st.}\beta = .25, t = 2.33, p < .05$). In Model 2, the Big Five and TIE were added as predictors of art judgement scores and significantly accounted for an additional 15% of the variance ($F(8, 93) = 5.59, p < .01, \text{Adj. } R^2 = .27$). This confirmed H8. There were several significant predictors in this model. The most powerful predictor was Extraversion ($\text{st.}\beta = -.30, t = 2.89, p < .01$), followed by Wonderlic scores ($\text{st.}\beta = .24, t = 2.45, p < .05$), Raven scores ($\text{st.}\beta = .23, t = 2.29, p < .05$) (which further confirmed H4), and Conscientiousness ($\text{st.}\beta = -.23, t = 2.44, p < .05$) (which confirmed H6b).

In a second regression, the same independent variables were tested as predictors of art experience. In Model 1, Wonderlic and Raven scores significantly predicted art experience, accounting for 7% of the variance ($F(2, 99) = 4.65, p < .05$) (this did not confirm H5). Wonderlic scores were the only significant predictors of the model ($\text{st.}\beta = -.33, t = 3.03, p < .05$), while Raven scores only approached significance levels ($\text{st.}\beta = .20, t = 1.78, p = .08$). It should be noted that Wonderlic scores were negatively related to art experience; that is, a high score on general intelligence predicted low self-report art experience and vice-versa. Model 2 added personality variables as predictors and (confirming H9) significantly

accounted for an additional 6% of the variance in art Experience ($F(8, 93) = 2.82, p < .01$, $Adj.R^2 = .13$). The only significant predictor in the model was the Wonderlic Personnel test ($st.\beta = -.32, t = 2.89, p < .01$).

A third hierarchical regression repeated both models as predictors of art activities. According to expectations (H5) Model 1 showed that Wonderlic and Raven did not significantly predict art activity, accounting for 1% of the variance ($F(2, 99) = .59, p = .60$, $Adj.R^2 = .01$). There were no significant predictors in the model. Confirming initial predictions, Model 2, which added the Big Five and TIE, significantly predicted art activities, accounting for an additional 15% of the variance ($F(8, 93) = 3.64, p < .01$, $Adj.R^2 = .16$). Openness was the most powerful and only significant predictors in the model ($st.\beta = .37, t = 3.06, p < .01$). This provided support to H1.

Table 4.13 Intelligence, personality and art interests as predictors of art judgement

	Art interests		Art judgement	
	st. β	t	st. β	t
Art interests	-	-	.26	2.68*
Adj. R^2		-		.07
Wonderlic	-.23	2.11*	.24	2.26*
Raven	.30	2.29*	.18	1.72
Adj. R^2		.04		.18
Neuroticism	.03	.30	.06	.56
Extraversion	-.13	1.27	-.27	2.63*
Openness	.36	3.15**	.09	.75
Agreeableness	-.10	1.02	.01	.05
Conscientiousness	-.01	.10	-.22	2.46*
TIE	.22	2.04*	-.10	.90
Adj. R^2		.26		.30

* $p < .05$. ** $p < .01$

In a fourth regression, intelligence and personality were tested as predictors of art recognition. Model 1 showed that art recognition could not be significantly predicted by Wonderlic and Raven scores, which only accounted for 4% of the variance ($F(2, 99) = .79$,

$p = .46$, $\text{Adj.R}^2 = -.00$). Thus this model confirmed H5. There were no significant predictors in this model. Confirming H9, Model 2 added the Big Five and TIE personality traits and accounted for 9% of the variance in art recognition ($F(8, 93) = 2.21$, $p < .05$; $\text{Adj.R}^2 = .09$). Openness was the best powerful prediction in the model ($\text{st.}\beta = .37$, $t = 2.90$, $p < .01$), which further supported H1, followed by Extraversion ($\text{st.}\beta = -.23$, $t = 1.99$, $p < .05$).

5.8 Discussion

The present study set to explore the link between personality traits, psychometric intelligence, art interests (self-report artistic background) and art judgement (Meier, 1940). The findings will be discussed in three sub-sections, namely (a) the relationship between art judgement and art interests, (b) the relation between art judgement and psychometric intelligence (Wonderlic and Raven), and (c) the relation between art judgement and personality traits. However this study also explored the link of art interests with personality and intelligence. Furthermore, the main aim of the present analyses was to determine whether art judgement may be conceived as a mixed construct comprising both non-cognitive (personality) and cognitive (intelligence) individual differences.

a) Art judgement and art interests: Confirming the results of study 9, art judgement (in this occasion measured by the Meier art test instead of the Maitland Graves art test) was significantly related to art interests, as assessed through a self-report questionnaire. Specifically, this inventory addressed self-reported art experience (e.g., formal education in the arts, reading habits in arts), music experience (e.g., preference for opera, knowledge of

composers), art activities (visits to galleries) and art recognition (of different art styles). Intercorrelations between these three measures suggested they could be conceptually combined to provide a single measure of art interests: high scorers being overall interested and educated in the visual arts. This factor was a significant (albeit modest) predictor of art judgement scores, accounting for 7% of the variance in the Meier art judgement test. This indicates that participants who reported greater interests in arts tended to score higher in art judgement and vice-versa (no doubt due to exposure). Hence the data suggests a positive and significant relation between interests (in arts) and ability (in art judgement). Although one may only speculate about the causal direction of this relation (whether people tend to be interested in arts because of their natural ability, or whether interests in arts may lead to a more developed art judgement), this correlation may be indicative of the construct validity of the Meier test. Furthermore, it is clear from this correlation that the Meier art judgement test is related to non-cognitive variables such as interests.

b) The relation between art judgement and intelligence: Another predictable finding was the significant correlation between art judgement and the two intelligence measures employed, i.e., Wonderlic and Raven. These results confirmed those of study 9, in which the Wonderlic Personnel test was examined against the Maitland Graves Design test. It is worth noticing that in the present study a measure of Gf (Raven) was also included; interestingly both general and fluid intelligence were similarly correlated with art judgement (about $r = 0.30$)(although multiple regression showed that Wonderlic accounted for unique variance in art judgement). A hierarchical regression indicated that psychometric intelligence (Wonderlic and Raven combined) had incremental validity (with regard to art interests) in the prediction of art judgement, accounting for an additional 11% of the

variance. The moderate correlation between psychometric intelligence and art judgement suggests that art judgement may be measuring a distinct ability (but certainly *something* of the ability domain). The results therefore provide further evidence for the validity of the test, particularly as a measure of maximal performance (see Seashore, 1929; Meier, 1940; Cronbach, 1949; study 9). It thus seems straightforward to interpret these correlations: if art judgement is an ability, it must show to be significantly correlated with well-established intelligence tests.

c) The relation between art judgement and personality traits: Regarding the relation between art judgement and personality traits (Big Five and TIE), correlational analyses indicated that three of the Big Five, namely Neuroticism, Extraversion and Conscientiousness, were significantly associated with art judgement scores. According to the initial prediction, the negative relation between art judgement and Conscientiousness may be interpreted in terms of the negative associations between this personality trait and creativity on one hand (Furnham, 1999; Eysenck, 1993, 1994b, 1995b), and intelligence on the other (study 1). Further, it is also possible that conscientious individuals are less likely to express interests in arts and creative disciplines (As shown by the negative, albeit not significant, correlation between Conscientiousness and all aspects of art interests).

With regard to the significant correlation between art judgement and Extraversion, interpretation appears to be less straightforward, as the initial prediction was of a positive, rather than a negative, relation between these variables. However and running counter to the results of study 9, Extraversion was negatively related to art judgement. One possibility to explain this relation is that introverts may be more likely to “invest” in art appreciation, for instance, reading more about arts than extroverts; yet correlations between Extraversion

and art interests were not significant (and very low). Another possible interpretation would be to attribute these correlations to the test characteristics, for the Meier art test requires respondents to concentrate for more than 40 minutes and carefully evaluate each set of stimuli: these characteristics are known to favor introverts rather than extraverts (see Mathews et al, 2000). However in study 9 a similar measure (roughly the same administration time) of art judgement was employed. It is thus recommended that future research should further explore the relation between art judgement and Extraversion.

On the other hand, Neuroticism was positively related to art judgement. Although no predictions were made with regard to the relation between Neuroticism and art judgement, it is possible that neurotic participants (like introverts) may have been better at focussing and concentrating on the stimuli of the art test, particularly if one considers that participants were tested under no pressure (Mathews et al, 2000). Thus the unthreatening test-environment and the attentional demanding nature of the test (which requires concentration and discrimination from the participants) may have interacted, resulting in the positive correlation between Neurotic and art-judgement.

As predicted, and confirming previous findings (study 9), Openness was not significantly related to art judgement. Moreover (and also following predictions) TIE was not significantly related to art judgement either. Since both Openness and TIE are significantly and positively related to art interests (See below), it is however possible that the relation between Openness and TIE with art judgement may be mediated by interests, such that people high on Openness and TIE would be more likely to engage in artistic activities (and hence score higher on art judgment).

The correlational pattern of personality traits with art judgement was replicated in the series of regressions, which indicated that personality traits significantly predict art judgement scores. Further, personality traits showed incremental validity with regard to art interests and psychometric intelligence in the prediction of art judgement. This further indicated that the Meier art test taps on both cognitive (intelligence) as well as non-cognitive (personality, interests).

Finally this study also explored the relation between intelligence and personality with art interests. As discussed above, results showed that Openness and TIE were significantly and positively related to art interests. This confirmed initial predictions. In the case of Openness, the positive correlations between this trait and art interests are also consistent with McCrae and Costa's (1997a; see also Costa & McCrae, 1992) characterisation of open personalities as intrinsically "artistic": "as neurotics can be used as examples of high scores on the dimension of Neuroticism, so artists can be considered primer examples of individuals high in Openness to Experience" (McCrae & Costa, 1997a; p.825). Thus the imaginative and sensitive nature of open individuals may lead them to engage in artistic experiences. Likewise, individuals high on TIE seem inclined to get involved in artistic activities. Although this may reflect the reported overlap between TIE and Openness (Rocklin, 1994), it is noteworthy that TIE also comprises aspects of Conscientiousness (which, as shown in the present results, is negatively albeit non-significantly related to art interests and negatively and significantly related to art judgement). In addition, it is also noticeable that the TIE scale (unlike Openness) does not include items referring to "artistic" engagement. Rather, this scale assesses the frequency and satisfaction with which individuals engage in philosophical thinking and intellectual

reading (Goff & Ackerman, 1992). However the present results clearly indicate that people high on TIE are more likely to get involved in (and enjoy) artistic activities.

There are of course some criticisms of this study. Firstly, the fact that the sample was composed of highly selected university students, may suggest that variables such as IQ and Conscientiousness were not fairly distributed. Hence there may be a restriction of range in these variables, which implies that the findings of the present study may not be applicable to the overall population. Also the sample size was rather small ($N = 102$), which generates restrictions to the present analyses, limiting it to correlations and regressions instead of the more meaningful tests of mediation and structural modeling. It is therefore encouraged that future research on the relation between art interests, art judgement, personality and intelligence, employs larger data sets that would enable to effectively tests for mediating and moderating variables as well as specific models.

Despite this limitations, the present study presented enough evidence for the mixed nature of art judgement, as a construct which comprises both cognitive (intelligence) and non-cognitive (interests, personality) individual differences. Given the recent interests in the integration of these individual differences (Ackerman & Heggestad, 1997), art judgement appears to be a promising and rather original approach for psychometricians. Further, the theoretical challenge of understanding the processes underlying the development of art judgement may be regarded as an area of interest not only to psychologist, but also to educational and art researchers, as well as artists themselves.

4.9 Conclusions

This chapter has explored the relationship between art judgement, intelligence, and personality traits. In addition, several indicators of art experience (interests, activities and self-reported knowledge in art) have been analysed with regard to these constructs. Two studies were reported.

As predicted, the results showed that art judgement is related to both personality and psychometric intelligence. Hence it may refer to a mixed construct, comprising both cognitive and non-cognitive individual differences. In light of the recent interest in identifying relationships between personality and intelligence (see chapters 1 & 2), the implications of the results reported in this studies are important. Particularly, they refer to another way in which personality traits and intellectual competence may be associated. This association refers not to a direct link between personality and intelligence (as posited by Ackerman & Heggestad, 1997; Goff & Ackerman, 1992), but to a third variable in which elements of both constructs are comprised. In that sense, art judgement may be compared to SAI or AP, two variables that were found to be associated with both personality and intelligence (see chapters 2 & 3, respectively). However, before discussing the results of this chapter in relation to the previous findings reported in the present thesis (for a discussion of this point please refer to chapter 5), it is worth examining the specific correlations of art judgement and art experience with psychometric intelligence and personality traits (Big Five and TIE).

The most consistent finding concerns the significant association between previous

art experience and Openness, as well as TIE. In both studies it was shown that participants with high Openness and TIE scores were more likely to have a stronger art background (as revealed by the questionnaire on art interests, activities and knowledge). This is consistent with several studies on art preferences (e.g., Furnham & Avison, 1997; Furnham & Walker, 2001a; Rawlings, Twomey, Burns & Morris, 1998; Rawlings, Barrantes & Furnham, 2000), as well as McCrae and Costa's (1997a) conceptualisation of the Openness factor. It was also clear that Openness and TIE are not significantly related to art judgement (see studies 9 & 10), although previous art experience was. This suggests that art experience may mediate the relationship between Openness/TIE and art judgement.

Another consistent finding regards the relationship between art judgement and Conscientiousness: in both studies this personality factor was a negative predictor of art judgement scores. Given the fact that art judgement was also significantly (and positively) related to psychometric intelligence, the negative relationship between Conscientiousness and art judgement seems to be in line with recent studies reporting negative correlations between Conscientiousness and ability tests (see for instance study 1; Moutafi, Furnham & Patiel, 2003). Nevertheless most of the studies reported in chapter 2 have shown no significant association between Conscientiousness and psychometric intelligence. It may be therefore more appropriate to interpret this association in terms of the more "conservative" nature of highly conscientious individuals (see Furnham & Walker, 2001b).

As mentioned earlier, psychometric intelligence was a significant correlate of art judgement, and so was personality (as assessed by the Big Five). Interestingly, the correlational pattern of both studies suggested that psychometric intelligence (as measured by two well-established ability tests) was more consistently related to art judgement than personality. However in the regressions personality traits were more significant predictors

of art judgement than intelligence.

Another inconsistency concerns the relationship between art judgement and Extraversion. Although this personality traits was significantly related to art judgement in both studies, it was positively correlated in study 9, and negatively correlated in study 10. While it seems more likely that Extraversion is negatively (rather than positively) related to art judgement (introverts may be more likely to “invest” in art appreciation, for instance, reading more about arts than extroverts), this hypotheses is yet to be tested and replicated.

In any case, the results of the hierarchical regressions indicate that individual differences in art judgement can be explained in terms of both personality and intelligence. Furthermore, previous art experience is also related to performance on the art judgement test. Specifically, it was shown that individuals who tend to engage more in artistic experiences (as shown not only by the art experience questionnaire, but also by an individual’s Openness and TIE scores) tend to be better at art judgement. Further, being clever and not being conscientious may also lead to superior art judgement (regardless of an individual’s previous art experience).

One important limitation to the present studies is that the samples were relatively small and homogeneous, since they were composed exclusively of psychology undergraduates. Thus several statistical analyses (e.g., a larger data reduction or SEM) could not be performed on the data. Moreover, it may have been interesting to examine the relationship of art judgement and art experience with personality and intelligence across different groups, notably artists vs. non-artists.

Another limitation is that the data is correlational (as opposed to experimental) in nature. It is therefore impossible to determine either the processes underlying art judgement

or the causal relation between the explored variables. Are individuals good at art judgement because they tend to invest in artistic experiences (e.g., visiting galleries, watching art documentaries, reading art books), or vice-versa? Does previous art experience partly determine the development of an open personality, or is it the other way around? Are people more conscientious and conservative because they lack the ability to appreciate art, or vice-versa? The answers to these questions would certainly exceed the scope of the statistical analyses and design underlying the reported studies.

Nevertheless, studies 9 and 10 have provided important novel information on the nature of a (rather old) construct, namely art judgement (Seashore, 1929; Meier, 1940). Considering the current interest in the relationship between cognitive and non-cognitive traits and, particularly, in the identification of mixed constructs that may comprise individual differences in both personality and intelligence (Goleman, 1996; Sternberg, 1997; Gardner, 1999; Mayer & Salovey, 1997), the results of this chapter suggest that it may be worth further exploring the construct of art judgement

Chapter 5: Conclusions

5.1 Summary of findings

This thesis explored the relationship between personality traits and intellectual competence. Personality was assessed primarily through the Big Five (Costa & McCrae, 1992) and Gigantic Three (Eysenck & Eysenck, 1985) personality inventories. Intellectual competence was conceptualised and measured through several ability tests (psychometric intelligence), university examination grades and course work (AP), and self-estimates or subjectively-assessed intelligence (SAI). In addition, other variables such as gender, academic behaviour, lay conceptions of intelligence, and self-estimated personality have also been examined. Further, the last two empirical studies reported in this thesis have also examined a measure of art judgement as a possible mixed construct between personality and intelligence.

In chapter 2, it was shown that, at the psychometric level, personality and intelligence are only weakly (and mostly non-significantly) related: no more than 7% of the correlations between personality traits and psychometric intelligence were significant.

As discussed previously (see section 2.17), the fact that the relationship between psychometric intelligence and personality was investigated in opportunity samples (i.e., participants completed the ability tests under no pressure) may affect the interpretation of the correlation between Neuroticism and psychometric intelligence, since the previous literature suggested that the negative relationship between these two variables is predominantly observable under stressful or arousing conditions (e.g., Hembree, 1988; Zeidner, 1995; for a detailed discussion see section 1.2.3.1).

With regard to Agreeableness, the results of chapter 1 are consistent with most of the published literature linking personality traits to psychometric intelligence, which suggested that Agreeableness is orthogonal to cognitive ability (see Ackerman & Heggestad, 1997; Zeidner & Matthews, 2000). On the contrary, claims that Extraversion is significantly related to psychometric intelligence, even when correlations may vary from negative to positive depending on the type of measure employed, were not supported by studies 1 to 4.

With regard to the two other traits, namely Openness and Conscientiousness, results are less consistent since these traits were found to be significantly correlated with psychometric intelligence, albeit only in two studies (1 & 3). Interestingly (and unlike the other Big Five traits) Openness and Conscientiousness may be theoretically linked to intelligence, reflected only partly in test performance. Thus significant correlations between these personality traits and psychometric intelligence may be interpreted not just as a consequence of specific test-taking styles (such as has been the case with Extraversion, see Furnham, 1995; Furnham, Forde & Cotter, 1998ab) or test-anxiety (such as it has been argued with regard to Neuroticism, see Hembree, 1998; Zeidner, 1995), but in terms of direct links between personality and intellectual ability. Specifically, low intellectual ability may partly determine the development of a highly conscientious personality (Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003; see also section 1.2.3.5), while high intellectual ability may partly determine the development of an open personality (Ackerman, 1999; Goff & Ackerman, 1992; see also section 1.2.2.3.2). Nevertheless, the present results are clearly insufficient to provide empirical support to these hypotheses. They do however suggest awareness for further research.

Rather than encouraging an integration of personality and intelligence at a

psychometric level, overall the results of chapter 1 suggest that (at least in well-educated and bright individuals) consistent links between personality traits and intelligence at the psychometric level are unlikely. Although this suggestion may run counter to recent findings on the personality-intelligence interface (notably Ackerman & Heggestad, 1997) and even challenge the development of more integrative approaches to individual differences (notably Snow, 1992, 1995), the idea that personality and intelligence are independent and thus differentiated areas within the realm of individual differences has a longstanding support in the psychological literature (Eysenck, 1994a; Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000; see section 1.2 for a detailed discussion). Before discussing the implications of these findings, it is important to summarise the results that concern the relationship between personality traits and two other aspects of intellectual competence, namely SAI and AP, as well as the mixed construct of art judgement.

Regarding the relationship between personality and SAI, studies 1 to 4 indicated that personality traits (notably Neuroticism and Agreeableness) are significantly related to SAI. Almost 50% of the correlations between personality traits and SAI were significant and regression analyses across chapter 2 showed that personality was a significant predictor of SAI. Although previous research had rarely examined the relationship between SAI and personality traits (see Furnham, Kidwai & Thomas, 2001; Furnham & Thomas, 2003) the results of chapter 1 show a relatively consistent pattern for SAI to be associated with low Neuroticism and Agreeableness, and relatively high Extraversion and Openness to Experience. In addition, and confirming past research (Furnham, 2001b; Furnham & Rawles, 1995, 1999), SAI was systematically linked to psychometric intelligence. Since personality traits predict SAI (but not to psychometric intelligence), and SAI predicts

psychometric intelligence, it has been argued (section 2.17) that SAI may be a construct related to both personality and intelligence. Personality may thus influence SAI, which in turn can influence performance on ability tests. Thus, even when personality traits may not be directly related to performance on psychometric intelligence tests, they are likely to affect SAI and consequently influence test performance. High Openness and Extraversion, and low Agreeableness and Neuroticism, are associated with higher SAI, which in turn is associated with higher intelligence.

Another robust finding in chapter 2 concerns the relationship between SAI and gender: in 75% of the regressions gender was a significant predictor of SAI. This is consistent with several recent studies and the initial hypotheses (see Furnham, 2001b; see section 1.4.3). SAI may therefore expand the relationship between gender and psychometric intelligence: men tend to give higher SAI, and people with higher SAI tend to score higher on psychometric intelligence tests. Another variable that was significantly associated with SAI (see study 2) is people's conceptions of intelligence; specifically whether individuals hold positive or negative attitudes towards IQ testing. There are therefore several non-cognitive variables (e.g., gender, lay conceptions of intelligence, personality traits) that may influence SAI. These results therefore suggest that SAI is a variable of crucial importance in the relationship between cognitive and non-cognitive traits.

Chapter 3 has examined another important indicator of intellectual competence, namely AP. Although the prediction of AP has a longstanding tradition in psychology (e.g., Binet, 1903; Busato, Prins, Elshout & Hamaker, 2000; Ebbinghaus, 1897; Harris, 1940; see sections 1.3.1 & 1.3.2), only few recent studies have examined the impact of modern and well-established cognitive and non-cognitive measures in the prediction of academic success

and failure.

The results of this chapter indicate that personality traits are consistently related to AP, even when psychometric intelligence and previous academic behaviour (e.g., attendance, participation in class, teacher's ratings) are included as predictors. Throughout this chapter, longitudinal evidence was reported in support of the predictive validity of personality inventories (EPQ-R, NEO-FFI, and NEO-PI-R) for the prediction of AP in secondary school and university settings. The personality traits most strongly related to AP seem to be Neuroticism (negatively), Extraversion (negatively), Psychoticism (negatively) and Conscientiousness (positively). Regression analyses showed that the percentage of variance in AP accounted for by personality traits may range from 10% to 30%. Although primary traits (e.g., anxiety, activity, achievement-striving) account for the maximum amount of variance in AP, personality traits assessed at the super trait level seem more reliable and methodologically sound to predict AP (see study 7).

Finally, chapter 4 reported the results of two studies on the relationship between personality traits (Big Five and TIE) and psychometric intelligence with a measure of art judgement (e.g., Meier, 1940) and several indicators of art interests. It was shown that personality (i.e., Neuroticism, Extraversion and Conscientiousness) and intelligence are both significantly related to art judgement. This may imply that art judgement is a mixed construct comprising both cognitive and non-cognitive individual differences. Further, personality traits showed incremental validity with regard to art interests and psychometric intelligence in the prediction of art judgement. This further indicated that the Meier (1940) art test taps on both cognitive (intelligence) as well as non-cognitive (personality, interests) traits. It is also noteworthy that art judgement is measured as an ability (power test) but more related to personality than to psychometric intelligence.

In addition, Openness (and to a lesser extent TIE) was found to be a strong positive predictor of art experience/interests. Since art experience/interests are significantly related to art judgement, it is likely that the relationship between Openness and TIE with art judgement may be mediated by interests, such that people high on Openness and TIE would be more likely to engage in artistic activities (and thus score higher on art judgment).

Considering the current interest in the relationship between cognitive (intelligence) and non-cognitive (e.g., personality, interests, gender) traits and, specifically, in the identification of mixed constructs that may comprise individual differences in both personality and intelligence (Goleman, 1996; Sternberg, 1997; Gardner, 1999; Mayer & Salovey, 1997), the results of chapter 4 suggested that art judgement may be a construct of interest for those interested in the development of an integrative framework for the study of individual differences (e.g., Austin et al, 1997; Ackerman, 1999; Matthews, 1999).

Table 5.1 summarises the most relevant findings concerning the relationship between personality traits and intellectual competence, as described above and the concluding sections of each chapter. It is based on the guiding hypotheses of this thesis (see Table 1.7) and the overall results reported across the empirical chapters of this dissertation.

Table 5.1: Summary of the most relevant results

	Psychometric intelligence	Academic performance	SAI	Art judgement
Neuroticism	n/s	-	-	n/s
Extraversion	n/s	-	+	+/-
Openness	n/s	n/s	+	n/s
Agreeableness	n/s	n/s	-	n/s
Conscientiousness	n/s	+	n/s	-
Psychoticism	n/t	-	n/t	n/t

+ = positive significant relationship - = negative significant relationship, n/s = not significant n/t = not tested

5.2 Limitations and criticism

As mentioned earlier (2.17, 3.17, 4.9) there are several limitations to the studies reported in this thesis. First, it should be noted that with exception of two studies (studies 5 & 7), all studies were conducted on relatively small samples ($N < 200$). Although the size of these samples may still be considered acceptable, this has limited the possibility of replicating previous meta-analytical or large-scale studies between the investigated constructs (e.g., Ackerman & Heggestad, 1997; Austin, Deary & Gibson, 1997) as well as performing additional statistical analyses on the data (notably LISREL). Further, all but one sample were composed of students from British universities, which may also restrict the generalisability of the results. It is thus necessary to be prudent when considering the implications of these findings: personality and intellectual competence may be differentially related at earlier or later stages of an individual's life. Moreover, it is also likely that in more heterogeneous samples, where there is a larger range in the distribution of ability and (perhaps) personality scores, the correlational pattern between personality traits and intellectual competence may vary from that of the present samples. Hence the investigation of the relationship of personality traits with AP, psychometric intelligence, SAI and art judgement in samples with a larger distribution of scores on each of these variables remains an unaccomplished goal.

A second limitation of this thesis is that SAI, one of the most relevant variables in this investigation, was assessed through a single item, namely a score on the bell curve. Accordingly it may be argued that SAI has not been reliably assessed. While it is probably true that a multi-item approach to the assessment of SAI would have provided higher

reliability, it could also be argued that single estimates of intelligence are closer to participants' self-concept and estimated general ability, thus capturing more aspects of people's self-esteem, self-confidence and self-conception. Nevertheless it is noteworthy that multiple estimations of intelligence, such as estimates of verbal, logical, mathematical and spatial intelligences, would have been useful with regard to participants' actual scores. Moreover, it is possible that estimations of different aspects of intelligence are differentially related to personality traits, a fact that has not been noticed at the time of planning the present studies.

A third weakness of the present thesis is its lack of experimental evidence, since all of the reported studies are correlational in nature. As pointed out earlier (section 1.2), this type of design is concerned with differences between individuals, rather than tasks (Matthews, Davies, Westerman & Stammers, 2000). Although psychometric methods appear to be the most suitable method to identify relationships between individual differences at a structural and descriptive level (Boyle, 1991), research should attempt to combine both methodological approaches (correlational/psychometric and experimental/cognitive). Due to several practical constraints such as available testing time and the fact that a great percentage of the data was compiled from an existing archival source, this thesis has focused on the psychometric relationship between personality traits and intellectual competence. As a consequence, it has been possible to identify different associations between the examined variables, but not the nature of the processes or the causal effects underlying these associations (although the SEM included in study 5 may have partly overcome this problem). While it is possible that an experimental/cognitive design would have provided information on the processes and causational directions of the

relationships between personality and intellectual competence, the development of an empirically founded theory or conceptual framework needs as much psychometric as experimental evidence. Furthermore, it is likely that the lower level hypotheses that can be tested by experimental designs may be meaningless unless their implications with regard to higher order constructs and the associations between these constructs are fully considered. Thus experimental designs may, indeed, provide a better answer to the question of *why* personality and intellectual competence are related; however to *what extent* or *whether* personality traits and intellectual competence are or not related (a question which may be considered as precedent of the previous one), can be better understood in light of psychometric evidence. Moreover, it is the aim of psychometric research to correct and improve the prediction of intellectual competence and human performance in a variety of real-life settings. Hence the implications of the present thesis are twofold, theoretical on one hand and applied on the other. These implications should be discussed in the next and final section of the present thesis.

5.3 Implications

As mentioned earlier (chapter 1), there has been a renewed interest in the last ten years in the relationship between personality and intelligence (Barrat, 1995; Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000), as well as empirical studies examining cognitive and non-cognitive individual differences in AP (Siepp, 1991; Goff & Ackerman, 1992; De Fruyt & Mervielde, 1996; Rindermann & Neubauer, 2001; chapter 3). In addition, researchers have also looked at SAI and its relationship to personality traits and psychometric intelligence (see Furnham, 2001b; Furnham & Thomas, 2003). Despite this interest, which may reflect an attempt to provide sound empirical evidence for the

integration of fundamental cognitive and non-cognitive individual differences, only a few researchers (e.g., Cattell, 1971/1987; Eysenck & Eysenck, 1985; Ackerman, 1999; Matthews, 1999) have attempted to provide a theoretical framework for integrating and explaining the results of either experimental or psychometric investigations.

Further there are few models or theories that attempt to describe the processes or mechanisms by which personality traits may affect intelligence test performance/outcome. The present section shall discuss the theoretical and applied implications of the results reported in this thesis.

With regard to the relationship between personality and psychometric intelligence, as examined in chapter 2 (studies 1 to 4), it has been shown that personality traits are only weakly and mostly non-significantly related to psychometric intelligence tests. A well-known theoretical position against the integration of personality and intelligence is that of Cattell's (1971/1987), who conceived personality and intelligence as separate predictors of human behavior. Thus both variables could have a joint influence on academic, work-related or social behavior. Whilst this conceptualization posits that personality and intelligence should be kept separate (as reflected in the results of chapter 2) it also implies that certain types of behavior (notably performance) may not be classified under the domain of personality or intelligence, but of necessity as a mix of both. Accordingly, IQ test results, which are obtained through performance, cannot be considered a "pure" measure of intelligence (for performance may also be influenced by personality traits)(see Strelau, Zawadzki & Piotrowske, 2001). This approach, which posits that non-cognitive factors may affect the results of IQ tests, is often referred to as top-down (Rindermann et al, 2001).

Whereas theoretically, a diversity of variables, from test conditions and distractibility to test-anxiety and physical illness, may have a significant incidence in the test

results, it is unlikely that personality traits have a significant impact in IQ/ability test performance, as shown by the modest and mostly non-significant correlations between personality traits and psychometric intelligence reported in studies 1 to 4. Since psychometric intelligence is unrelated to personality traits, it seems safe to assume that, even when intelligence is measured through performance, the type of performance required to complete an ability test is not influenced by personality traits. Thus, this suggests that psychometric intelligence is, indeed, a measure of cognitive individual differences, i.e., intellectual ability, and not a mere evaluation of performance, which may be affected by both cognitive and non-cognitive traits. As a consequence, there is little empirical evidence in support of the top-down argument that questions the validity of psychometric intelligence as a measure of intellectual ability. Instead, the idea that an individual's intellectual ability is a distinct characteristic and hence unrelated to well-established personality traits (Zeidner & Matthews, 2000) can be supported by the present results.

The fact that the validity of psychometric intelligence is judged not in terms of the orthogonal nature of ability measures with regard to personality traits (as discussed above), but in terms of the predictive power of these measures with regard to other criteria such as AP, clearly implies that psychometric intelligence is only one, and perhaps a secondary, aspect of intellectual competence. In that sense, AP may be considered the criterion *per excellence* of intellectual competence: as mentioned in section 1.3.1, the relationship between psychometric intelligence and AP is comparable to that of weather forecast and actual weather. Thus another important issue underlying the relationship between personality and intellectual competence is the relationship between AP and personality traits.

Although AP has been traditionally associated with intelligence, rather than

personality, the idea that personality traits may influence AP was also present in Cattell's (1971/1987) theory (as stated above). Further, several researchers have attempted to predict AP from well-established personality traits (e.g., Bustao et al, 2000; De Fruyt & Mervielde, 1996; Eysenck & Eysenck, 1985).

In the present thesis (chapter 3), it was shown that personality traits are consistently related to AP. This is true particularly with regard to Conscientiousness and Psychoticism, which are positive and negative predictors of AP, respectively; although Neuroticism and Extraversion have also been found to be significantly related to academic examination grades, both negatively. Furthermore, an examination of the primary facets of the Big Five revealed that the sub-scales of activity, dutifulness and achievement striving, are consistently related to AP. Across four studies and five samples, the longitudinal predictive power of personality traits was tested and compared to that of other well-established predictors such as psychometric intelligence, academic behaviour and previous AP. The findings have important theoretical and applied implications.

From a theoretical perspective, the data suggest that personality may play an important, albeit moderate, role in the achievement of academic excellence and failure. Accordingly, it is likely that certain personality traits (high Conscientiousness, low Psychoticism, low Extraversion, low Neuroticism) are beneficial in most educational settings and, furthermore, facilitate the acquisition and consolidation of knowledge. This is in line with Snow's (1992, 1995) and Ackerman's (1996, 1999) ideas on the historical effects of personality traits on the development of a person's intellectual competence. Although the results of chapter 2 (see above) have suggested that a person's ability to reason and learn new things is independent of his/her personality characteristics, the results of chapter 3 suggest that specific personality characteristics may partly determine a person's

academic attainment (and vice-versa). Further, it has been shown that a student's AP is as dependent of his/her personality traits as of his/her intellectual ability, behaviour in school or university, and previous academic achievement (see studies 5 to 7). If the relationship between intellectual ability (psychometric intelligence) and AP (see section 1.3.1) is explained in terms of the beneficial effects of the capacity to perform a variety of mental operations, ranging from logical and mathematical problem-solving to the recall and recognition of historical and geographical facts, there is no reason to suppose that the relationship between AP and personality traits could not be explained in terms of certain behavioural patterns in an individual's everyday life that are beneficial (or counterproductive) for his/her future performance in school or university.

Another interesting theoretically important issue is the fact that personality traits are related to AP, but not to psychometric intelligence. While these findings may seem contradictory (psychometric intelligence and AP are two aspects of intellectual competence), there is at least one sound explanation to understand this relationship. This explanation or hypothesis concerns the distinction between Gc and Gf (Cattell, 1971). As observed, Gf refers to individual differences in the ability to process information and reason; that is the capacity to apply inductive, conjunctive and disjunctive reasoning to abstract prepositions (Stankov, 2000). On the other hand Gc is conceptualised in terms of acquired or acculturated knowledge (Ackerman & Heggestad, 1997). The distinction between Gf and Gc may be comparable to that of psychometric intelligence and AP: psychometric intelligence is similar to Gf, since it refers to an individual's reasoning ability or capacity to learn and understand novel material, while AP refers to the specific content of what an individual has learned (as well as his ability to retrieve this content). In that sense most of the psychometric intelligence tests (and certainly the measures employed throughout the

studies reported in this dissertation) can be regarded as measures of Gf, rather than Gc (a thorough theoretical argumentation in support of this differentiation can be found in Ackerman & Heggestad, 1997; Mackintosh, 1996, 1998; see also chapter 1). It is noteworthy that despite the increased research on the relationship between personality traits and intellectual ability, there has been no theoretical explanation for the possible effects of personality traits on Gf and, as it was indeed anticipated in sections 1.2.1 and 1.2.3.2, it is perfectly possible that personality traits are related to some, but not to other, aspects of intellectual competence. In that sense it is perhaps one of the most important strengths of this thesis to have examined several aspects of intellectual competence. The implications of two aspects need yet to be considered.

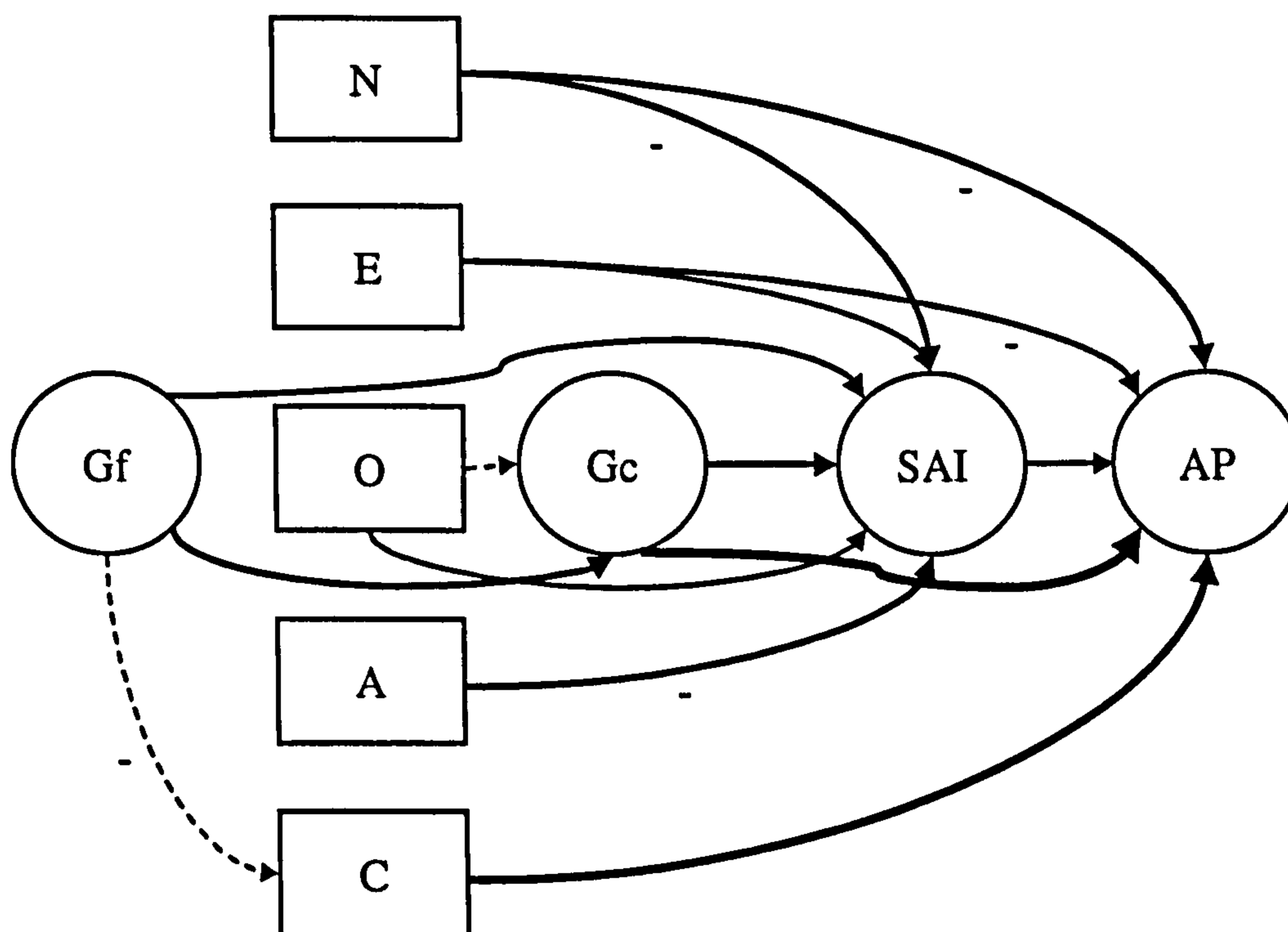
Regarding the relationship between personality and SAI, it has been noted that several personality traits (notably Neuroticism and Agreeableness) are significantly related to SAI. Further, it has also been argued that these personality traits may partly determine an individual's perception of his/her own intellectual ability. Thus being anxious, depressive, fearful or modest, may lead people to think of themselves as less bright, and vice-versa. Considering the conceptual similarities between SAI and a number of "subjective" measures referring to people's self-conception (see Bandura, 1986; Metalsky & Abramson, 1981; Stankov, 1999, see section 1.4.2 for a detailed discussion of this point), it is likely that SAI have a direct effect on an individual's performance. It has been thus noted that SAI may affect psychometric intelligence: people who think of themselves as intelligent may obtain higher scores and vice-versa (see Furnham, 1995, 2001b). Support for this hypothesis can be found across the studies reported in chapter 2. Thus personality traits may be indirectly related to psychometric intelligence, through SAI. That is, SAI may bridge the relationship between personality traits and psychometric intelligence. While it is

noteworthy that this relationship refers to the influence of personality traits on test performance, rather than actual intellectual ability, it is likely that SAI may also mediate the relationship between personality traits and actual ability: this may be particularly evident in academic settings, where the effects of personality can be tested on Gc or the acquisition of knowledge. Furthermore, chapter 4 has suggested that suggested that personality traits, intellectual ability and interests (art experience) may jointly determine the development of art judgment. Thus individual differences in art judgment, like individual differences in AP, are influenced by both a person's intellectual ability and his/her personality characteristics.

The applied implications of this thesis can be summarised very briefly. The best single measure to predict an individual's future intellectual competence is psychometric intelligence. Furthermore, the ability to reason and learn novel things cannot be successfully predicted from an individual's personality. However intellectual competence conceived not as abstract reasoning or Gf, but as knowledge or real-life performance, can be successfully predicted by personality traits. Moreover, because personality accounts for unique variance in the prediction of adult intellectual competence, it is important not only that researchers, psychologist and educators begin to consider personality inventories in the prediction of academic success and failure, but also in their evaluation of an individual's intellectual competence in general.

To conclude, Figure 5.1 presents a conceptual model for understanding the interactions between personality traits (Big Five) and intellectual competence (Gf, Gc, SAI, and AP). The model contains several paths that represent the complexity of these interactions. Although some of these paths have not been directly examined in this thesis, most of the sections of the model have been psychometrically tested across the three empirical chapters (2, 3 & 4). The width of the arrows represents the intensity of the

specific relationships between the variables, while the negative sign (-) indicates that the relationship is negative. It should also be noted that the causal relationships represented in the model are merely hypothetical, although from a theoretical perspective it may seem clear why some variables influence others, and not vice-versa; that is, personality traits and psychometric intelligence can be considered stable constructs (Deary, 2001; Matthews & Deary, 1998), and thus pre-exist other indicators of intellectual competence such as SAI and AP.



N = Neuroticism, E = Extraversion, O = Openness, A = Agreeableness, C = Conscientiousness

Figure 5.1 A conceptual model for the interaction between personality and intellectual competence

As can be observed in Figure 5.1, there are no significant relations between personality and cognitive ability (Gf & Gc). Personality and cognitive ability should thus be considered two different and independent aspects of an individual. This implies that having some information about an individual's personality (no matter how accurate this information

is) will not provide any information about that individual's intellectual or cognitive ability. As mentioned earlier, this idea is consistent with a longstanding and traditional perspective in individual differences (see Eysenck, 1994a; Saklofske & Zeidner, 1995; Zeidner & Matthews, 2000; see section 1.2 for a detailed discussion). Nevertheless, it is likely that certain personality traits such as Openness and Conscientiousness are conceptually more related to cognitive ability, albeit weakly (note the dashed paths between these personality factors and Gc and Gf, respectively). The model in Figure 5.1 suggests that Openness may influence Gc, that is, whilst Gf may partly affect Conscientiousness. Although this hypothesis was only modestly supported by the results of this thesis (see studies 1 & 3), psychometric evidence can be found elsewhere (Ackerman & Heggestad, 1997; Moutafi, Furnham & Crump, 2003; Moutafi, Furnham & Patiel, 2003). Moreover, it seems theoretically sound to suppose that Openness to Experience, which is related to intellectual curiosity, may pre-determine intellectual investment and thus lead to increased Gc, and that Conscientiousness may partly develop as a compensatory traits for low Gf, particularly in competitive environments. In any case, it is necessary to bear in mind that high Gf is a more important precondition for high Gc than is Openness to Experience, and that most of the variance in Conscientiousness can not be accounted for by Gf.

With regard to the relation between personality and SAI, it can be seen in Figure 5.1 that there are several personality traits that may affect SAI. The results of the present thesis suggest that Neuroticism and Agreeableness (both negatively) may affect SAI more than the other traits, although Openness and Extraversion (both positively) may also influence SAI. Since SAI may be expected to affect AP (an assumption that has not been directly tested in the studies of this thesis)(for a discussion of this point see section 1.4.2), SAI may have an important mediating role in the relationship between personality and AP. Furthermore,

chapter 2 has shown that SAI may also widen the relationship between personality traits and psychometric intelligence, not in that it affects *actual* cognitive ability, but performance on cognitive ability tests (psychometric intelligence). This is true especially in the case of Neuroticism, since the conceptualisation of high neurotic individuals as being more fearful, pessimistic, and less confident, is consistent with the idea that they may think of themselves as less intellectually able. This may predispose them to experience situations as stressful and therefore affect their ability to cope with specific situations such as academic examinations or psychometric intelligence tests. Thus, although individuals may be expected to be able to estimate their intellectual ability with a certain degree of accuracy (as shown by the paths between SAI and Gf on one hand, and Gc on the other), certain personality traits, such as Neuroticism, Agreeableness, Extraversion and Openness, may also be expected to influence an individual's perception of his/her intellectual ability.

Finally, the paths between personality traits and AP suggest that Neuroticism, Extraversion, and Conscientiousness, may all play a significant role in the processes underlying AP. As mentioned earlier (e.g., section 2.17), the influence of personality on AP is particularly noticeable at higher levels of formal education, notably highly competitive and selective university programs. The relationship between AP and Neuroticism can be mainly explained in terms of anxiety, particularly under stressful conditions such as university examinations (this is consistent with the findings of Hembree, 1988; Siepp, 1991). Further, study 8 also showed that neurotic students are more likely to be absent in examinations due to medical illness or to request and require "special treatment". Thus Neuroticism may be associated not only with impaired examination performance, but also with lower levels of attendance and even negative physical consequences such as racing heart, perspiration, gastric disturbances and muscle tension (Matthews, Davies, Westerman

& Stammers, 2000). With regard to the relationship between AP and Extraversion, it is likely that introverts have an advantage in written assessments, whereas extraverts would benefit from oral examinations (study 6; see also Furnham & Medhurst, 1995; Robinson, Gabriel & Katchan, 1993). However, it can be expected that introverts may have an advantage over extraverts with respect to the ability to consolidate learning, as well as lower distractibility and better study habits. It would appear that introverts condition faster and have slower decay of their conditioned behaviour (Eysenck & Eysenck, 1979). Accordingly, it can be expected that, in university samples and with other salient factors controlled for, introverts will tend to outperform extraverts. This is also consistent with the findings of Rolfhus and Ackerman (1999), who found negative correlations between Extraversion and several knowledge tests, and suggested that these correlations may be a consequence of differences in knowledge acquisition time between introverts (spend more time studying) and extraverts (spend more time socialising).

The relationship between Conscientiousness and AP seems more straightforward. Conscientiousness appears to be a solid predictor of AP, which is not surprising since Conscientiousness has been linked to “strength of character” (Smith, 1969), motivation (see Andersson & Keith, 1997; Boekaerts, 1996; Furnham, 1995; Pelechano, 1972), and several performance-related traits that are directly assessed by the scale, such as achievement striving, dutifulness, order and responsibility (see study 7). Thus, careful, organised, hard working, persevering and achievement-oriented students may be expected to succeed in academic settings, a fact that may be almost regarded as common sense, but that had not been empirically supported with such consistency before this thesis.

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