Personality correlates of fluid and crystallised intelligence in the New Zealand workplace

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Abstract

This study investigated relationships between personality traits and intelligence, and the extent to which personality traits can predict intelligence. The General Reasoning Test 2 served as the general intelligence measure, also assessing crystallised and fluid intelligence (N=4120). Two personality inventories were used to measure personality traits. 1576 participants completed the Fifteen-Factor Questionnaire; and 2544 participants completed the Occupational Personality Profile. Overall, the strongest correlations with intelligence for the Fifteen-Factor Questionnaire were for the personality traits 'Conscientious' and 'Disciplined'. The strongest correlations with intelligence for the Occupational Personality Profile were those related to the personality traits 'External locus of control' and 'Detail-Conscious'; followed by the personality traits 'Pragmatic', 'Contesting', 'Trusting', and 'Conform'. The predominant relationships were between personality traits and crystallised intelligence. Hypothesis testing established consistently negative relationships for the primary personality traits that combine to make up the Five-Factor Model (FFM) personality trait of 'Conscientious', which is consistent with previously reported findings (e.g. Ackerman & Heggestad, 1997). Also consistent with previous research, combinations of personality traits predicted intelligence to varying degrees (Moutafi, Furnham, & Crump, 2003), and did so most successfully for crystallised intelligence. Implications of the findings include issues concerning the homogeneity of the job performance construct, the consistency of the measurement of job performance, and the additive use of the personality trait 'Conscientious' and intelligence scores to increase predictive validity in workplace selection decisions. Further implications of the findings, limitations and suggestions for future research are also addressed.

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CHAPTER 1: INTRODUCTION

This investigation examines the relationship between the two most ubiquitous psychometric measures in the New Zealand workplace: those of psychometric intelligence, and those identifying personality traits (P. Englert, personal communication, December 29, 2002). In doing so it will attempt to answer a number of pertinent questions regarding the combined use of these measures, and determine whether personality traits can function as predictors of psychometric intelligence.

A major trend in industrial/organisational (I/O) psychology research concerns the categorisation of individuals for the purpose of workplace selection, training, or promotion decisions (Ackerman & Humphreys, 1990). The idea of using methods of determining individual differences in intelligence and personality to facilitate such classification is by no means novel. We know that the application of intelligence testing for employee selection dates back to at least 200-100 B.C. China in the late Qin (Ch'in), or early Han period when written tests identified the most capable applicants for civil service posts (Bowman, 1989). We also know that recognition of the value of testing individual differences in both personality and intelligence for classification and selection purposes can be traced back in European civilisation to at least Plato's *Republic* (Plato, trans. 1999) in the fourth century B.C.

Today the use of intelligence and personality measures to determine the "fit" of an individual to a role or job in the workplace, or an organisation, is widespread and growing (Dunnette, 1990). According to a recent cross-national survey of staff selection practices in 18 countries New Zealand is in the vanguard of this trend. In fact, this survey found the prevalence of intelligence testing in personnel selection greater in New Zealand than all but three other countries (Ryan, McFarland, Baron, & Page, 1999). One question necessarily accompanying the current, and growing ubiquity of personality and intelligence tests, is whether such tests are being utilised as efficiently as possible, both in terms of benefits to the individuals tested and the companies using them. The purpose of this research will be to add to the knowledge base assisting organisational psychologists to answer this question in the affirmative.

However, a prerequisite to achieving this goal is a shared, and thus consistent understanding of what this investigation means by intelligence and personality.

1.2: Intelligence

Intelligence research and conceptualisation has gone through successive, and quite sweeping changes in approach over the years. However, the differential, individual-differences, or psychometric approach to intelligence is generally accepted as the first, and primary paradigm of modern intelligence research and theorisation (Sternberg, Lautrey, & Lubart, 2003). The differential approach is epistemologically rooted in the belief that it is possible to identify and measure individual differences in intelligence. The origins of the differential approach to intelligence are often associated with Sir Francis Galton (1869), and later Alfred Binet and his colleague Theophile Simon (1911). Galton (1869) conceptualised intelligence in terms of two qualities for which it was possible to identify and measure individual differences. The first was *energy,* or the capacity for intellectual labour. The second was *sensitivity,* or perceptivity to the reception of external stimuli. Binet and Simon (1911) conceptualised intelligence in terms of three distinct elements for which it was possible to identify and measure individual differences. The first consists of knowing what is to be done and how (*direction*). The second involves the selection and monitoring of one's strategy during goal directed activity (*Adaptation*). The third is the ability to evaluate one's thoughts and actions (*Control*).

Another paradigm of significance in the study of intelligence is that of the cognitive-processing, or developmental approach. Rather than being concerned with individual differences the developmental approach is interested the way people learn to perceive, manipulate, and think about the world (Sternberg et al., 2003). Piaget and Vygotsky have been two prominent theorists within this paradigm. Piaget (1981) largely considered intelligence as arising from the biological maturation of cognitive structures as a function of an organism's adaptation to its environment, and operationalised adaptation in terms of the *Assimilation* or *Accommodation* of new information. Vygotsky (1978) emphasised the role of individuals' interactions with the environment, and suggested that basic to intelligence is the internal reconstruction of an external operation (*internalisation*).

The most recent paradigm to play a role in the study of intelligence is the information-processing approach. The information-processing approach is based on understanding intelligence via research methods developed to study the types of skills people use to think and solve problems, often in terms of identifying the cognitive processes involved in intelligent thinking (Sternberg et al., 2003). A common example of a model of intelligence arising from the information-processing approach is Sternberg's (1986) triarchic theory of intelligence. Sternberg conceptualises intelligence in his triarchic theory as comprised of three subtheories. The *componential* subtheory of intelligence is comprised of metacomponents, performance components, and knowledge-acquisition components. The componential subtheory specifies the fundamental information processes such as encoding, comparing, combining information, planning, and evaluating that are essential for learning and executing cognitive tasks. These components, when jointly sequenced, lead to task performance. People can employ their component processes to accomplish analytic type tasks (e.g., answering textbook problems), synthetic tasks (e.g., creating a haiku), or practical tasks (e.g., reaching a desired destination in a foreign city).

The *experiential* subtheory of intelligence is comprised of the ability to deal with novelty, and the ability to automatise processing. The experiential subtheory suggests that intelligence involves coping with novel situations in adaptive ways and, via experience, automatising the performance of habitual tasks to free up cognitive resources for novel tasks. Expertise involves, at least in one respect, the development of automatic procedures that aid in processing a selected set of frequent tasks.

Finally, the *contextual* subtheory of intelligence is comprised of the adaptation to, selection of, and shaping of one's environment. The contextual subtheory concerns intelligence at the interface between an individual and their environment. To be contextually intelligent, an individual may adapt to the environment's demands, may try to alter the environment to fit with their abilities, or may ultimately choose to leave the situation and select a different environment. For example, in working in an office situation, an individual may exhibit intelligence because they (a) accomplish a specific task by learning pertinent skills for task performance, (b) adapt the

undertaking by agreeing to do particular parts of the work for which their skills are suited, or (c) find an alternative venture or job that better matches their skills (Lubart, 2003).

Other influential models of intelligence have included that of Terman (1916), which defined intelligence as the ability to use symbols and concepts in dealing with novel problems or situations; and Thorndike's (1927) definition of intelligence as an individual's ability to respond in adherence to truth or fact. Alternatively, Stoddard (1943) modelled intelligence as the ability to, with focus and emotional control, engage in activities characterised by 1) difficulty, 2) complexity, 3) abstractness, 4) economy, 5) adaptivity, 6) social value, and 7) originality. Wechsler (1958) defined intelligence as the combined capacities to think rationally, act purposefully, and interact effectively with the environment. Whereas Cleary, and Humphreys et al. (1975) conceptualised intelligence as all acquired knowledge, skills, learning sets, and tendencies towards generalisation contemporaneously available and considered intellectual in nature.

As well as often adhering to different approaches or types of conceptualisations of intelligence, different models of intelligence have also often come into conflict regarding the numbers of intellectual abilities necessary for an adequate conceptualisation of intelligence. For example, Spearman's (1904) single all encompassing *g*. Gardner's (1993) theory of seven multiple intelligences: logical-mathematical, linguistic, spatial, bodily kinaesthetic, interpersonal, and intrapersonal intelligence. Or the 150-factor structure of intellect model expounded by Guilford (1982).

The preceding list of models of intelligence is by no means exhaustive, and it is not the purpose of this report to provide an exhaustive list of models of intelligence. Nor is it the purpose of this investigation to analyse, critique, or compare those that have been described. The empirical analysis that follows in later chapters does not necessitate it; moreover, it is a topic comprehensively addressed in other literature (see Fry, 1984; Jenkins, & Patterson, 1969; Neisser et al., 1996; Sternberg, 1982,1994; Sternberg et al., 2003; Sternberg, & Wagner, 1994). The focus of this investigation is instead specifically concerned with, and limited to an applied

psychometric conception of intelligence utilised in the workplace, which despite the many changes in conceptualisations of intelligence, has continued to serve as a benchmark of intelligence testing within organisational psychology (Riggio, 2000).

There is a great deal of controversy concerning the failure of definitions of intelligence within standard psychometric testing to include factors relevant to employed work and considered fundamental in models of intelligence (e.*g*., Brebner & Stough, 1995; Cattell, 1987b; Dixon, 2003; Lowman, 1991; Necka, 2003; Stankov, 2003; Sternberg, 1986, 1990; Sternberg et al., 2003; Wagner & Sternberg, 1985; Weinert & Hany, 2003). Including such examples as "social" and "emotional" intelligence (see for review Benson, 2003). However, definitions of intelligence for standard psychometric tests do measure one's capacity for information processing, problem solving, and abstract reasoning, which are considered key components for most definitions of intelligence (Ackerman & Rolfhus, 1999; Feist & Barron, 2003; Horn, 1968; Snyderman & Rothman, 1987); and for which, according to a fairly wide consensus, hierarchical models provide the best coverage (Ackerman & Heggestad, 1997; Carroll, 1982, 1993).

The origins of hierarchical models of intelligence are attributed to Spearman (1927), who proposed that intelligence consists of a general factor (*g*) and a set of specific factors (s). According to Spearman, *g* is the general intellectual ability that is responsible for the positive manifold (observed relations) among intelligence tests. Some critics of intelligence research maintain that the concept of *g* is illusory; however, agreement as to the utility of *g* has reached the point where theories that disregard it are classified as "pseudo-science" (Deary, 2001).

The hierarchical theory utilised in this research has its origins in Cattell's separation of Spearman's *g* into the factors of Crystallised (abbreviated - *gc*) and Fluid intelligence (abbreviated - *gf*) (Cattell, 1987c). Fluid intelligence concerns an individual's innate intellectual resources, whereas crystallised intelligence refers to an individual's intelligence via acculturation (Cattell, 1943b, 1963, 1987c; Horn, 1985; Horn & Cattell, 1966c; Ryckman, 1993). The use of fluid and crystallised intelligence to discriminate different components of general intelligence has gained considerable popularity in recent years (Ackerman & Goff, 1994; Lohman, & Rocklin, 1995;

Stankov, Boyle, & Cattell, 1995), which is probably due to comprehensive and well-supported empirical evidence for this distinction (e.g., Cattell, 1963, 1979, 1982; Dixon & Johnson, 1980; Hakstian & Cattell, 1974; Horn, 1968, 1977; Horn & Bramble, 1967; Horn & Cattell, 1966b, 1966c, 1967; Horn & Donaldson, 1980b; Vandenberg, 1967).

The theory of crystallised and fluid intelligence (Cattell, 1957, 1963; Horn & Cattell, 1966a, 1966b) questioned the belief that there existed a unitary structure for which the designation of general intelligence is appropriate. It questioned the idea that the best estimate of intelligence is derived from a conglomerate measured by combining sub-scores from a collection of intellectual tests (McNemar, 1964). The theory of crystallised and fluid intelligence also questioned the contention that the most theoretically and practically worthwhile course of action was to fragment the intellectual domain into a very large number of narrow, slightly distinct abilities (Guilford, 1959, 1966; Guilford & Merrifield, 1960). The theory of crystallised and fluid intelligence took issue with the notion that general verbal and quantitative abilities were really general, that is, were representative of distinct, unitary concepts at a high level of organisation encompassing all human abilities. The theory of crystallised and fluid intelligence is in certain respects similar to theories specifying a distinction between general verbal-education (v: ed) and general practical-mechanical (k: m) abilities (Burt, 1949; Vernon, 1950). However, the theory of crystallised and fluid intelligence differs from these conceptions in two important respects. Firstly, it differs in terms of the specification of which abilities go into each major dimension. Secondly, it differs in relation to the development of abilities in childhood and the adult years (Horn & Cattell, 1966c).

The theory of fluid and crystallised intelligence contends that the primary abilities, which to any considerable degree can be said to involve intelligence, are organised at a general level into two principal dimensions or classes. The dimension designated fluid intelligence is said to be the chief measurable outcome of the influence of biological factors on intellectual development (e.g., heredity, injury to the central nervous system or to basic sensory structures). The other broad dimension of crystallised intelligence is considered the major manifestation of the unitary nature of the impact of experiential, educative, and acculturation influences. According to

theory, the dimensions of crystallised and fluid intelligence are so pervasive relative to other ability structures, and so clearly of an intellectual nature that each merits the name "intelligence" (Horn & Cattell, 1966c). According to Carroll (1993) the Cattell-Horn model of crystallised and fluid intelligence is a "true" hierarchical model encompassing all principle domains of intellectual functioning. Carroll found the crystallised/fluid theory of intelligence "the most well-founded and reasonable approach to an acceptable theory of the structure of cognitive abilities" (p.62).

Both fluid and crystallised intelligence rely on processes defined by Horn and Cattell (1966c) as perceiving relationships, reasoning, abstracting, concept formation, and problem solving. They can be measured by speed and power tests based on pictorial-spatial, verbal-symbolic, and verbal-semantic materials (Stankov et al., 1995). Fluid intelligence is related to speed of reasoning, crystallised intelligence to reading speed, visual perception/spatial ability to perceptual speed, ideational fluency with retrieval capacity, the speed in which a test is undertaken with cognitive speed, and reaction time with processing speed (Bates & Shieles, 2003).

Fluid intelligence is labelled as such because "it could be diverted into almost any activity calling for the exercise of intelligence" (Horn, 1977, p.148.). Fluid intelligence is considered as consisting of general reasoning ability, or facility in reasoning, particularly that involving figural or nonverbal content/symbolic materials (Horn, 1976; Horn & Cattell, 1966c). It is measured by tests in which the limits of elementary relation perceiving, correlate-inducing capacities determine the limits of performance (Horn, 1977). This dimension is also characterised by some as nonverbal intelligence (although verbal tests can measure it), or performance IQ. It is generally indicated in tests such as letter series, matrices, mazes, figure classifications, and word groupings (Horn, 1976).

Crystallised intelligence derives its name from the fact that the abilities it encompasses appear to "crystallise out of experience" (Horn, 1977, p.150). Crystallised intelligence is conceived of as intelligence involving the application of verbal or conceptual knowledge (Horn & Cattell, 1966c). It concerns the awareness of concepts and terms pertaining to a broad variety of topics - as measured in general information and vocabulary tests and in tests that measure knowledge, including

mathematics. It is the dimension most likely to be referred to as indicating intelligence (Horn, 1976, 1977).

The benefit of examining both general intelligence (*g*) and fluid and crystallised intelligence is that it allows this model to provide both a general overview of intelligence, and to differentiate between individual differences at a level of greater detail, while avoiding the unwieldy complexity of multiple common factor models (Humphreys, 1986; McNemar, 1964). It promotes parsimony (Carroll, 1993; Goff & Ackerman, 1992; Marshalek, Lohman, & Snow, 1983), a refined interpretation of results, and encapsulates the three most often-discussed aspects of intelligence (Sternberg et al., 2003).

The approach to measuring intelligence used in this research is also consistent with Carroll's (1993) hierarchical model of intelligence, which involved the reanalysis of previous intelligence research and is considered by many the most definitive study into the structure of psychometric intelligence (Stankov et al., 1995; Sternberg et al., 2003). After reanalysing more than 450 data sets covering a full spectrum of tool and sample diversity, and observing the consistencies across results, Carroll extended the fluid/crystallised intelligence theory. Carroll postulates a "Three-Stratum" theory, according to which the structure of intelligence is comparable to a pyramid. Stratum III (the summit of the pyramid) is the equivalent of Spearman's "*g*". Stratum II consists of eight factors each representing enduring characteristics of individuals that influence their performance on a given domain. The largest of the Stratum II factors are fluid and crystallised intelligence, which are considered the most important factors within the paradigm of intelligence testing (Kline, 1995). Stratum I consists of a number of specific factors, such as mathematical reasoning and verbal ability.

1.3: Personality

Measures of personality are continuing to play a more prominent role than previously in the applied practice of organisational psychology (Murphy, 1996; Salgado, 1999). Mostly through meta-analytic work, there is now ample evidence that personality traits account for significant amounts of the variance (i.e., 10%-30%)

in work related outcomes (Furnham, 2001). Personality variables influence one's choice of work, reaction to it, and productivity therein (Lowman, 1996). Vocational choice selection success, training efficiency, and job satisfaction are all related to personality traits (George, 1996; Spencer & Spencer, 1993).

The increased use of personality traits in research and theorisation has resulted in a variety of advances in organisational psychology. One trend that has led to an improved understanding of important work-related variables and their relationships with each other is the development of construct-oriented thinking for both predictors (individual differences) and criteria (job performance). This increased use of personality traits in research and theorisation has led to job analysis methods that attend more comprehensively to areas that were previously ignored or dismissed as irrelevant in job performance. This expanded outlook has led to greater accuracy in predicting job performance in selection decisions (Hough, 2001).

Selection is the process of matching people and jobs. To optimise the use of personality traits in matching people with occupations it is beneficial to know how personality relates to other relevant individual variables. Due to the prevalence of combining personality trait measures with measures of intelligence in test batteries and in incremental validity, acquiring a better understanding of how personality and intelligence interact is particularly appropriate (S. Burke, personal communication, November 6, 2003). Consistent with an applied focus the personality variables utilised in this investigation encompass those considered most relevant in the organisational psychology context in terms of work-related characteristics (Budd, 1991; Roberts & Hogan, 2001; Spencer & Spencer, 1993). Brief descriptions of the personality variables used are contained in Tables 1 and 2, more detailed descriptions are provided in Appendices A and B. A brief discussion of the history of personality measures in industrial and organisation psychology, and the theoretical background underpinning the operational definition of personality used in this research follows. For a more comprehensive overview of the history of personality measures in industrial and organisational psychology see Kanfer, Ackerman, Murtha, and Goff (1995), or Hogan and Roberts (2001).

Throughout much of the earlier half of the twentieth century organisational psychologists generally considered "personality" an all-inclusive reference to any traits, which could account for what a person would do when placed in a given situation (Ryckman, 1993). These pioneers defined traits as relatively permanent and broad reaction tendencies; the most important distinction between which was ability and non-ability traits (Ewen, 1988) – contrasting sharply with the common current view that "ability" is not a personality trait (Ewen, 2003). Although this total individual, or "whole person" definition was consistent with the idea of personality, the separation of personality into its various traits was recognised by "whole person" proponents as enabling researchers to go beyond recognising and admiring the complexity of human beings, and select manageable aspects which they could study, even if only by the artificial treatment of such components as independent constructs (Ewen, 1988; Mischel, 1981; Saklofske & Zeidner, 1995, etc.).

Modern investigation into the use of personality within the workplace began in earnest during the early 1900s with the advent of the World War I. The main goal of personality testing during WWI was to screen out individuals considered unsuitable for recruitment due to characteristics predisposing them to being susceptible to wartime disorders. The first standardised personality test used for this purpose was the Woodworth Test of Emotional Stability (A.K.A., Woodworth Personal Data Sheet) (see Franz, 1919; Zubin, 1948). During the early part of the 20th century interest in the use of personality measures also developed in the private sector. This research had the goal of promoting the development of scientific methods for selecting salesmen and producing valid measures of personality defined by characteristics other than intelligence (e.*g.*, Kornhauser, 1922; Young, 1923).

The period between the great wars saw a steady increase in research into personality test development and the use of non-intelligence measures for screening and selection in the workplace (Viteles, 1930; Watson, 1932, 1933). The 1940s saw a steady increase in research into the use of standardised personality tests for selection and promotion decisions (Balinsky, 1945; Forlano & Kirkpatrick, 1945; Harrell, 1949; Jensen & Rotter, 1947; Kurtz, 1948). Three personality measures that were the focus of considerable attention during the 1940s were the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1940, 1951), the Cornell

Selectee Index (Weider, Mittelmann, Wechsler, & Wolff, 1944), which was the World War II equivalent of the Woodworth Test of Emotional Stability (Kanfer et al., 1995), and the Personal Inventory (Shipley, Gray, & Newbert, 1946). However, a controversy over the usefulness of personality tests in workplace selection was brewing (Barnabas, 1948). This controversy was driven by reviews of early research into the use of personality measures used to predict performance within an industrial and organisational framework. Such reviews often concluded that personality measures were generally ineffective for predicting performance (Ellis & Conrad, 1948).

Although controversy abounded as to the usefulness of non-intelligence personality measures in the prediction of job performance, rapid advances were being made in the development of clinically oriented personality measures. These advances in the development of clinically oriented personality measures coincided with military findings indicating the usefulness of these measures in screening for possible psychiatric problems when selecting personnel for high-stress or high-security positions (Kanfer et al., 1995). A considerable amount of research in the 1950s and 1960s was directed towards personality assessment. However, the vast majority of this research was directed towards the development of educational and counselling tools, with very little of this research directed towards the workplace (Taylor & Nevis, 1961).

During the 1960s what would go on to become a very influential review of personality measures in personnel selection was published by Guion and Gottier (1965). Many of the personality measures included in this review were those designed to assess normal personality to predict job performance, as opposed to more clinically oriented measures designed to screen for pathology. Guion and Gottier concluded "it cannot be said that any of the conventional personality measures have demonstrated really general usefulness as selection tools in employment practice." (p.140). As well as the concerns raised by Guion and Gottier the 1960s and 1970s witnessed considerable debate over the consistency and generalisability of personality traits versus the situational specificity of behaviour (Anastasi, 1985). The "situationist" debate is beyond the scope of this investigation. However, it can be summed up as an argument over whether people's behaviour was more influenced by

the nature of and forces acting in the environment than by an individual's characteristics (see Hogan, Desoto, & Solano, 1977; Kenrick & Funder, 1988, for reviews).

As a result of methodological and theoretical issues such as those detailed above, the late 1960s and 1970s were a relatively quiet period for personality assessment in industry. Although personality tests such as the Minnesota Multiphasic Personality Inventory (MMPI) or Sixteen-Factor Personality Questionnaire (16PF) (see Section 2.3.1) would continue to be used for pre-employment screening in the most sensitive positions, such as nuclear power plant operator, or air traffic controller, the use of personality tests for personnel selection in industry peaked during the early 1960s (Kanfer et al., 1995). However, by raising issues such as predictor and criterion breadth, aggregation of items, and tool construct methods (Kenrick & Funder, 1988), the situationist debate resulted in the development of conceptually, theoretically, and methodologically superior measures in personality research (Hogan & Nicholson, 1988). It was during this period that research began to unite around a Five-Factor Model of personality classification (Digman, 1990). The emergence of a common model of personality provided an unrivalled opportunity for applied psychologists to organise personality trait constructs and to link these constructs to job performance constructs (Kanfer et al., 1995). The introduction and nature of the Five-Factor Model and its implications for the current investigation are examined in Section 1.5.2.

Although there were considerable distinctions between early research into personality measures in industry and more modern research, one commonality throughout this research is the treatment of personality traits and intelligence as separate constructs. As a result of the continuation of the focus upon non-intelligence personality characteristics, over the last eighty years or so the term personality has come to be used by many researchers and practitioners as a concept to describe a compendium of traits or characteristic ways of behaving, thinking, feeling, reacting etc., other than intelligence (e.*g*., Buss & Plomin, 1975; Mischel, 1981; Necka, 2003). As a matter of convenience, and in recognition of such idiomatic use within the practice and theory of organisational psychology (Barratt, 1995; Eysenck, 1970;

Eysenck & Eysenck, 1985), this more restrictive use of personality - excluding intelligence - will be utilised in this investigation.

1.4: Joint Use of Personality and Intelligence Measures in Personnel Selection

The origins of the joint use of personality trait and intelligence measures in organisational psychology are largely in "multiple-hurdle frameworks" (Kanfer et al., 1995, p.594). As a result of some of the issues surrounding the use of "normal" personality measures in industry, the personality trait measures used within the context of this early personnel selection process were typically clinical in nature. These personality trait measures were not generally used to identify characteristics consistent with role requirements, but rather to exclude applicants who exhibited pathology (e.g., Balinsky, 1945; Weider et al., 1944; Zubin, 1948). Applicants that were without pathology would make it into the next round in the selection process. The next hurdle would involve ability testing. Successful applicants would be those who exhibited no pathology and a high level of ability relative to other applicants (Kanfer et al.).

Rather than the clinical personality measures discussed in the proceeding paragraph, personality trait measures in personnel selection now overwhelmingly involve "normal person" trait measures, such as the "Big Five" (see Section 1.5.2). The benefit of "normal person" trait measures over those of a clinical bent is that they focus upon information that is relevant in predicting important work-related behaviours. The provision of relevant information in predicting job performance has meant that the focus upon the joint use of personality trait and intelligence measures in personnel selection has moved from a multiple-hurdle paradigm, to issues of the incremental validity personality scores can add to intelligence scores in the prediction of job relevant criteria in the search for an optimal job/person fit (Cook, 2004; Gatewood & Feild, 2001; Kanfer et al.).

To identify the most favorable job/person fit it is first necessary to be aware of the most advantageous personal characteristics for predicting success in a particular job. Finding the optimal job/person fit is beneficial to both employers and employees. For the employed it promotes job satisfaction and well-being. For employers it has

performance implications in terms of employee productivity and effectiveness as well as workplace safety (Hesketh, 1993).

In order to achieve an optimal fit it is critical that the characteristics best suited to a particular job are identified. This is generally accomplishable in one of two ways. One way in which information pertaining to the characteristics best suited to a particular job is acquired is through job analysis and job description (Kline, 1993). Job analysis requires developing insights into the components of a particular job. These components generally include an understanding of what tasks need to be accomplished in a job, an analysis of those tasks and what resources are used to accomplish them, and the organisational implications for performing well or poorly on those tasks (Guion, 1991; Jewell & Siegall, 1990). Following the process of job analysis is the development of a job description, which involves a minutely detailed statement of the requirements of a particular job (Miller, 1966).

Job analysis and job description is able to provide information that facilitates identifying the right job/person fit for a particular job. However, the preferred method of identifying the crucial characteristics for success in a job is through the use of regression equations (Kline, 1993). Regression equations are statistical procedures that are able to identify the variance in criterion variables (such as job performance) accounted for by predictor variables (such as personality traits or intelligence) identified as related to the criterion of interest. The one advantage of job analysis over regression equations is that the data required to identify the predictor variables necessary in regression equations is often absent (Guion, 1991).

The pre-eminence of regression equations in identifying the most advantageous characteristics for the job/person fit in personnel selection has led to the common joint use of personality trait and intelligence measures in test batteries (Levy-Leboyer, 1989). A basic idea behind test batteries in personnel selection is that by combining the results of various characteristics independently related to job performance, greater predictive validity will be achieved. The development of a battery of predictors increases criterion related validity. The addition of predictors requires that the measures added to a battery function as valid predictors of criterion performance and that they are not greatly related to other predictors (Guion, 1991).

The need for any relationship between predictors to be minimal is to ensure that predictors are not simply predicting the same aspects of future job performance (Cook, 2004).

Support for incremental validity in the addition of personality traits to intelligence scores for predicting job performance comes predominantly from meta-analyses (Cook, 2004). Meta-analytic research by Schmidt and Hunter (1998) suggests greater predictive validity is achievable through the addition of personality trait scores' to intelligence scores. The investigation of Schmidt and Hunter, and a meta-analysis by Salgado (1998) have both been particularly optimistic regarding the use of the personality trait 'Conscientious' with intelligence scores for incremental gains in predictive validity. This optimism is based upon the lack of correlation between intelligence and the personality trait 'Conscientious' found in these meta-analyses, and the putative importance of both intelligence and the personality trait 'Conscientious' in job performance.

The focus on incremental validity and the general consensus that the constructs of intelligence and personality traits are independent is reflected in the literature (Zeidner, 1995). Rather than enhancing our knowledge of the cross-domain relationships among personality traits and intelligence (Lowman, 1991), most recent research within the workplace has focused upon the incremental validity personality trait scores may add to intelligence scores in predictions of job performance or other criterion variables (e.g., Avis, 2002; Barrick, Mount, & Strauss, 1993; Day & Silverman, 1989; Denton, 1997; Judge, Higgins, Thoresen, & Barrick, 1999; McHenry, Hough, Toquam, Hanson, & Ashworth, 1990; Spector, Schneider, Vance, Hezlett, 2000; Tenopyr, 2002). This focus is perhaps partly the result of the relationships among personality traits and intelligence being targeted by research within the applied framework of personnel selection rather than a more theoretically exploratory paradigm. The applied research approach is popular as it serves such practical goals as identifying economical, and efficient psychometric predictors of job performance; often leading to their incorporation into the specification equation for a job, which combines psychometric predictors of job performance in order to achieve the greatest degree of predictive validity possible (Kline, 2000).

Investigations such as those conducted by Avis (2002) etc., have yielded a considerable amount of support for the additive use of personality trait scores to intelligence scores to achieve greater incremental validity, and thus predictive validity in selection decisions. However, the computation of incremental validity requires knowledge of the intercorrelations among the predictors, not just the relationship between each predictor and the criterion (Ones & Viswesvaran, 2001; Kline, 2000).

The incremental benefit of using both personality traits and intelligence scores in selection decisions is based on the idea that the association between intelligence and personality traits is zero, making any additive association between the two against a criterion variable (such as job performance) indicative of a net increase in predictive validity for that variable (Kanfer et al., 1995). Through investigating the relationships among intelligence and personality traits this investigation will test the legitimacy of this oft-implicit premise that intelligence and personality traits do not co-vary (Kanfer et al.).

1.5: Correlates for Intelligence and Personality

1.5.1: Historical Research

Research into correlations among intelligence and personality traits can be traced back to the beginning of the 20th century, such as that undertaken by Karl Pearson (1906-1907). Pearson reported correlations between teacher judgments of intelligence and "mental characters" ('Shyness', 'Popularity', 'Conscientiousness', 'Quiet habits', 'Self-Consciousness', and 'Temper'). The highest correlation reported by Pearson was that between rated intelligence and the personality trait 'Conscientiousness' (.45). Webb (1915) was another early investigator of the relationships between personality and intelligence. Like Pearson, Webb relied upon teacher ratings to discover associations among personality traits and intelligence. The limitation of relying upon subjective teacher ratings to determine the relationships among intelligence and personality traits illustrates the types of methodological issues surrounding research of this period. Lorge (1940) undertook an early review of research such as that of Pearson and Webb. Lorge examined more than 200 correlations between intelligence and personality scales, which he found to have a

range of from -.49 to +.77; however, the vast majority of correlations were more modest in magnitude and often contradictory in sign. Unfortunately, the only "conclusion" that can be drawn from this short review is the conceptual confusion over personality traits and the imprecision with which they were measured.

Following Lorge's (1940) review, a number of researchers continued to investigate, and find relationships between intelligence and personality traits (e.g., Adorno, Frenkel-Brunswick, Levinson, & Sanford, 1950; Butcher, Ainsworth & Nesbitt, 1963; Ferguson & Maccoby, 1966; Fisher, 1967; Haley & Lerner, 1972; Heim, 1970; Horn, 1968; Kipnis, 1971; Korman, Stubblefield, & Martin, 1968; Matarazzo, 1972; Mischel, 1968; Thompson & Michel, 1972). Much of the research conducted following Lorge's review revolved around relationships between the personality traits 'Extroversion'/'Introversion' and intelligence. Research on the correlates of the personality traits 'Extroversion'/'Introversion' with intelligence has had mixed and often contradictory results (Eysenck, 1971; Eysenck & Cookson, 1969; Robinson, 1985, 1986). Some studies reported positive relationships between intelligence and the personality trait 'Extroversion' (Lynn, Hampson, & Magee, 1982; Crookes, Pearson, Francis, & Carter, 1981). Some studies reported that the personality trait 'Extroversion' did not correlate with intelligence (Eysenck, 1971; Robinson, 1985). Other research reported positive relationships between intelligence and the personality trait 'Introversion' (Revelle, Amaral, & Turriff, 1976), often suggesting that these results were a function of extroverts opting for speed in experimental tasks in which introverts went for accuracy (Eysenck, 1967; Jensen, 1964; Rawlings & Carnie, 1989). Reviews of literature in connection with the relationship between the personality traits 'Extroversion'/'Introversion' and intelligence has led some authors to conclude that extroverts and introverts do not significantly differ in intelligence (Zeidner, 1995).

Interest in research examining relationship between intelligence and personality traits other than 'Extroversion'/'Introversion' also followed Lorge's (1940) review and Wechsler's (1950) prompting. Wechsler first attempted to broaden the consideration of intelligence beyond that contained in standardised tests in an American Psychological Association presentation in 1940, and again later in an APA Division of Clinical and Abnormal Psychology address, published in the *American*

Psychologist (1950). Wechsler lobbied for the use of a more inclusive framework that would encompass "cognitive, conative, and non-intellective intelligence" (p.82). However, when reviews by Guion and Gottier (1965), and then Ghiselli (1973), suggested that the validity of the traits comprising personality tests was so low as to render their applied use impractical, many researchers turned away from studies involving personality traits, and thus studies in which the relationship between personality traits and intelligence may have been examined.

One group of researchers who were never deterred from conducting studies involving personality traits by Guion and Gottier (1965), and Ghiselli's (1973) reviews was Raymond B. Cattell and his colleagues. Although not the only researchers investigating relationships between personality traits and intelligence (Crowe, 1979; Roessler, Lester, Bulter, Rankin, & Collins, 1978; Wilson, 1977), Cattell and his colleagues were the most pre-eminent, and have been a formative influence on our knowledge of relationships between intelligence and personality traits. This group consistently found various significant relationships between the personality traits they measured and distinctive aspects of behaviours that fall under the general rubric of intelligence (e.*g*., Barton, Cattell, & Silverman, 1974; Cattell, 1945a, 1971; Cattell & Drevdahl, 1956; Cattell, Sealy, & Sweney, 1966; Horn & Cattell, 1966c). In fact at one time or another many of Cattell's 16 Personality Factor (16PF) Questionnaire dimensions (see Section 2.3.1) have been found to correlate with psychometric intelligence, or components thereof (Butcher et al., 1963; Cattell, 1987a; Cattell & Horn, 1963; Cattell, Horn, & Butcher, 1962; Horn, 1968; Horn & Turner, 1974; Turner & Horn, 1976; Turner, Willerman, & Horn, 1976, etc.).

One of the most commonly reported, though not always consistent, relationships between intelligence and personality traits by Cattell and his colleagues were relationships between intelligence and the personality trait 'Conscientious'. Most of the research carried out suggested a positive relationship between general intelligence and the personality trait 'Conscientious' (e.g., Cattell, 1945b, 1946, 1957, 1987a; Hakstian & Cattell, 1978). However, some research suggested a negative relationship between the personality trait 'Conscientious' and intelligence (Meredith, 1967). Some research examining the relationship between intelligence and the personality trait 'Conscientious' utilised Cattell's hierarchical model of intelligence.

The research employing this hierarchical framework suggested that the personality trait 'Conscientious' was positively related to crystallised intelligence (Cattell, 1963; Horn, 1976), yet negatively related to fluid intelligence (Cattell, 1963). This would suggest that the contradictory findings for relationships between the personality trait 'Conscientious' and intelligence of other research may be the result of different degrees of loading on fluid and crystallised intelligence in the intelligence tests used in the respective studies. That such different relationships were demonstrated with the personality trait 'Conscientious' for crystallised and fluid intelligence reinforces the necessity for the crystallised – fluid intelligence distinction when examining relationships between personality traits and intelligence.

1.5.2: Modern Research, Current Issues and Goals

A re-evaluation of the apparently doom-and-gloom reviews published in the 1960s and 1970s prompted a resurgence of research in the 1980s into relationships between personality traits and intelligence (Lowman, 1991). This modern research differs from its predecessors in that much of it has been conducted within a paradigm of general consensus regarding the structure of personality traits. This consensus is reflected by several researchers' adoption of a Five-Factor Model (FFM) of personality, often referred to as the "Big-Five" (Ashton, Lee, Vernon, & Jang, 2000; Austin, Deary, Whiteman, Fawkes, 2002; Barratt, 1995; Bates & Shieles, 2003; Costa & McCrae, 1978, 1985; Dweck, 1986; Dweck & Leggett, 1988; Goff & Ackerman, 1992; Hojat, Robeson, Damjanov, Veloski, Glaser, & Gonnella, 1993; Holland, Dollinger, Holland, & MacDonald, 1995; McCrae, 1993, 1994; McCrae & Costa, 1982; Moutafi et al., 2003; Norem, 1989; Van der Zee, Zaal, & Piekstra, 2003, etc.).

The Five-Factor Model of personality dimensions was introduced, and convincingly argued, by Costa and McCrae (1985) on their adding the personality dimensions of 'Conscientious' and 'Agreeableness' to the NEO[1] Personality Inventory (NEO-PI). The Five-Factor Model paradigm is consistent with a growing body of research supporting the utility of five major personality traits (Costa, Herbst, & McCrae, 2002; Digman, 1990; Hough & Schneider, 1996; McCrae & Costa, 1985,

[1] 'Neuroticism', 'Extroversion', 'Openness-to-Experience'.

1987, 1997a; McCrae & John, 1992), which have been found predominantly stable throughout adulthood through both cross-sectional and longitudinal studies (e.g., Costa & McCrae, 1988; Costa et al., 1986; McCrae et al., 2000) and across cultures/genders (Costa, Terracciano, & McCrae, 2001; McCrae et al., 1999; McCrae, Costa, & Del Pilar, 1998; McCrae, Costa, & Terracciano, 2002). However, while there is general agreement as to the utility of a Five-Factor Model of personality, the question of *which* five factors it should comprise is considerably more controversial (Matthews & Deary, 1998).

Five-Factor Models of personality have come under inherent criticisms of their design, theoretical rationale, and science-directing implications (e.*g*., Ben-Porath &Waller, 1992a, 1992b; Eysenck, 1992; Hough, 1992; McAdams, 1992; Tellegen, 1993; Waller & Ben-Porath, 1987). This is particularly true of Costa and McCrae's popular model, which is prefaced by the earlier work of Tupes and Christal (1961), built upon by Norman (1963) (See Boyle, 1989; Boyle, Stankov, & Cattell, 1995; Kline, 1995; Lohman & Rocklin, 1995). However, due to its scope this investigation is most concerned with those criticisms that directly concern the practical application of research findings for Five-Factor Models' relationship with intelligence within the workplace environs.

One particularly apposite criticism of the use of personality inventories which use the Five-Factor approach to trait classification is that they fail to provide the same degree of predictive value as the primary traits of which they are comprised (Boyle et al., 1995; Kline, 1995; Mershon & Gorsuch, 1988). The designation of personality traits as second-order/global, or primary/first-order is made in reference to whether or not the traits described are divisible into further measurable traits. For example, the Fifteen-Factor Questionnaire (15FQ) personality trait of 'Extroversion' is a second-order trait as it is further measurably divisible into the personality traits from which it is comprised: 'Outgoing', 'Enthusiastic', 'Socially bold', and 'Group-orientated' (see Section 2.3.1). Whereas, the personality traits 'Outgoing', 'Enthusiastic', 'Socially-bold', and 'Group-orientated' are primary traits because while defined by specific characteristics, they are not further divisible into measurable personality traits (Cattell, Eber, & Tatsuoka, 1970; Jennrich, & Sampson, 1968).

The criticism that second-order traits lack the predictive value of their primaries is consistent with research by Schmit and Ryan (1993). Schmit and Ryan found that while portions of the Five-Factor Model existed in their job applicant sample, the largest factor by far, was a conglomerate of item composites from across four of the five subscales of the NEO-FFI. They suggested that the five factor structure used to develop the NEO-FFI did not allow an applicant the freedom necessary to describe his or her personality in a manner that reflects the more complex model of personality related to performance at work. This proposition is also consistent with findings by Hogan and Hogan (1992), and McAdams (1992) gained through the application of Item Response Theory to the prediction of job performance.

This is consistent with Cattell's (Boyle et al., 1995) criticism of Five-Factor Models that in their pursuit of parsimony Ockham's razor may have slipped[2]. Cattell draws an analogy between the Greeks having started with four elements – air, earth, fire, and water – yet modern chemists recognising the need for 100 elements. Wherein the popularity of Five-Factor Models, like the four elements of the Greeks, represents an understandable, but inadequate view of the world (Boyle et al.). A criticism supported by a wide survey of predictions of occupational and clinical performances in which predictions from Cattell's 16 primary factors greatly exceeded that from Five-Factor Models (Mershon & Gorsuch, 1988). For a greater appreciation of the debate over the use of broad or narrow personality measures in the workplace see Ones and Viswesvaran (1996), J. Hogan and Roberts (1996) and Schneider, Hough and Dunnette (1996).

The relevance of the criticism concerning the apparent coarseness of Five-Factor Models for this investigation concerns the idea that not only may such second-order models lack the sensitivity of their primary counterparts when it comes to predicting outcomes (such as future job performance), but they may obscure relationships between personality traits and intelligence. If this concern is well grounded, the value of much recent research into the relationship between intelligence and personality traits could be reduced. Examining the directions of the significant

[2] The principle of Ockham that *entia non sunt multiplicanda praeter necessitatem:* entities are not to be multiplied beyond necessity (Blackburn, 1994).

correlations between those primary dimensions that comprise second-order models, and making a comparison of these directions with those that would be expected on the basis of previous research, which has used comparable, if not equivalent Five-Factor Models, will test this potential obfuscation.

The vast majority of recent research into the relationship between intelligence and personality within industry has focused upon the Five-Factor Model personality trait of 'Openness-to-Experience', which Norman (1963) originally called 'Culture', and others have called 'Intellect' (Digman & Takemoto-Chock, 1981; Peabody & Goldberg, 1989). Most research supported a positive relationship between the personality trait 'Openness-to-Experience' and intelligence (Ackerman & Goff, 1994; Ackerman & Heggestad, 1997; Brand, 1994;Costa, Fozard, McCrae, & Bosśe, 1976; Holland et al., 1995; Hough, 2001; McCrae & Costa, 1985, etc.), particularly crystallised intelligence (Bates & Shieles, 2003; Brand, 1994; Goff & Ackerman, 1992; Kanfer et al., 1995; Van der Zee et al., 2003, etc.). However, research between the personality trait 'Openness-to-Experience' and the fluid and crystallised components of intelligence has not always produced consistent findings. Some research has yielded results suggesting correlations for the personality trait 'Openness-to-Experience' with crystallised but not fluid intelligence, whereas some has suggested correlations with fluid but not crystallised intelligence (Ashton et al., 2000).

That correlations between the personality trait 'Openness-to-Experience' and intelligence have been suggested is of no great surprise as out of the Five-Factor Model personality dimensions 'Openness-to-Experience' is considered the most conceptually similar to intelligence (Barrick & Mount, 1991; Eysenck, 1992; McCrae & Costa, 1987). It has been suggested that the construct domains for the personality trait 'Openness-to-Experience' and intelligence overlap (McCrae & Costa, 1985, 1997a; McCrae & John, 1992).

'Anxiety' is another personality trait that has been the focus of considerable research since the broad adoption of Five-Factor Models of personality. Meta-analytic studies of the literature bearing on the personality trait 'Anxiety' and performance on intelligence tests have shown average negative correlations of about

.20 (Hembree, 1988; Seipp, 1991). Much contemporary research into the relationship between intelligence and the personality trait 'Anxiety' has concentrated on whether the trait 'Anxiety' is inherently negatively related to intelligence. Contemporary research has investigated whether the personality trait 'Anxiety' is negatively related to intelligence because it impairs cognitive functions important for test taking success, such as attention and working memory (Eysenck, 1982, 1992; Matthews & Dorn, 1995; Necka, 2003; Wells & Matthews, 1994; Zeidner & Matthews, 2000). The benefit of utilising the hierarchical model of intelligence employed in this investigation is that it will be able to provide support, or otherwise, for this hypothesis. If the negative relationship between intelligence and the personality trait 'Anxiety' is consistent across both fluid and crystallised intelligence it will support the idea that the trait 'Anxiety' interferes with cognitive processes necessary for test taking success.

However, the relationship of greatest interest for this investigation is between intelligence and the personality trait 'Conscientious'. Research by Ackerman & Heggestad (1997) found a negative, albeit weak relationship between the personality trait 'Conscientious' and intelligence. Research by Furnham et al. (as cited in Moutafi et al., 2003), and Moutafi et al., has found even stronger negative relationships between the personality trait 'Conscientious' and intelligence – for which the personality trait 'Conscientious' was also found to be a significant predictor, in a negative direction. Research by Van der Zee et al. (2003) has reported a negative relationship between the personality trait 'Conscientious' and crystallised intelligence, which was mirrored by a positive correlation between the personality trait 'Flexibility' and crystallised intelligence. Recent research into the relationship between personality traits and intelligence has also suggested that fluid intelligence is largely unrelated to personality traits (Van der Zee et al.; Wart, Miles, & Platts, 2001). The question of whether such results are replicated will be a focal point of this research.

There are two major reasons for this research focusing upon the relationship between the personality trait 'Conscientious' and intelligence. First, a negative correlation between the personality trait 'Conscientious' and intelligence is important in terms of the presumption of nil covariance between personality traits and

intelligence in their addition for increased predictive validity in selection decisions (see Section 1.4). This is especially relevant as among personality traits, the trait 'Conscientious' was found to be the single best predictor of job performance (Barrick & Mount, 1991, 1993; Barrick, Mount, & Judge, 2001; Hough, 2001; Matthews & Deary, 1998; Tett, Jackson, & Rothstein, 1991), and intelligence is considered the single best predictor of job performance (Barrett & Depinet, 1991; Barrick, Mount, & Strauss, 1994; Rosse & Noel, 1996; Clark, & Gist, 1938; Coward, & Sackett, 1990; Gottfredson, 1986; Hawk, 1986; Herrnstein & Murray, 1994; Hunter & Hunter, 1984; Johnson, 1983; Lynn, 1986; Murphy, 1996; Ones & Viswesvaran, 2001; Ree, Earles, & Teachout, 1994; Schmidt & Hunter, 1998; Schmidt, Hunter, & Pearlman, 1981; Schmidt, Ones, & Hunter, 1992; Thorndike, 1986). The putative value of the personality trait 'Conscientious' and intelligence in the prediction of job performance makes the personality trait 'Conscientious' and intelligence the most likely combination of factors to be added for increased predictive validity (Black, 2000, Yoon, 1998 etc.). The result of such a replication would require a rethink into what the addition of the personality trait 'Conscientious' scores to intelligence scores contributes to predictive validity. Intriguingly, it would also prompt an examination of explanations for how these constructs can both be such putatively excellent predictors of future job performance if they are negatively related? Secondly, there has been a relative paucity of research examining the correlations between the personality trait of 'Conscientious' and intelligence (Moutafi et al., 2003; Van der Zee et al., 2003)

Methodological limitations reducing the utility of contemporary research findings into the relationship between personality traits and intelligence have included insufficient sample sizes (Austin et al., 2002; Goff & Ackerman, 1992; Holland et al., 1995); a scarcity of research in an I/O context (Hunter & Hunter, 1984; Lowman, 1991); and the use of atypical samples rendering potential generalisations questionable (Caspy, Reisler, & Mendelson, 1987; Egan, 1989; Horn & Turner, 1974) – exemplified by research exclusively using clinical scales of personality such as the MMPI (Hathaway & McKinley, 1940) (*e.g.*, Bloom & Entin, 1975; Holland & Watson, 1980; L'Abate, 1962; Lacks & Keefe, 1970; Sutker, Moan, & Allain, 1974). The validity/reliability of the instrument scales used has also been criticised (Bad, Mann, & Mar-Hayim, 1975; Denton & Taylor, 1955; Ferguson & Maccoby, 1966;

Furnham, Forde, & Cotter, 1998; Hakstian & Cattell, 1978; Horn & Turner, 1974; McCrae, Stone, Fagan, & Costa 1998; Sattler, Hillix, & Neher, 1970, etc.).

Another concern, spanning the history of research into the relationships between personality traits and intelligence, is that it has covered a few key personality traits individually without attempting an exhaustive examination of such traits in combination (Zeidner, 1995). This investigation will remedy many of the preceding concerns by exhaustively examining all personality traits contained within the personality measures utilised, using a sufficiently large sample size, and using measures of known and acceptable validity and reliability.

1.6: Hypotheses

This investigation utilises two distinct subsamples of subjects: Subsample 1, and Subsample 2. Participant assignment to either subsample was determined by which personality inventory they had completed. Those who had completed the 15FQ were assigned to Subsample 1; those who had completed the OPP were assigned to Subsample 2 (see Section 2.1). The personality traits chosen from the 15FQ and OPP for hypothesis testing have been done so on the basis of their standing as the primary traits of which the second-order personality trait of 'Conscientious' (FFM), or its equivalent is comprised. The hypotheses relating to Subsample 1 and Subsample 2 respectively are listed below.

Because both personality tests used within this research have bi-polar traits some of the hypotheses are formulated in terms of the predicted relationship between intelligence and the opposite trait intended. For example, as the OPP provides a measure for the personality trait 'Flexibility' (OPP), but not explicitly its bi-polar opposite the personality trait 'Detail Conscious' (OPP), it is necessary to infer the relationship between the trait 'Detail Conscious' (OPP) and intelligence from the relationship found for the trait 'Flexibility' (OPP). As long as bipolarity is assumed a positive relationship between the personality trait 'Flexibility' (OPP) and intelligence will indicate a negative relationship between the personality trait 'Detail Conscious' (OPP) and intelligence.

Trait descriptions of the personality variables listed in the below hypotheses are provided in Tables 1 and 2 respectively. Conceptual information for the below personality traits is contained in Appendices A and B respectively.

1.6.1: Hypotheses for Relationships Between Fifteen-Factor Questionnaire Personality Traits and Intelligence

- **Hypothesis 1:** There will be a negative relationship between the variables of intelligence and 'Conscientious' (FG).
- **Hypothesis 2:** There will be a negative relationship between the variables of intelligence and 'Disciplined' (FQ3).
- **Hypothesis 3:** There will be a positive relationship between the variables of intelligence and 'Tense-driven' (FQ4).
- **Hypothesis 4:** There will be a positive relationship between the variables of intelligence and 'Restrained' (FN).

1.6.2: Hypotheses for Relationships Between Occupational Personality Profile Personality Traits and Intelligence

- **Hypothesis 5:** There will be a negative relationship between the variables of intelligence and 'Conform' (OPP).
- **Hypothesis 6:** There will be a positive relationship between the variables of intelligence and 'Phlegmatic' (OPP).
- **Hypothesis 7:** There will be a positive relationship between the variables of intelligence and 'Flexible' (OPP).

Both sets of hypotheses have been devised on the basis of specific expectations of prior research. However, the respective hypotheses presented above are in no way representative of all of the relationships that may be expected in the actual empirical findings on a New Zealand sample. Instead they are the hypotheses in keeping with the goals, and logistics of this investigation.

CHAPTER 2: METHOD

2.1:Participants

The participants consisted of 4120 individuals who had undergone psychometric testing in New Zealand in an organisational context. These participants can be viewed as a "sample of convenience" as their selection occurred via nonprobability sampling on the basis of available archival data and selection criteria, not random sampling from any population (Pedhazur & Schmelkin, 1991). The selection criteria used to determine inclusion in the "sample of convenience" was the completion of the General Reasoning Test 2 (GRT2), and either the Fifteen-Factor Questionnaire (15FQ) or Occupational Personality Profile (OPP). The participants comprised two distinct subsamples differentiated on the basis of the specific personality inventory completed.

Information pertaining to the majority of participants' demographics was not available to the researcher. Such information was likely to have been absent for one of two reasons. Firstly, participants may have chosen not to disclose this information when they originally completed the measures. Secondly, such information may have been provided by participants, but not passed on by the company that primarily acquired this information.

2.1.1: Subsample 1

The first subsample comprises 1576 individuals. Of these participants, 1325 completed measures within the context of making a job application and 5 completed measures as a function of their current employment (246 lacked reference to any such information). The criteria for inclusion in this subsample required participants to have completed both the 15FQ and GRT2.

In terms of information pertaining to participant demographics: 877 of the participants were male, 686 female, with gender information absent for 13. 1295 of the 1576 participants provided information pertaining to their age. The mean age of

these participants was 32.11 years with a standard deviation of 8.36 years and a range of between 17 and 61. Information regarding participants achieved level of education was also provided, and ranged from an uncompleted secondary school education through to postgraduate qualifications. However, such information was only available for 225 of the participants.

258 individuals also provided information on their ethnicity. European descent was the most prominent ethnicity (N = 180), followed by Maori (N = 53), Pacific Islander (N = 9), and Asian (N = 16). However, information pertaining to the ethnicity of the vast majority of participants (N = 1318) was unavailable.

2.1.2: Subsample 2

The second subsample comprises 2544 individuals. 2163 completed measures within the context of making a job application, and 7 completed measures as a function of their current employment (information absent for 374). The criteria for inclusion distinguishing this subsample required participants to have completed both the OPP and GRT2.

In terms of information pertaining to participant demographics: 1214 of the participants were male, and 1318 female (gender information absent for 12). 2246 of the 2544 participants also provided information pertaining to their age. The mean age of these participants was 27.04 years with a standard deviation of 13.08, and a range of between 17 and 63. Information regarding participants achieved level of education was also provided, and ranged from an uncompleted secondary school education through to postgraduate qualifications. However, such information was only available for 331 of the participants.

216 individuals also provided information on their ethnicity. Maori was the most prominent ethnicity (N = 80), followed by European descent (N = 76), Pacific Islander (N = 27), Asian (N = 32), and African (N = 1). However, information pertaining to the ethnicity of the majority of participants (N = 2328) was unavailable.

2.2: Design

The present study employs a cross-sectional, correlational design. The correlational paradigm is consistent with the aims of this study. Because it is not possible, nor ethical, to manipulate participants' personality traits to determine what effect this has on their intelligence levels, or vice versa, the use of a correlational design is appropriate. It is also appropriate due to the nascent level of knowledge relating to the area of interest, and as a means of testing hypothetical relationships in a real world setting (Bordens & Abbott, 1996).

The correlational approach is also sufficiently broad in scope to identify important previously unknown relationships among variables that can provide direction for future research (Bordens & Abbott, 1996); and thus consistent with Turkey's (1977) emphasis on combining both exploratory and confirmatory research goals within research design. According to Guba and Lincoln (1994) the correlational approach generally avoids the major pitfalls of *context stripping* that are often of concern in more precise, yet less ecologically valid quantitative approaches utilising experimentally controlled designs.

The correlational design is consistent with the multivariate nature of this investigation. The use of multivariate rather than univariate approaches to the examination of personality and intelligence variables is widely spread (see for reviews, Boyle, 1991; Nesselroade & Cattell, 1988). It has been adopted extensively within the Cattellian school (see Boyle & Cattell, 1984; Stankov, 1980, 1987, 1989; Stankov & Chen, 1988).

2.3: Materials

Three psychometric tools are used in this research. One of these is the GRT2, which is an intelligence test. The other two are personality inventories: the 15FQ, and OPP. Information relating to the design and theoretical foundation of these instruments is presented below.

2.3.1: Fifteen-Factor Questionnaire (15FQ)

The 15FQ is a normative personality test, which has specifically been developed for use in research, and I/O settings (Barrett & Paltiel, 1993). The 15FQ comprises 191 items, assessing 15 bipolar personality traits (see Table 1), and three administration scales: 'Social desirability', 'Random responding', and 'Central tendency'. The scale of 'Central Tendency' measures one's propensity to provide central "not sure" responses to items rather than more informative extreme responses (Budd, 1992). As with other personality profile variables in this report, the distortion scale variable of 'Central Tendency' is underlined and enclosed in quotation marks, this identifies it as referring to the distortion scale variable, and not the statistical property of central tendency. The 15FQ takes on average 25-30 minutes to complete (Budd).

Budd (1992) shows that 15FQ dimensions have internal-consistency reliability coefficients above $r > .64$, which although less than optimal, indicate acceptable degrees of reliability; and is likely to reflect conservative estimates of the scales' reliability (Carmines & Zeller, 1979). The test-retest coefficients provided also show acceptable levels of stability for the 15FQ, which compare very well with test-retest coefficients reported for comparable personality instruments (Budd).

The construct validity of the 15FQ has been established by examining the relationship between the 15FQ and a wide range of alternative measures of personality. The results of these comparisons have demonstrated the validity of 15FQ scales. For example, 15FQ scales were found in varying, but always acceptable degrees to measure similar personality traits to the Sixteen Personality Factor Questionnaire-A (16PF-A), Occupational Personality Questionnaire (OPQ), Jung Type Indicator (JTI), Eysenck Personality Questionnaire – Revised version (EPQR), Eysenck 17 Scales (17), and the NEO-Personality Inventory (NEO-PI) (Budd, 1992).

The 15FQ was developed on the basis of the 16PF (Cattell et al., 1970). The 16PF was first published in 1949 and has remained one of the most widely used personality inventories (Krug & Johns, 1986). Cattell saw "personality" as a variable predicting what a person will do in a given set of circumstances (Cattell, 1946, 1950).

Cattell shared Allport and Odbert's preference for using the term "traits" to describe these assumed to be relatively stable characteristics (Ewen, 1988).

Table 1.

15FQ Primary Dimensions (adapted from Budd, 1992)

Trait	Low Score Description	High Score Description
FA	**Reserved:** reserved, cool, aloof, distant	**Outgoing:** gregarious, warm, participating
FC	**Temperamental:** emotional, moody	**Calm-stable**: mature, resilient, unruffled
FE	**Accommodating:** empathic, mild, modest	**Assertive**: forceful, confrontational
FF	**Cautious:** deliberating, sober, serious	**Enthusiastic**: lively, impulsive, animated
FG	**Expedient**:expedient, tolerant, spontaneous	**Conscientious:** rule-bound, meticulous
FH	**Retiring**: timid, shy, Restrained	**Socially Bold:** attention-seeking, confident
FI	**Factual:** realistic, hard-headed, unmoved	**Intuitive:** aesthetic, tender-minded
FL	**Trusting**: easy-going, accepting, tolerant	**Suspicious:** cynical, questioning, wary
FM	**Practical:** pragmatic, down-to-earth	**Conceptual**: imaginative, abstract
FN	**Direct:** forthright, uncalculating, frank	**Restrained:** inhibited, guarded, diplomatic
OF	**Confident:** self-assured, complacent	**Self-doubting**: apprehensive, insecure
FQ1	**Conventional:** conservative, traditional	**Radical:** innovative, liberal-minded
FQ2	**Group Orientated**: dependent, affiliative	**Self-sufficient**: self-reliant, solitary
FQ3	**Informal:** undisciplined, unconventional	**Disciplined**: self-controlled, rigid
FQ4	**Relaxed:** composed, placid	**Tense-driven**: impatient, irritable

Note. These definitions of the above dimensions are further elaborated on in Appendix A.

Cattell's (1943a) initial development of the 16PF built upon the results of Allport and Odbert's (1936) examination into English language personality descriptive terms. Allport's (1937) proposed idiographic science of personality was antithetic to the Cattellian nomothetic approach to personality theory. However, as a result of Cattell's use of Allport's dictionary descriptions of personality, the 16PF was

methodologically distinguished among personality tests as the only one based upon all descriptive words for attributes of a person (Boyle, 1990; Cattell, 1946, 1957b, 1964, Cattell et al., 1970; Kline, 1995).

The underlying theory behind the development of the 16PF has received a great deal of empirical support for the validity of its scales, both within the original Western context of its design, and cross-culturally (Cattell, 1973; Cattell & Johnson, 1986; Cattell & Kline, 1977; Stankov et al., 1995). It has also withstood the test of critical appraisal over many editions of the *Mental Measurements Yearbooks* and/or *Test Critiques* (Boyle et al., 1995; Matthews & Dearly, 1998).

Stage one in Cattell's (1943a) development of the 16PF involved reducing Allport and Odbert's list of English trait adjectives from 4500 to 171. This was accomplished through the elimination of what were perceived to be "synonyms". Cattell then obtained observer ratings for individuals on these adjectives (Ryckman, 1993). Based on these ratings Cattell was able to distinguish 36 clusters of correlations, or surface traits. Cattell defined surface traits as visible personality characteristics that are the result of the combination of two or more source traits, which he considered the basic elements of personality, and only identifiable through factor analysis.

On the basis of psychiatric literature, and further acquisition of data - through self-reports on written questionnaires (Q data), objective tests (T data), and by studying and rating the behaviour of individuals in everyday life (L data) - Cattell would subsequently add ten more surface traits to these 36 clusters. Cattell maintains that these 46 personality traits cover the whole "personality sphere" (Cattell & Kline, 1977, pp. 30-31).

Once the 46 personality traits had been identified, Cattell and his colleagues constructed personality questionnaires with items embodying each trait. Once these measures had been administered to subjects, then scored, Cattell was able to conduct a factor analysis on the results and in doing so identify the underlying source traits of personality. Through the use of such techniques Cattell was able to identify the 16

major independent source traits of personality that would subsequently serve as the basis for the construction of the 16PF (Cattell, 1965; Craig, 1999).

Due to esoteric terms and taxonomies 16PF trait dimensions have invited criticism from many psychologists (Ewen, 1998). As a partial result of such criticism there has been alterations in 16PF trait nomenclature over the years. Initially the 16 traits that made up the 16PF were listed alphabetically (A, B, C, D, E, etc.,) (Ryckman, 1993). More recently, factors D, J, K, and P have been replaced by Q1, Q2, Q3, and Q4; the prefix of Q for these factors referring to the fact that they have been obtained solely through factor analysis utilising self-reports or written questionnaires (i.e., Q data), whereas the other factors are derived from both L and Q data (Ewen, 1988). 15FQ factors are similarly labelled regarding their prefixes, but with the initial F proceeding to identify them as those of the 15FQ. However, 15FQ long names serve as idiomatic descriptive classifications to avoid criticisms levelled against the 16PF nomenclature.

Of the 16 factors of the 16PF, 15 measure non-ability source traits, and one (B) measures an ability source trait (intelligence) (Cattell et al., 1970). All 16PF traits are continuous. A person's score may fall anywhere along the continuum, from low through average to high (Ewen, 1998). It is these 15 non-ability factors that serve as the basis of the 15FQ. Like those in the 16PF, the 15 primary dimensions of the 15FQ are continuous, and bipolar in that high or low scores on each dimension measure opposite personality characteristics (Budd, 1992) (see table 1). The major distinction between the 15FQ and the 16PF is the exclusion of the 16PF's B factor in the 15FQ's design (Budd, 1992).

One of the most consistent criticisms that have been levelled against the 16PF is that the reliabilities of some first-order factors are very low and make profile interpretation of the primaries hazardous (Saville & Blinkhorn, 1976). However, results from comparative normative item-total statistics for both the 15FQ and 16PF-A illustrate a number of benefits of the 15FQ over the 16PF-A. Normative data for the 15FQ were based upon the responses from 1,162 British working adult volunteers. The 16PF-A data on the other hand were drawn from the United Kingdom standardisation sample data reported in Saville (1972) and Saville and Blinkhorn

(1981). This comparison found the 15FQ mean item-total correlations to exceed those of the 16PF-A for every scale, which provides clear support for the 15FQ scales' greater overall homogeneity. As Barrett and Paltiel (1993) have demonstrated that low item homogeneity leads to inferior reliability and greater measurement error, the greater overall homogeneity of 15FQ scales leads to the expectation of a greater reliability of measurement and as such, less error of measurement for the 15FQ.

Barrett and Paltiel (1993) were initially concerned that this improved scale homogeneity may have reduced the similarity of 15FQ scales to the 16PF scales in content, and thus the ability to evaluate their relationship. However, contrary to this concern moderate to good scale relationships between the 15FQ and 16PF were still found.

Another positive the 15FQ inherited from the 16PF design is that its hierarchical factor structure enables secondary factors to be derived from intercorrelations of primary factors via factor-analysis (Cattell, 1973; Cattell et al., 1970; Matthews & Deary, 1998). The most prevalent of such secondary models of personality is currently the earlier discussed Five-Factor Model (Matthews & Deary, 1998).

Through factor analysis the primary dimensions of the 15FQ have been reduced to five underlying second-order or global factors of personality. A benefit of using the Five-Factor Model as a framework within which to discuss the global factors of the 15FQ, in terms of the primary factors from which they are derived, is that it accounts for dimensions of personality found in most major personality instruments (Costa, 1996). Therefore allowing a degree of comparison among previous research using alternative measures.

Investigations into factorial similarity between second-order factors for the 15FQ, and other popular Five-Factor Models, have shown fairly consistent results. Research by Barrett and Paltiel (1993) demonstrated adequate degrees of shared variance among 15FQ second-order dimensions, those of Kline's PPQ questionnaire, and the 16PF Five-Factor Model. Research by Budd (1992) is consistent with this

finding, and also reports some fairly substantial correlations between the 15FQ and popular NEO second-order factors.

Like its primary dimensions the 15FQ second-order factors are bipolar. These 5 factors and the combination of primary personality traits upon which they are based are as follows:

Extroversion: 'Outgoing', 'Enthusiastic', 'Socially bold', and 'Group-orientated'.
Anxiety: 'Temperamental', 'Suspicious', 'Self-doubting', and 'Tense-driven'.
Tough minded: 'Factual', 'Practical', and 'Conventional'.
Independence: 'Assertive', 'Direct', 'Radical', 'Confident', and 'Enthusiastic'.
Control: 'Conscientious', 'Disciplined', 'Tense-driven', and 'Restrained'.

2.3.2: Occupational Personality Profile (OPP)

The OPP is a nomothetic personality test. The OPP is specifically designed for use in I/O settings. It measures nine personality dimensions and two distortion (administration) scales, which comprise 98 items. It takes on average about 15-20 minutes to complete (Budd, 1991).

The OPP's 'Social Desirability' scale of distortion was developed from the work of Crowne and Marlow (1964). This scale measures social desirability for the purpose of identifying test participants who are attempting to present an unrealistically positive image of themselves (Budd, 1991). The second distortion scale measures 'Central Tendency', which identifies the propensity to provide noncommittal "in between" (unsure) responses (see Section 2.3.1), identifying participants' who are lacking in self-insight, or are disinclined to reveal pertinent information (OPRA, 2000).

The OPP's personality dimensions are bipolar in design – with high or low scores on a dimension discriminating between opposite personality characteristics (See Table 2). All OPP dimensions have been chosen for their relevance to personnel selection, and because of extensive empirical evidence demonstrating their validity

(Budd, 1991). The items for each dimension were selected with the aim of achieving sufficient coverage, whilst maintaining acceptable levels of scale cohesiveness and minimum overlap with other scales (Budd, 1991). The OPP utilises a Likert five-point attitude scale (strongly agree; agree; in between/unsure; disagree; and strongly disagree) (Stuart-Hamilton, 1996). This has the advantage over a more standard trichotomous response option of achieving the same level of reliability with fewer items through an increase in variance (Budd, 1991)

The theoretical rationale for each of the OPP dimensions is presented within the OPP technical manual, and individually supported by research. The dimension comprising the personality traits 'Accommodating' – 'Assertive' has been consistently supported by both personality theorists and researchers (Cattell, 1965; Guilford, 1954; McDougall, as cited in Budd, 1991). The dimension of the personality traits 'Flexible' – 'Detail-conscious' is closely related to the notion of the authoritarian personality (Adorno et al., 1950), and widely used (Kline, as cited in Budd, 1991). The dimension of the personality traits 'Cynical'– 'Trusting' was developed on the basis of research into the so-called "Machiavellian" personality (Christie & Geis, 1970). The dimension of the personality traits 'Emotional' – 'Phlegmatic' is based upon recognised inter-individual differences in emotionality (i.e., anxiety) (Cattell, 1965; Eysenck & Eysenck, 1969; Thurstone, 1950). The dimension of the personality traits 'Reserved' –'Gregarious' has its origins in McDougall's (as cited in Budd, 1991) work on the "gregarious instinct," and more recently Maslow's (1970) "need for affiliation;" and has extensive empirical support (Eysenck & Eysenck, 1992). The dimension of the personality traits 'Genuine' – 'Persuasive' is based upon Snyder's (1979) concept of "self-monitoring." The dimension of the personality traits 'Composed' – 'Contesting' is based upon the work of Jenkins (1971) into the "Coronary Type A Personality". The dimension of the personality traits 'Internal locus of Control' – 'External locus of Control' has been developed on the basis of far reaching research prompted by Rotter's (1966) concept of "Locus of Control". The dimension of the personality traits 'Abstract' – 'Pragmatic' has its origins in introverted and extroverted thinking styles (Jung, 1933; see also Caine, as cited in Budd, 1991).

Table 2.

OPP Primary Dimensions (adapted from OPRA, 2003)

Low Score Description	High Score Description
Accommodating: Empathetic, People oriented, Accepting, Sensitive to other's feelings, Non-confrontation.	**Assertive:** insensitive to other's feelings, Dominant, Task-oriented, Challenging & Confrontational.
Detail Conscious: Deliberating, Controlled, Rigid, Enjoys attending to detail, Conscientious.	**Flexible:** Lacks discipline & self-control, Flexible, Dislikes attending to detail, Spontaneous, Disregards rules & obligations.
Cynical: Suspicious, Cynical, Inclined to question other's motives, Sceptical, Distrustful.	**Trusting:** Trusting, Philanthropic, Takes people at face value, Straightforward, Open.
Emotional: Open with feelings, Prone to anxiety & self-doubt, Sensitive to offence, Mood variation.	**Phlegmatic:** Self-assured, emotionally stable, Socially confident, Secure, Resilient.
Reserved: Reserved, Introspective, Prefers to work alone, Enjoys own company & that of a few close friends.	**Gregarious:** Outgoing & sociable, Lively & talkative, Group-oriented, Warm & participating.
Genuine: Bases behaviour on own feelings & attitudes, Forthright, Honest & open, genuine & sincere, possibly tactless.	**Persuasive:** Behavioural determinants situational, Perceptive, Diplomatic, Manipulative & Political.
Composed: Calm & composed, Able to unwind and relax, Tolerant, Able to keep work pressures separate from home life.	**Contesting:** Ambitious & competitive, Tense, Impatient, Takes a lot on, Works long hours, May be prone to stress.
Internal: Internal locus of control, Positive approach to set backs, Optimistic, Goal-oriented.	**External:** Accepting, External locus of control, Inclined to pessimism, Believe in forces outside their control.
Abstract: Imaginative, Aesthetically sensitive, Creative & artistic, Abstract & intellectual, Has a theoretical orientation.	**Pragmatic:** Down-to-earth, Less interest in artistic matters, Pragmatic & realistic, Practical orientation.

Note. These definitions of the above dimensions are further elaborated on in Appendix B.

Data for OPP dimensions using Cronbach's alpha demonstrates reliability coefficients above $r>.65$ for internal consistency (Budd, 1991). As with those of the 15FQ, these internal consistency coefficients should be considered conservative estimates of reliability (Carmines & Zeller, 1979). Acceptable levels of stability for the OPP are also demonstrated by test-retest coefficients (average coefficients above $r>0.80$ over three months) provided by Budd. Such coefficients compare favourably with test-retest results reported for relevant other personality instruments (Budd).

Like the 15FQ, the construct validity of the OPP has also been tested by establishing scores on its scales relationships with a wide range of scores on scales

from alternative measures of personality, which has provided support for OPP scales as valid measures of personality. For example, the OPP was found in acceptable, albeit varying degrees to measure similar personality traits to the Sixteen Personality Factor Questionnaire-A (16PF-A), Sixteen Personality Factor Questionnaire-5 (16PF-5), Occupational Personality Questionnaire - Factor 5 (OPQ-F5), Jung Type Indicator (JTI), Eysenck Personality Questionnaire – Revised version (EPQR), Eysenck 17 Scales (17), and the NEO-Personality Inventory (NEO-PI) (Budd, 1992). Multiple correlations also demonstrated that most of the OPP dimensions could be predicted with a high degree of accuracy from the 15FQ. The only OPP dimensions not well predicted by the 15FQ were the personality traits 'Contesting' (0.49) and 'External locus of control' (0.57), which is not surprising as the concepts of the "Coronary Type A Personality" and "Locus of Control" had not been developed when the 16PF was constructed, and as the 15FQ is a derivative of the 16PF it does not directly measure these dimensions (Budd, 1991).

Like the 15FQ the application of factor analysis enables the primary dimensions of the OPP to be reduced to five underlying second-order factors of personality. Like those of the 15FQ these five second-order factors have been compared to the 'Big-Five' factors of personality postulated by McCrae and Costa (1985), and are consistent with the growing body of research supporting the use of Five-Factor Models of personality traits that was identified for the 15FQ.

These OPP second-order factors and the combination of primary personality traits upon which they are based are as follows:

Anxiety: 'Emotional' and 'Pessimistic'.
Extroversion: 'Gregarious' and 'Persuasive'.
Openness To Ideas: 'Abstract' and 'Flexible'.
Agreeableness: 'Trusting', 'Accommodating', and 'Composed'.
Conscientious: 'Conformity', 'Detail-Conscious', and 'Phlegmatic'.

2.3.3: General Reasoning Test 2 (GRT2)

The GRT2 is a timed test designed to determine the psychometric intelligence of the general population. It comprises three sub-scales: Verbal reasoning (VR2), Numerical reasoning (NR2), and Abstract reasoning (AR2), which are widely utilised, combined measures of intelligence (Ackerman, Kanfer, & Goff, 1995; Ackerman & Rolfhus, 1999; Hyde & Linn, 1988, Wechsler, 1950, etc.).

The verbal component of the GRT2 is designed to assess a participant's understanding of words and relationships among words, thus functioning as a measure of crystallised intelligence. It has 35 tasks, each followed by six potential responses. It is a timed test with an 8 min limit.

The numerical component of the GRT2 is designed to assess participants' ability to work with numbers. It has 25 items, each with 6 possible responses. Some of these items measure numerical reasoning based on acquired skills, and thus measure crystallised intelligence. Other items (such as those involving the identification of novel numerical patterns) load more heavily on fluid intelligence. It is timed (10 minutes).

The abstract component of the GRT2 is designed to determine a participant's ability to work out relationships between shapes and figures, and functions as a measure of fluid intelligence. It relies on 25 items, each with 6 possible responses. Again, this tool is timed (10 minutes).

Each GRT2 dimension is scored separately, and then summed to determine general intelligence (*g*). Budd (1993) reports the alpha coefficients for the three sub-scales as follows (n=135): VR2 $r = .83$; NR2 $r = .84$; AR2 $r = .83$. Each reliability estimate exceeds the "gold standard" (.75) (Eatwell, 1997, pg.271).

In support of the GRT2's construct validity Budd (1993) provides Pearson correlations between each of the three sub-scales of the GRT2, demonstrating relatively strong correlations among sub-scales. This is consistent with the GRT2

functioning as a measure of general reasoning ability. The fact that each sub-scale accounts for only a relatively small amount of the variance in the other sub-scales ($r <$ .65) also indicates that each sub-scale is measuring distinct aspects of reasoning ability (Budd). Concurrent validity is supported by results utilising Heim's (1970) widely known AH series of reasoning tests as an external measure. The results provided suggest the GRT2 is indeed measuring the construct of general reasoning ability assessed by the AH3.

The GRT2 has been designed in keeping with the hierarchical paradigm of intelligence earlier discussed. This model recognises Spearman's (1927) *g* at the apex of intelligence, further subdivided into Fluid and Crystallised intelligence (Cattell, 1987c).

As fluid intelligence is manifested in abilities that do not represent intensive acculturation, its testing allows identification of individuals who while scoring low on crystallised intelligence, nevertheless possess the capacity to benefit from training (e.g. on-the-job training programme). This is an important function from an ethical point of view, as it avoids discrimination on the basis of having experienced unequal environmental opportunities, such as quality of education. Although not the only ethical concern in the use of intelligence tests for selection, this point has been singled out as one of serious concern (Boehm, 1972; Gael & Grant, 1972; Humphreys, 1973; Jackson, 1975; Schmidt, Berner, & Hunter, 1973; Schmidt, & Hunter, 1974; Thorndike, 1971).

The GRT2's use of a crystallised intelligence scale is equally important in order to identify those who possess the skills necessary to perform the requirements of the job, especially where on the job training etc., is not the preference. Thus, like most popular tests of intelligence (Horn, 1977), the GRT2 utilises a mixture of both fluid and crystallised intelligence dimensions.

2.4: Procedure

In agreement with the Director of OPRA Publishing & Consulting Group, permission was granted by OPRA for this research to utilise archival, cross-sectional data sets acquired by OPRA within the context of its commercial practice. The data was derived from individuals who had completed both a personality and intelligence measure in New Zealand between June of 1998 and April of 2003, within the context of application for employment, or as a function of their current employment. All involved in the acquisition of the data had undergone training in the administration of psychometric tests based upon the standardised procedural guidelines for psychometric test conduction set down by the British Psychological Society. (The specific guidelines followed are detailed in Appendix C.)

Once the raw data had been edited and encoded into a usable format, statistical analysis of the data was undertaken utilising the package *Statistica*. Further information regarding the data editing and cleaning undertaken is detailed in Appendix D.

CHAPTER 3: RESULTS

Section 3.1.1 contains results for Subsample 1 hypotheses, non-hypothesised significant correlation coefficients, and novel correlation coefficients. Section 3.1.2 contains results for Subsample 2 hypotheses, non-hypothesised relationships, and novel relationships. Section 3.1.3 contains multiple regression results for *g*, Abstract reasoning, Numerical reasoning, and Verbal reasoning. Correlation coefficients for Subsamples 1 and 2 are presented in Table 4 and 5 respectively; descriptive statistics in Table 3 and 6 respectively; multiple regression results Table 7.

Correlation matrices examining relationships among personality traits and intelligence scales were also developed for the 15FQ and OPP respectively on the basis of demographic differences. These include differences in: sex, education, and ethnicity. However, as these are peripheral to the central goals of this initial research, and are often severely statistically limited due a paucity of information, tables for these calculations are not contained in this section, but are instead located in Appendix E.

The probability value with which the analysis for Tables 4 and 5 was conducted was $p < .001$. The decision to use this probability value rather than the more standard $p < .05$ was primarily due to its consistence with Moutafi et al.'s (2003) policy that when dealing with such a large sample size, and so many correlations and regressions, correlations worthy of serious consideration are probably only those achieving this level of significance. The second consideration was power, for with so many participants it was still possible to use such a restrictive probability value and yet avoid the normally high risk of type II errors it would accompany. Thus, in keeping with recommended practice (Lipsey, 1990) the β value could be set equal to the probability value ($\beta = 0.999$), and in so doing add confidence to statements regarding the significance of any correlations found (Cohen, 1988). After taking into consideration the achievement of desired power, and an application of the Bonferroni correction to ensure the most important statistically significant results received the most attention (Winer, Brown, & Michels, 1991), correlations over *r* 0.18 for the 15FQ, and *r* 0.15 for the OPP were determined as the results of greatest interest.

3.1.1: Subsample 1 Results for Relationships Between Personality Traits and Intelligence

I): Results for Subsample 1 Hypotheses:

1) Hypothesis 1 predicted a negative correlation between the personality trait 'Conscientious' (FG) and intelligence. The observed coefficients confirmed Hypothesis 1. The coefficients were as follows: For *g*, $r = -0.22$ ($p < .0001$), Abstract, $r = -0.12$ ($p < .0001$), Numerical, $r = -0.18$ ($p < .0001$), and Verbal reasoning, $r = -0.23$ ($p < .0001$).

2) Hypothesis 2 predicted a negative correlation between the personality trait 'Disciplined' (FQ3) and intelligence. Hypothesis 2 was confirmed by the following significant coefficients: For *g*, $r = -0.22$ ($p < .0001$), Abstract, $r = -0.12$ ($p < .0001$), Numerical, $r = -0.17$ ($p < .0001$), and Verbal reasoning, $r = -0.23$ ($p < .0001$).

3) Hypothesis 3 predicted a positive correlation between the personality trait 'Tense-driven' (FQ4) and intelligence. Hypothesis 3 was disconfirmed. No positive correlations were found; instead significant negative correlations were identified: For *g*, $r = -0.13$ ($p < .0001$), Abstract, $r = -0.09$ ($p < .001$), Numerical, $r = -0.13$ ($p < .0001$), and Verbal reasoning, $r = -0.10$ ($p < .0001$).

4) Hypothesis 4 predicted a positive correlation between the personality trait 'Restrained' (FN) and intelligence. Hypothesis 4 was disconfirmed. No positive correlations were found; instead significant negative correlations were found: For *g*, $r = -0.11$ ($p < .0001$), Numerical, $r = -0.10$ ($p < .0001$), and Verbal reasoning, $r = -0.09$ ($p < .001$).

II): Subsample 1 Descriptive Statistics and Correlation Matrix Tables

Descriptive statistics for Subsample 1 are presented in Table 3 (p.45). The descriptive statistics detail participant distributions for personality dimensions,

distortion scales for the personality profile, and *g* and its subscales. Descriptive statistics were utilised to ensure relationships identified between personality traits and intelligence scales did not involve any obvious anomalous variables in terms of the shape of participant distributions.

Table 4 (p.46) details the correlation coefficients between the 15FQ personality and distortion scales on the one hand, and *g* and its subscales on the other. Examining relationships between individual personality traits and intelligence scales provided information as to which scales of intelligence vary as a function of personality traits and vice versa. Correlation coefficients also identified which personality traits were most profitability combined within multiple regression equations as a function of the significance and strength of their relationship with the various intelligence scales. As well as being examined for relationships with intelligence, the 15FQ distortion scales were used to screen for unreliable participant profiles (see Appendix D for further details).

Out of the 72 coefficients detailed in Table 4, 27 have reached statistical significance ($p<.001$). These 27 coefficients encompass 10 of the available 18 15FQ dimensions; all 10 involve personality dimensions as opposed to distortion scales. Of the 27 significant coefficients eight are significant for *g*, four for Abstract reasoning, seven for Numerical reasoning, and eight for Verbal reasoning.

Of the 27 significant coefficients detailed in Table 4, five exceeded *r* 0.18. Coefficients beyond this value have been identified as focal (see p.42). Of these five coefficients three are accounted for by relationships with the personality trait 'Conscientious' (FG) on the one hand, and intelligence variables *g*, $r = -0.22$ ($p<.0001$), Numerical, $r = -0.18$ ($p<.0001$), and Verbal reasoning, $r = -0.23$ ($p<.0001$) on the other. The other two involve relationships between the personality trait 'Disciplined' (FQ3) and *g*, $r = -0.22$ ($p<.0001$), and 'Disciplined' (FQ3) and Verbal reasoning, $r = -0.23$ ($p<.0001$).

Table 4 also contains a number of coefficients near zero that demonstrate non-co-occurrence between personality dimensions and psychometric intelligence. This non-co-occurrence is most apparent for the personality scale of 'Outgoing' (FA) in its

correlations with *g*, $r = 0.02$, Abstract, $r = 0.04$, Numerical, $r = -0.01$, and Verbal reasoning, $r = 0.02$; and the personality scale of 'Calm/Stable' (FC) in its correlations with *g*, $r = 0.03$, Abstract, $r = 0.03$, Numerical, $r = 0.05$, and Verbal reasoning, $r = -0.01$.

Table 3.

Descriptive Statistics for 15FQ Primary Factors and GRT2 Dimensions

Trait	Valid N	Mean	Minimum	Maximum	Std.Dev.
15FQ_FA	1576	16.13	2.00	20.00	3.17
15FQ_FC	1576	14.39	4.00	20.00	3.07
15FQ_FE	1576	8.51	0.00	20.00	3.55
15FQ_FF	1576	14.31	2.00	24.00	4.21
15FQ_FG	1576	13.01	0.00	20.00	4.64
15FQ_FH	1576	12.50	0.00	20.00	4.34
15FQ_FI	1576	13.18	0.00	26.00	5.03
15FQ_FL	1576	7.08	0.00	25.00	4.41
15FQ_FM	1576	12.16	0.00	22.00	4.47
15FQ_FN	1576	10.49	0.00	20.00	3.89
15FQ_FO	1576	10.89	0.00	22.00	4.51
15FQ_FQ1	1576	8.40	0.00	20.00	3.99
15FQ_FQ2	1576	5.77	0.00	20.00	3.33
15FQ_FQ3	1576	14.91	1.00	22.00	4.33
15FQ_FQ4	1576	7.31	0.00	20.00	3.81
15FQ_FMD	1576	16.22	0.00	26.00	4.93
15FQ_MID	1576	21.01	0.00	89.00	16.45
15FQ_INF	1576	1.21	0.00	7.00	1.33
ABSTRACT	1576	17.18	1.00	25.00	4.64
NUMERICAL	1576	15.26	1.00	25.00	5.50
VERBAL	1576	23.18	3.00	35.00	5.49
TOTAL (*g*)	1576	55.63	11.00	84.00	12.81

Note. FMD = 'Social desirability' scale; MID = 'Central Tendency'; INF = 'Random responding' (Infrequency) scale, (N = 1576). Extreme scorers in distortion scales were excluded from further analysis – see Appendix D for further information.

III): Novel Results

There were a number of relationships demonstrated within the investigation that were unexpected. Some of these were unexpected in terms of the direction of the correlation between variables, some in terms of the presence of significant relationships at all, and some in terms of the apparent lack thereof.

Table 4.

Correlation Matrix for 15FQ & GRT2

Trait	Abstract	Numerical	Verbal	Total (*g*)
15FQ_FA	0.04	-0.01	0.02	0.02
15FQ_FC	0.03	0.05	-0.01	0.03
15FQ_FE	0.07	0.05	0.03	0.06
15FQ_FF	0.07	-0.01	0.01	0.02
15FQ_FG	**-0.12***	**-0.18****	**-0.23****	**-0.22****
15FQ_FH	-0.06	**-0.09***	-0.07	**-0.09***
15FQ_FI	-0.07	-0.07	**0.14***	0.00
15FQ_FL	-0.06	**-0.11***	**-0.11***	**-0.12***
15FQ_FM	0.05	-0.01	**0.15***	0.08
15FQ_FN	-0.07	**-0.10***	**-0.09***	**-0.11***
15FQ_OF	-0.07	-0.08	-0.03	-0.07
15FQ_FQ1	**0.09***	0.04	**0.09***	**0.09***
15FQ_FQ2	0.08	**0.11***	0.08	**0.11***
15FQ_FQ3	**-0.12***	**-0.17***	**-0.23****	**-0.22****
15FQ_FQ4	**-0.09***	**-0.13***	**-0.10***	**-0.13***
15FQ_FMD	0.01	0.00	-0.06	-0.02
15FQ_MID	0.08	0.01	0.02	0.05
15FQ_INF	-0.02	-0.04	-0.07	-0.05

Note. Correlations marked *are significant at $p<.001$, correlations marked ** remain significant after Bonferroni adjustment (are significant at $p<.0001$) (N=1576).

One statistically significant relationship that was unexpected in terms of the replication of findings of previous research was a negative correlation between the personality trait 'Suspiciousness' (FL) on the one hand, and intelligence variables, *g*, $r = -0.12$ ($p<.0001$), Numerical, $r = -0.11$ ($p<.0001$), and Verbal reasoning, $r = -0.11$ ($p<.0001$) on the other. Two other such novel correlations were those between the personality trait 'Restrained' (FN) on the one hand, and intelligence variables, *g*, $r =$ -

0.11 ($p<.0001$), and Numerical reasoning, $r = -0.10$ ($p<.0001$) on the other; and those between the personality trait 'Tense-driven' (FQ4) on the one hand, and intelligence variables, *g*, $r = -0.13$ ($p<.0001$), Numerical, $r = -0.13$ ($p<.0001$), and Verbal reasoning, $r = -0.10$ ($p<.0001$) on the other.

Certain previously reported relationships of significance could not be found on the sample of this study. For example, negative correlations between the personality trait 'Outgoing' (FA) and Verbal reasoning (Cattell, 1987a; Ferguson & Maccoby, 1966; Fink, Schrausser, & Neubauer, 2002); or positive correlations between the personality trait 'Assertive' (FE) and *g* (Cattell, 1987a; Denton & Taylor, 1955).

3.1.2: Subsample 2 Results for Relationships Between Personality Traits and Intelligence

I): Results for Subsample 2 Hypotheses:

1) Hypothesis 5 predicted a negative correlation between intelligence and the personality trait 'Conform' (OPP). Hypothesis 5 was confirmed with significant coefficients for *g*, $r = -0.15$ ($p<.0001$), Abstract, $r = -0.11$ ($p<.0001$), Numerical, $r = -0.12$ ($p<.0001$), and Verbal reasoning, $r = -0.15$ ($p<.0001$).

2) Hypothesis 6 predicted a positive correlation between intelligence and the personality trait 'Phlegmatic' (OPP). Hypothesis 6 was confirmed with significant coefficients for *g*, $r = 0.12$ ($p<.0001$), Abstract, $r = 0.11$ ($p<.0001$), Numerical, $r = 0.11$ ($p<.0001$), and Verbal reasoning, $r = 0.10$ ($p<.0001$).

3) Hypothesis 7 predicted a positive correlation between intelligence and the personality trait 'Flexible' (OPP). Hypothesis 7 was confirmed by significant coefficients with *g*, $r = 0.29$ ($p<.0001$), Abstract, $r = 0.20$ ($p<.0001$), Numerical, $r = 0.21$ ($p<.0001$), and Verbal reasoning, $r = 0.33$ ($p<.0001$).

II): Subsample 2 Descriptive Statistics and Correlation Matrix Tables

Descriptive statistics for the variables utilised in Subsample 2 are presented in Table 5 (p.49). The descriptive statistics detail participant distributions for personality dimensions, distortion scales of the personality profile, *g* and its subscales. As with Subsample 1, significant relationships identified between personality traits and intelligence scales were checked against descriptive statistics to ensure they did not involve obvious anomalous variables in terms of the shape of participant distributions.

Table 6 (p.50) lists the correlation coefficients between OPP personality and distortion scales on the one hand, and *g* and its subscales on the other. As with Subsample 1, by examining relationships between individual personality traits and intelligence scales, information was provided as to which scales of intelligence vary as a function of personality traits and vice versa. Correlation coefficients identified which personality traits would be most profitability combined within multiple regression equations as a function of the significance and strength of their relationship with the various intelligence scales.

Out of the 44 coefficients detailed in Table 6, 30 are statistically significant ($p<.001$). These 30 are coefficients for nine of the available 11 OPP dimensions; seven of these 11 involve personality dimensions, two involve distortion scales. Of these 30 coefficients, nine were calculated for the variable *g*, five for Abstract reasoning, seven for Numerical reasoning, and nine for Verbal reasoning.

Of the 30 significant coefficients reported in Table 6, 15 exceed either plus or minus 0.15. As with the 15FQ coefficients, this value has been identified as salient for the consideration of coefficients (see p. 42). Of these 15 coefficients four involve relationships between the personality trait 'Flexible' (OPP) on the one hand, and intelligence variables, *g*, $r = 0.29$ ($p<.0001$), Abstract, $r = 0.20$ ($p<.0001$), Numerical, $r = 0.21$ ($p<.0001$), and Verbal reasoning, $r = 0.33$ ($p<.0001$) on the other. Another four involve relationships between the personality trait 'External locus of control' (OPP) on the one hand, and intelligence variables, *g*, $r = -0.35$ ($p<.0001$), Abstract, $r = -0.26$ ($p<.0001$), Numerical, $r = -0.27$ ($p<.0001$), and Verbal reasoning, $r = -0.35$ ($p<.0001$) on the other. One involves the personality trait 'Trusting' (OPP)

and Verbal reasoning, $r = 0.16$ ($p<.0001$); one the personality trait 'Pragmatic' (OPP) and Verbal reasoning, $r = -0.21$ ($p<.0001$); three the personality trait 'Contesting' (OPP) on the one hand, and intelligence variables, Numerical reasoning, $r = -0.15$ ($p<.0001$), Verbal reasoning, $r = -0.17$ ($p<.0001$), and *g*, $r = -0.15$ ($p<.0001$) on the other; and two the variable 'Conform' (OPP) on the one hand, and Verbal reasoning, $r = -0.15$ ($p<.0001$) and *g*, $r = -0.15$ ($p<.0001$) on the other.

Table 5.

Descriptive Statistics for OPP Primary Factors and GRT2 Dimensions

Trait	Valid N	Mean	Minimum	Maximum	Std.Dev.
OPP_ASSERTIVE	2544	29.69	14.00	50.00	4.77
OPP_FLEXIBLE	2544	27.00	12.00	44.00	4.79
OPP_TRUSTING	2544	38.23	15.00	55.00	6.29
OPP_PHLEG	2544	40.42	12.00	60.00	6.09
OPP_GREGAR	2544	34.70	11.00	50.00	5.33
OPP_PERSUAS	2544	25.77	9.00	45.00	5.42
OPP_CONTEST	2544	25.98	10.00	50.00	5.72
OPP_EXTERNAL	2544	17.78	8.00	40.00	4.98
OPP_PRAGMATIC	2544	27.08	11.00	46.00	5.90
OPP_CONFORM	2544	22.64	8.00	38.00	4.00
OPP_MIDRESP	2544	88.42	0.00	152.00	18.52
ABSTRACT	2544	16.52	0.00	25.00	4.96
NUMERICAL	2544	14.78	1.00	25.00	5.74
VERBAL	2544	22.83	2.00	35.00	5.58
TOTAL (*g*)	2544	54.13	5.00	84.00	13.81

Note. Conform = 'Social desirability' scale, and Midresp = 'Central Tendency' scale, (N = 2544). Extreme scorers in distortion scales were excluded from further analysis – see Appendix D for further information.

Table 6.

Correlation Matrix for OPP and GRT2

Trait	Abstract	Numerical	Verbal	Total (*g*)
OPP_ASSERTIVE	0.05	0.04	0.02	0.04
OPP_FLEXIBLE	**0.20****	**0.21****	**0.33****	**0.29****
OPP_TRUSTING	0.05	0.06	**0.16***	**0.11***
OPP_PHLEG	**0.11***	**0.11***	**0.10***	**0.12***
OPP_GREGAR	0.01	-0.03	-0.01	-0.01
OPP_PERSUAS	**0.11***	**0.10***	**0.13***	**0.13***
OPP_CONTEST	-0.04	**-0.15****	**-0.17****	**-0.15****
OPP_EXTERNAL	**-0.26****	**-0.27****	**-0.35****	**-0.35****
OPP_PRAGMATIC	-0.06	0.02	**-0.21****	**-0.10***
OPP_CONFORM	**-0.11***	**-0.12***	**-0.15****	**-0.15****
OPP_MIDRESP	-0.05	**-0.08***	**-0.07***	**-0.08***

Note. Correlations marked *are significant at $p<.001$, correlations marked ** remain significant after Bonferroni adjustment (are significant at $p<.0001$), (N=2544).

Table 6 also contains a number of coefficients of near zero that demonstrate non-co-occurrence between personality dimensions and intelligence. The coefficients most consistently close to zero are for the personality trait 'Gregarious' (OPP) on the one hand, and *g*, $r = -0.01$, Abstract, $r = 0.01$, Numerical, $r = -0.03$, and Verbal reasoning, $r = -0.01$ on the other; and the personality trait 'Assertive' (OPP) on the one hand, and *g*, $r = 0.04$, Abstract, $r = 0.05$, Numerical, $r = 0.04$, and Verbal reasoning, $r = 0.02$ on the other.

III): Novel Results

There were a number of relationships demonstrated within this section of the investigation that were unexpected. Some of these were unexpected in terms of the presence of significant relationships at all, and some in terms of the apparent lack thereof.

One significant relationship that was unexpected in view of previous research was a positive relationship between the personality trait 'Trusting' (OPP) on the one hand, and the intelligence variables, *g*, $r = 0.11$ ($p<.0001$), and Verbal reasoning, $r = 0.16$ ($p<.0001$) on the other. Another unexpected result was the positive correlates between the personality trait 'Persuasive' (OPP) on the one hand, and *g*, $r = 0.12$ ($p<.0001$), Abstract, $r = 0.11$ ($p<.0001$), Numerical, $r = 0.10$ ($p<.0001$), and Verbal reasoning, $r = 0.13$ ($p<.0001$) on the other. In this investigation no significant positive correlation was found between the personality trait 'Assertive' and intelligence, contrary to earlier reports (Cattell, 1987a; Denton & Taylor, 1955).

3.1.3: Multiple Regressions

A series of multiple regressions were calculated. The predictor variables in these multiple regressions consisted of the personality variables that had been identified as having a significant correlation with general intelligence and/or its subscales. However, as personality dimensions for neither measure are independent, they could not all be included in the regression models. Instead, one of each of the bipolar dimensions was included. General intelligence, Abstract, Numerical, and Verbal reasoning were each utilised as criterion variables. Although predictor and criterion variables are analogous to the independent and dependent variables of experiments, unlike the independent and dependent variables of experiments, predictor variables can only predict changes in criterion variables not their causality (Bordens & Abbott, 1996).

The reason intelligence scales were assigned the role of criterion was because of the greater general utility of using personality to predict intelligence within a

commercial context than vice versa. For while there is a broad consensus that intelligence tests are the single best predictors of job performance (Schmidt & Hunter, 1998), there exists a common resistance to the use of intelligence tests that is absent for the use of personality tests in the applied field of psychology (e.g., Caspy et al., 1987; Holland & Watson, 1980; Moutafi et al., 2003; Snyderman & Rothman, 1987). Some researchers have been particularly resistance towards the use of intelligence testing in employee selection (Guenole, Englert, & Taylor, 2003). This is largely due to a body of evidence suggesting an adverse impact on applicants of ethnic minorities as a result of substantial differences in mean intelligence test scores (e.g., Gottfredson, 1994; Kelman, 1991; Sackett, Schmitt, Ellingson, & Kabin, 2001).

The rationale for regression analysis concerned the additional information such analyses would provide about the relationships among personality traits and intelligence. In particular, regressions were undertaken to learn how much combinations of several personality traits contributed to the prediction of intelligence, and thus how much variance in intelligence scales explained by specific personality traits is unique variance to those traits. For although the personality traits examined are intercorrelated (see Budd, 1991, 1992), previous research utilising intercorrelated multiple regressions has found that the variance explained by such variables for criterion variables can be unique to individual predictors (Cohen, Cohen, West, & Aiken, 2003; Horn & Cattell, 1967; Moutafi et al., 2003; Murensky, 2000, etc.). Thus, multiple regressions were performed because the information provided by correlation coefficients was limited to relationships among personality traits or between single personality traits and intelligence scales. Whereas, the information provided by regressions concerned the combined variance explained by a group of several personality traits for intelligence scales (Cohen et al.).

The first regression model presented in Table 7 combined the 15FQ personality traits of 'Conscientious' (FG) and Disciplined' (FQ3). The decision to use the personality traits 'Conscientious' (FG) and Disciplined' (FQ3) in this model was based the fact that these were the only variables retaining significance after the Bonferroni adjustment, and thus the 15FQ variables with the strongest relationships with intelligence scales.

The second regression model combined all 15FQ personality traits that were identified as significantly correlated with intelligence scales (see Table 7). The need to examine this combination of traits was based upon the importance of determining the degree to which the relationship among these traits on the one hand, and intelligence scales on the other, were due to unique variance. The relationships between many of the personality traits combined within this second model were weaker than the relationships for the personality traits combined in the first model. However, this has no inherent bearing on the degree to which variance accounted for by predictors is shared, or is unique variance. Thus, in order to identify the extent to which 15FQ traits were able to predict the variation in intelligence scales, it was important to examine all significant 15FQ traits in combination.

The third regression model combined the OPP personality traits of 'Flexible', 'External locus of Control' and 'Conform'. As with the first model, the third regression model combined the personality traits retaining significance after the Bonferroni adjustment. As a result the third model contains those OPP personality traits exhibiting the strongest correlations with intelligence scales.

Like the second model, which combined all significant 15FQ traits, the fourth regression model combined all OPP personality traits significantly related to intelligence (see Table 7). As with the second model, the need to examine this combination of traits was based upon the importance of determining the degree to which the relationship among these traits on the one hand, and intelligence scales on the other, were due to unique variance. Again, the relationships between many of the personality traits combined within this fourth model were weaker than the relationships for the personality traits combined in the third regression model. However, as this has no inherent bearing on the uniqueness of predictor variance, in order to determine the degree OPP traits are able to predict the variation in intelligence scales, it is necessary to examine all significant OPP traits in combination.

The rationale for combining personality traits within the regression models according to their respective personality measures, rather than across both the OPP and 15FQ is simple. A practical consideration within organisational psychology is the

time associated with the completion of tests. This concern is driven by a variety of factors, including the cost of expending unnecessary time on the supervision of participants undertaking measures, and the subsequent time required in the analysis of participant responses. The push to reduce the length of personality tests within the workplace (whilst retaining reliability) is indicative of this concern (e.g., Budd, 1991). Thus, the rationale for the separation of personality measures within regression models was a reflection of the general use of a single rather than combination of personality measures within a workplace setting (Gatewood & Field, 2001).

The β values for all coefficients are presented in Table 7. The possibility of a latent variable being responsible for the shared variance between psychometric intelligence and personality is acknowledged. However, currently assuming differences in personality are "responsible" for differences in intelligence in an analytic sense, adjusted r^2 is the appropriate proportion of variance measure (Cohen, 1988). Nevertheless, as selection psychologists are often interested in predicting mean performance rather than variability around the mean, and thus more likely to judge the importance of correlations in terms of r rather than r^2 (Ackerman & Humphreys, 1990), regression equations using r are included in Appendix F. The strength of association represented by r^2 was assessed as: .01 (weak), .09 (moderate), and .25 (strong) (Cohen, 1988, *p*. 532).

In keeping with the approach of Steiger and Fouladi (1992), instead of providing information regarding the significance level of the multiple regressions, exact confidence intervals for the squared multiple correlations are provided. This is done in the belief that such information conveys the statistical result more accurately than significance statements (Statistica [version 6.0]). The statistical results of the multiple regressions will be provided in terms of confidence levels of each range of respective interval estimates.

I): General Intelligence

1) General intelligence (*g*) was used as the criterion variable in four regression models. The first model used the two 15FQ dimensions that surpassed the $r >$

0.18 level of salience as predictor variables (see Table 4), and found this combination weakly significant, accounting for 7% of the variance in *g* scores. Significant predictors were the personality traits 'Conscientious' (FG) (β = -0.16), and Disciplined' (FQ3) (β = -0.16). There is 95% confidence that the squared multiple correlation is between .047 and .095. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .050.

2) The second model used the eight 15FQ dimensions significantly correlated with intelligence (see Table 4) as predictor variables. The combination of these eight predictor variables was moderately significant, accounting for 10% of the variance in *g* scores. Significant predictors were the personality traits 'Conscientious' (FG) (β = -0.16), 'Intuitive' (FI) (β = -0.07), 'Suspicious' (FL) (β = -0.07), 'Conceptual' (FM) (β = 0.084), 'Self-Sufficient' (FQ2) (β = 0.149), 'Disciplined' (FQ3) (β = -0.13), and 'Tense-Driven' (FQ4) (β = -0.06). There is 95% confidence that the squared multiple correlation is between .070 and .126. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .074.

3) The third model used the six OPP dimensions that surpassed the *r* 0.15 level of salience as predictor variables (see Table 6). This combination of predictor variables was moderately significant, accounting for 16% of the variance in *g* scores. Significant predictors were the personality traits 'Flexible' (β = 0.155), 'External locus of Control' (β = -0.30), and 'Conform' (β = -0.11). There is 95% confidence that the squared multiple correlation is between .134 and .186. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .138.

4) The fourth model used as predictor variables the nine OPP dimensions significantly correlated with intelligence (see Table 6). This combination of predictor variables was moderately significant, accounting for 17% of the variance in *g* scores. Significant predictors were the personality traits 'Flexible' (β = 0.158), 'Persuasive' (β = 0.066), 'External locus of Control' (β

= -0.27), and 'Conform' (β = -0.13). There is 95% confidence that the squared multiple correlation is between .143 and .196. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .147.

Table 7.

β values for Multiple Regression Coefficients of 15FQ and OPP on GRT2 Intelligence Scales

Trait	Abstract β	Numerical β	Verbal β	Total (*g*) β
15FQ_FG	-0.08*	-0.13*	-0.16*	-0.16*
15FQ_FQ3	-0.09*	-0.12*	-0.17*	-0.16*
Regression model	*F*(2,1576)=17.15	*F*(2,1576)=37.58	*F*(2,1576)=67.12	*F*(2,1576)=59.22
Adj. R^2	**0.02**	**0.04**	**0.08**	**0.07**
15FQ_FG	-0.09*	-0.14*	-0.15*	-0.16*
15FQ_FI	-0.14*	-0.11*	0.06*	-0.07*
15FQ_FL	-0.03	-0.08*	-0.06*	-0.07*
15FQ_FM	0.107*	0.019	0.087*	0.084*
15FQ_FN	-0.01	-0.02	0.021	-0.00
15FQ_FQ2	0.104*	0.143*	0.117*	0.149*
15FQ_FQ3	-0.07*	-0.09*	-0.14*	-0.13*
15FQ_FQ4	-0.05	-0.06*	-0.04	-0.06*
Regression model	*F*(8,1570)=10.38	*F*(8,1570)=18.07	*F*(8,1570)=23.60	*F*(8,1570)=22.22
Adj. R^2	**0.05**	**0.08**	**0.1**	**0.1**
OPP_FLEXIBLE	0.123*	0.114*	0.179*	0.155*
OPP_TRUSTING	-0.04	-0.05*	0.005	-0.04
OPP_CONTEST	0.064*	-0.05*	-0.01	-0.01
OPP_EXTERNAL	-0.26*	-0.26*	-0.27*	-0.30*
OPP_PRAGMATIC	0.00	0.08*	-0.13*	-0.02
OPP_CONFORM	-0.09*	-0.10*	-0.13*	-0.11*
Regression model	*F*(6,2555)=46.41	*F*(6,2595)=55.90	*F*(6,2600)=108.79	*F*(6,2617)=84.80
Adj. R^2	**0.1**	**0.11**	**0.20**	**0.16**
OPP_FLEXIBLE	0.129*	0.124*	0.179*	0.158*
OPP_TRUSTING	-0.04	-0.05*	0.011	-0.03
OPP_PHLEG	0.059*	0.032	-0.00	0.042
OPP_PERSUAS	0.044*	0.08*	0.042*	0.066*
OPP_CONTEST	0.067*	-0.06*	-0.02	-0.02
OPP_EXTERNAL	-0.23*	-0.22*	-0.26*	-0.27*
OPP_PRAGMATIC	0.010	0.108*	-0.12*	0.001
OPP_CONFORM	-0.11*	-0.11*	-0.13*	-0.13*
OPP_MIDRESP	-0.01	-0.04	0.005	0.000
Regression model	*F*(9,2552)=32.63	*F*(9,2592) = 0.24	*F*(9,2597) = 73.12	*F*(9,2614) = 58.88
Adj. R^2	**0.1**	**0.12**	**0.2**	**0.17**

Note. βs' marked * are significant at $p < 0.05$; (adapted from multiple regression table in Moutafi et al., 2003).

II): Abstract Reasoning

1) Abstract reasoning was used as the criterion variable in four regression models. The first model used the two 15FQ dimensions that surpassed the $r >$ 0.18 level of salience as predictor variables (see Table 4). This combination of variables was weakly significant, accounting for 2% of the variance in Abstract reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) ($\beta = -0.08$), and 'Disciplined' (FQ3) ($\beta = -0.09$). There is 95% confidence that the squared multiple correlation is between .008 and .035. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .010.

2) The second model used the eight 15FQ dimensions that were significantly correlated with intelligence as predictor variables (see Table 4). This combination of predictor variables was weakly significant, accounting for 5% of the variance in Abstract reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) ($\beta = -0.09$), 'Intuitive' (FI) ($\beta = -0.14$), 'Conceptual' (FM) ($\beta = 0.107$), 'Self-Sufficient' (FQ2) ($\beta = 0.104$), and 'Disciplined' (FQ3) ($\beta = -0.07$). There is 95% confidence that the squared multiple correlation is between .029 and .070. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .032.

3) The third model used as predictor variables the six OPP dimensions that surpassed the $r < 0.15$ level of salience (see Table 6). This combination of predictor variables was moderately significant, accounting for 10% of the variance in Abstract reasoning scores. Significant predictors were the personality traits 'Flexible' ($\beta = 0.123$), 'Contesting' ($\beta = 0.064$), 'External locus of Control' ($\beta = -0.26$), and 'Conform' ($\beta = -0.09$). There is 95% confidence that the squared multiple correlation is between .078 and .122. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .081.

4) The fourth model used as predictor variables the nine OPP dimensions significantly correlated with intelligence (see Table. 6). This combination of predictor variables was moderately significant, accounting for 10% of the variance in Abstract reasoning scores. Significant predictors were the personality traits 'Flexible' ($\beta = 0.129$), 'Phlegmatic' ($\beta = 0.059$), 'Persuasive' ($\beta = 0.044$), 'Contesting' ($\beta = 0.067$), 'External locus of Control' ($\beta = -0.23$), and 'Conform' ($\beta = -0.11$). There is 95% confidence that the squared multiple correlation is between .077 and .121. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .080

III): Numerical Reasoning

1) Numerical reasoning was used as the criterion variable in four regression models. The first model used the two 15FQ dimensions that surpassed the $r > 0.18$ level of salience as predictor variables (see Table 4). This combination of predictor variables was weakly significant, accounting for 4% of the variance in Numerical reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) ($\beta = -0.13$), and 'Disciplined' (FQ3) ($\beta = -0.12$). There is 95% confidence that the squared multiple correlation is between .023 and .060. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .025.

2) The second model used as predictor variables the eight 15FQ dimensions significantly correlated with intelligence (see Table 4). This combination of predictor variables was weakly significant, accounting for 8% of the variance in Numerical reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) ($\beta = -0.14$), 'Intuitive' (FI) ($\beta = -0.11$), 'Suspicious' (FL) ($\beta = -0.08$), 'Self-Sufficient' (FQ2) ($\beta = 0.143$), 'Disciplined' (FQ3) ($\beta = -0.09$), and 'Tense-Driven' (FQ4) ($\beta = -0.06$). There is 95% confidence that the squared multiple correlation is between .054 and .105. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .057.

3) The third model used the six OPP dimensions that surpassed the $r > 0.15$ level of salience as predictor variables (see Table 6). This combination of predictor variables was moderately significant, accounting for 11% of the variance in Numerical reasoning scores. Significant predictors were the personality traits 'Flexible' ($\beta = 0.179$), 'Trusting' ($\beta = -0.05$), 'Contesting' ($\beta = -0.05$), 'External locus of Control' ($\beta = -0.26$), 'Pragmatic' ($\beta = 0.08$), and 'Conform' ($\beta = -0.10$). There is 95% confidence that the squared multiple correlation is between .086 and .132. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .090.

4) The fourth model used as predictor variables the nine OPP dimensions significantly correlated with intelligence (see Table. 6). This combination of predictor variables was moderately significant, accounting for 12% of the variance in Numerical reasoning scores. Significant predictors were the personality traits 'Flexible' ($\beta = 0.124$), 'Trusting' ($\beta = -0.05$), 'Persuasive' ($\beta = 0.08$), 'Contesting' ($\beta = -0.06$), 'External locus of Control' ($\beta = -0.22$), 'Pragmatic' ($\beta = 0.108$), and 'Conform' ($\beta = -0.11$). There is 95% confidence that the squared multiple correlation is between .077 and .121. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .080.

IV): Verbal Reasoning

1) The Verbal reasoning scale was used as the criterion variable in four regression models. The first model used the two 15FQ dimensions that surpassed the $r > 0.18$ level of salience as predictor variables (see Table 4). This combination of predictor variables was weakly significant, accounting for 8% of the variance in Verbal reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) ($\beta = -0.16$), and 'Disciplined' (FQ3) ($\beta = -0.17$). There is 95% confidence that the squared multiple correlation is between .055 and .107. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .059.

2) The second model used as predictor variables the eight 15FQ dimensions significantly correlated with intelligence (see Table. 4). This combination of predictor variables was moderately significant, accounting for 10% of the variance in Verbal reasoning scores. Significant predictors were the personality traits 'Conscientious' (FG) (β = -0.15), 'Intuitive' (FI) (β = 0.06), 'Suspicious' (FL) (β = -0.06), 'Conceptual' (FM) (β = 0.087), 'Self-Sufficient' (FQ2) (β = 0.117), and 'Disciplined' (FQ3) (β = -0.14). There is 95% confidence that the squared multiple correlation is between .071 and .127. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .075.

3) The third model used as predictor variables the six OPP dimensions that surpassed the $r > 0.18$ level of salience (see Table 6). This combination of predictor variables was moderately significant, accounting for 20% of the variance in Verbal reasoning scores. Significant predictors were the personality traits 'Flexible' (β = 0.179), 'External locus of Control' (β = -0.27), 'Pragmatic' (β = -0.13), and 'Conform' (β = -0.13). There is 95% confidence that the squared multiple correlation is between .172 and .227. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .176.

4) The fourth model used nine OPP dimensions significantly correlation with intelligence as predictor variables (see Table. 4). This combination of predictor variables was moderately significant, accounting for 20% of the variance in Verbal reasoning scores. Significant predictors were the personality traits 'Flexible' (β = 0.179), 'Persuasive' (β = 0.042), 'External locus of Control' (β = -0.26), 'Pragmatic' (β = -0.12), and 'Conform' (β = -0.13). There is 95% confidence that this squared multiple correlation is between .171and .227. The lower bound confidence interval providing 95% confidence that the coefficient of determination is no less than .176.

CHAPTER 4: DISCUSSION

The examination of relationships between personality traits and intelligence identified some significant correlations within a "real-life" New Zealand context. It confirmed some of the predicted relationships between personality traits and intelligence, rejected others, and identified some that were novel. Moreover, it took a preliminary step towards establishing the degree to which combinations of personality traits are able to function as predictors of intelligence.

4.1.1: Summary of Findings

The hypotheses of this investigation predicted relationships between intelligence and the primary personality traits encompassed by the popular Five-Factor Model dimension of 'Conscientious', or its equivalent. Although the personality measures utilised in this investigation were not Five-Factor Model dimensions, they were comprised of personality traits that can be combined into Five-Factor Model dimensions. This made it possible to examine the OPP and 15FQ personality traits that when combined form the Five-Factor Model personality dimension of 'Conscientious' (or it's equivalent), without actually examining the dimension itself.

The importance of examining the personality traits that combine to form the Five-Factor Model personality dimension 'Conscientious' relates to questions raised regarding the homogeneity of the dimension 'Conscientious' (FFM) (Tett et al., 1991 etc.). It was important to determine if primary personality traits with heterogeneous relationships with intelligence obscured the relationships between intelligence and the personality dimension 'Conscientious' (FFM) in prior research. Examining the primary components of the personality dimension 'Conscientious' was valuable in determining which facets were negatively related to intelligence. This is important as the addition of facets of 'Conscientious' negatively correlated with intelligence may reduce the degree of incremental validity in selection decisions achieved by adding the personality trait 'Conscientious' to intelligence scores.

Hypothesis 1 predicted that the personality trait 'Conscientious' (FG) would be negatively related to intelligence. This relationship was indeed confirmed for *g* and its subscales. Although the relationships for the personality trait 'Conscientious' (FG) one the one hand, and the intelligence variables on the other were weak in all cases, they were noticeably stronger for *g* and Verbal reasoning (crystallised intelligence) than Abstract reasoning (fluid intelligence). The strength of the relationship with Numerical reasoning was intermediate, which is consistent with the scale that measures Numerical reasoning encompassing some items testing crystallised, and others fluid intelligence (see Section 4.5.1).

Hypothesis 2 predicted a negative relationship between intelligence and the personality trait 'Disciplined' (FQ3). This relationship was also confirmed for *g* and its subscales. The relationships between the personality trait 'Disciplined' (FQ3) on the one hand, and the intelligence variables on the other, were weak in all cases. However, as with Hypothesis 1, relationships were stronger for *g* and Verbal reasoning (crystallised intelligence) than Abstract reasoning (fluid intelligence), with the strength of Numerical reasoning again being intermediate between crystallised and fluid intelligence.

Hypothesis 3 predicted a positive relationship between intelligence and the personality trait 'Tense-driven' (FQ4). This assumption was not confirmed. Instead, a negative relationship between the two variables was discovered. Although this negative relationship was significant for *g* and its subscales, it was consistently weaker for all components than the relationships found for Hypotheses 1 and 2.

Hypothesis 4 predicted a positive relationship between intelligence and the personality trait 'Restrained' (FN), but was instead contradicted by the discovery of a negative relationship. This relationship was demonstrated for *g* and two of its subscales – Numerical and Verbal reasoning (crystallised intelligence), and was weak for all scales.

Hypothesis 5 predicted a negative relationship between intelligence and the variable 'Conform' (OPP). This relationship was confirmed for *g* and its subscales. Although the observed relationships were all weak, they were marginally stronger

with *g* and Verbal reasoning (crystallised intelligence) than with Abstract (fluid intelligence) or Numerical reasoning.

Hypothesis 6 predicted a positive relationship between intelligence and the personality trait 'Phlegmatic' (OPP), and thus a negative relationship between *g* and the personality trait 'Emotion' (OPP). This relationship was confirmed for *g* and its subscales, but was statistically weak in all cases.

Hypothesis 7 predicted a positive relationship between the personality trait 'Flexible' (OPP) and intelligence, and thus a negative relationship between the personality trait 'Detail-Conscious' (OPP) and intelligence. This relationship was confirmed as moderate for Verbal reasoning (crystallised intelligence), and weak-moderate for *g*. Although considerably weaker for Abstract (fluid intelligence) and Numerical reasoning than Verbal reasoning and *g*, the relationships between the personality trait 'Flexible' (OPP) on the one hand, and Abstract and Numerical reasoning on the other, were still towards the stronger end of the weak spectrum.

In addition to findings concerning the hypotheses, other conceptually meaningful relationships were demonstrated, some of which were in keeping with previous research findings, and some of which were novel. However, the vast majority of these relationships were weak ($r > 0.09 - 0.15$ [Subsample 1]) ($r > 0.10 - 0.21$ [Subsample 2]).

A very weak negative relationship was found between Numerical reasoning and *g* on the one hand, and the personality trait 'Socially-Bold' (FH) on the other. A very weak positive relationship was found between the personality trait 'Radical' (FQ1) on the one hand, and *g*, Verbal (crystallised intelligence) and Abstract reasoning (fluid intelligence) on the other. Weak positive relationships were also found between the personality traits 'Intuitive' (FI) and 'Conceptual' (FM) on the one hand, and Verbal reasoning (crystallised intelligence) on the other. The personality trait 'Suspicious' (FL) was found to have weak negative relationships with each of *g*, Numerical and Verbal reasoning (crystallised intelligence); and the personality trait 'Self-sufficient' (FQ2) was found to have a weak positive relationship with both *g* and Numerical reasoning. However, most of these relationships are of such insufficient

strength that further investigation into their significance is required before they are afforded further consideration (see Section 3).

Additional findings for relationships among Subsample 2 personality traits and intelligence found: The personality trait 'Trusting' (OPP) had a weak positive relationship with *g* and Verbal reasoning (crystallised intelligence). The personality trait 'Persuasive' (OPP) had a weak positive relationship with *g* and its three subscales that was marginally stronger with Verbal reasoning (crystallised intelligence) and *g*. The personality trait 'Contesting' (OPP) had a weak negative relationship with *g*, Numerical, and Verbal reasoning (crystallised intelligence) - which was strongest for crystallised intelligence. The personality trait 'Pragmatic' (OPP) had a weak negative relationship with *g* and Verbal reasoning (crystallised intelligence); again strongest for crystallised intelligence. The 'Central tendency' scale for the OPP, which detected a respondents propensity for taking the "unsure" response option on items (see Section 2.3.1), was found to relate very weakly, and negatively to each of *g*, Numerical, and Verbal reasoning (crystallised intelligence). The strongest relationship among these additional findings was between the personality trait 'External locus of Control' and intelligence variables. The personality trait 'External locus of Control' yielded moderate negative relationships with *g* and Verbal reasoning (crystallised intelligence), and weak-moderate relationships with Abstract (fluid intelligence) and Numerical reasoning.

Multiple regressions

Multiple regressions demonstrated that personality traits could be used to predict between 2%-20% of variance in intelligence scale scores. The personality dimensions chosen as predictors were chosen on the basis of their significance and strength as correlates with intelligence scale scores. The rationale for regression analysis was the additional information such an analysis was expected to provide on the relationships among personality traits and intelligence scales. Particularly the extent combinations of specific personality traits accounted for unique or shared variance in intelligence scores (Cohen et al., 2003).

Combinations of personality traits were able to account for 7%-17% of variance in scores on *g*. The personality traits 'Conscientious' (FG) and Disciplined' (FQ3) were able to weakly predict *g*, accounting for 7% of variance in *g* scores. The larger personality trait combination of 'Conscientious' (FG), 'Intuitive' (FI), 'Suspicious' (FL), 'Conceptual' (FM), 'Self-Sufficient' (FQ2), 'Disciplined' (FQ3), and 'Tense-Driven' (FQ4) did better, demonstrating a moderate ability to predict *g* with 10% of variance explained. The findings for combinations of OPP traits as moderate-strong predictors of *g* demonstrated greater predictive ability than 15FQ combinations. The combination of the personality traits 'Flexible' (OPP), 'External locus of Control' (OPP), and 'Conform' (OPP) was able to account for 16% of variance in *g* scores. The combination of personality traits 'Flexible' (OPP), 'Persuasive' (OPP), 'External locus of Control' (OPP), and 'Conform' (OPP) did even better accounting for 17% of variance in *g* scores.

Abstract reasoning (fluid intelligence) was also found to be open to prediction via personality traits, which could account for between 2%-10% of variance. Both combinations of 15FQ dimensions tested were found to be very weak predictors of Abstract reasoning (fluid intelligence). The personality traits 'Conscientious' (FG) and Disciplined' (FQ3) were only able to account for 2% of variance in Abstract reasoning scores. The personality traits 'Conscientious' (FG), 'Intuitive' (FI), 'Conceptual' (FM), 'Self-Sufficient' (FQ2), and 'Disciplined' (FQ3) were only able to account for 5% of variance in Abstract reasoning scores. However, the OPP combinations tested were both able to predict Abstract reasoning (fluid intelligence) moderately well. The personality traits 'Flexible' (OPP), 'External locus of Control' (OPP), 'Contesting' (OPP), and 'Conform' (OPP) were able to account for 10% of variance in Abstract reasoning scores; as was the combination of the personality traits 'Flexible' (OPP), 'Phlegmatic' (OPP), 'Persuasive' (OPP), 'Contesting' (OPP), 'External locus of Control' (OPP), and 'Conform' (OPP).

Both combinations of 15FQ traits tested as predictors of Numerical reasoning were found to do so weakly at best. The personality traits 'Conscientious' (FG) and Disciplined' (FQ3) were only able to account for 4% of variance in Numerical reasoning scores. The personality traits 'Conscientious' (FG), 'Intuitive' (FI), 'Suspicious' (FL), 'Self-Sufficient' (FQ2), 'Disciplined' (FQ3), and 'Tense-Driven'

(FQ4) were only able to account for 4% of variance in Numerical reasoning scores. On the other hand, both combinations of OPP traits were shown to be able to predict Numerical reasoning moderately well. The personality traits 'Flexible' (OPP), 'Trusting' (OPP), 'Contesting' (OPP), 'External locus of Control' (OPP), 'Pragmatic' (OPP), and 'Conform' (OPP) were able to account for 11% of variance in Numerical reasoning scores. The combination of personality traits 'Flexible' (OPP), 'Trusting' (OPP), 'Persuasive' (OPP), 'Contesting' (OPP), 'External locus of Control' (OPP), 'Pragmatic' (OPP), and 'Conform' (OPP) were able to account for 12% of variance in Numerical reasoning scores.

Consistent with the respective strengths of relationships between personality traits and intelligence, variance in Verbal reasoning (crystallised intelligence) scores was more accurately predicted than variance was for other intelligence scales. The first combination of 15FQ traits, which consisted of the personality traits 'Conscientious' (FG) and Disciplined' (FQ3), was found to be a weak predictor of Verbal reasoning, accounting for 8% of score variance. The combination of personality traits 'Conscientious' (FG), 'Intuitive' (FI), 'Suspicious' (FL), 'Conceptual' (FM), 'Self-Sufficient' (FQ2) and 'Disciplined' (FQ3) did moderately well, accounting for 10% of variance in Verbal reasoning scores. The strength of predictive ability greatly increased for OPP combinations. Both the first combination of the personality traits 'Flexible' (OPP), 'External locus of Control' (OPP), 'Pragmatic' (OPP), and 'Conform' (OPP), and the second combination, with the addition of the personality trait 'Persuasive' (OPP) to the variables comprising the first combination, demonstrated a moderate-strong capacity for predicting crystallised intelligence by accounting for 20% of variance in Verbal reasoning scores.

4.1.2: Explanations for Findings

One explanation for the confirmation of Hypotheses 1 and 2 is that less intelligent people may cope in the long term with their lack of intelligence by becoming more methodical, organised, thorough and persistent - all of which are conceptual features of the personality traits 'Conscientious' (FG) and 'Disciplined' (FQ3). More intelligent people may also feel that rather than relying on effort, or procedure, they can rely on their relative efficiency in cognitive processing to get by,

and in doing so behave in ways that tend to characterise a person who has a high score on the personality traits 'Expedient' (-FG) and/or 'Informal' (-FQ3) (P. Englert, personal communication, December 29, 2002; Moutafi et al., 2003).

That individuals scoring less well on intelligence tests may adopt in the long-term behaviours that tend to characterise a person who has a high score on the personality trait 'Conscientious' (FFM) as coping strategies, dovetails with Sternberg's (1986) triarchic theory of intelligence. Sternberg's theory embraces three elements of information processing that are useful in different kinds of situations (see Section 1.2). The componential element is concerned with analytic aspects of intelligence representative of intelligence tests. The contextual element on the other hand concerns how people cope with their environment; the practical aspect of intelligence individuals use to adapt to, change, or find a new more comfortable setting. In the explanation proffered above some individuals scoring less well in intelligence tests cope by employing strategies that promote behaviours tending to characterise a person who has a high score on the personality trait 'Conscientious' (FFM), and which are likely to be rewarded in the workplace (see Section 4.4.3). That individuals scoring less well in intelligence tests (componential intelligence) may be more competent in practical intelligence (contextual intelligence), and using behaviours tending to characterise a person who has a high score on the personality trait 'Conscientious' (FFM) as a coping strategy, is supported by findings that the tacit knowledge associated with contextual intelligence seems unrelated to IQ, yet a moderate predictor of job performance (Sternberg, 2003; Sternberg & Wagner, 1993; Sternberg et al., 2000; Sternberg & Hedlund, 2002; Wagner & Sternberg, 1986, 1990; Wagner et al., 1999).

The concept of tacit intelligence is considered fundamental to work on contextual intelligence. Tacit knowledge is conceptualised as what needs to be known that has not been explicitly taught, that enables a person to work effectively in an environment (Sternberg et al., 2000; Sternberg & Wagner, 1993; Sternberg, Wagner, & Okagaki, 1993). Sternberg and his colleagues represent tacit knowledge in the style of production systems, or series of "if-then" statements describing procedures followed in a variety of everyday situations. Sternberg and his colleagues

have generally measured tacit knowledge employing work-related dilemmas that present situations possibly encountered on the job.

As Hypotheses 3 and 4 involve factors related to those targeted by the first two hypotheses, the explanation for the negative relationships confirmed for Hypotheses 1 and 2 also potentially accounts for negative relationships disconfirming Hypotheses 3 and 4. The behaviour that tends to characterise a person who has a high score on the personality trait 'Tense-driven' (FQ4), which tends to promote achievement through strenuous effort, and the personality trait 'Restrained' (FN), which tends to promote more guarded behaviours, may also act as coping strategies for a lack of intelligence. The positive relationships with intelligence for the opposite traits of 'Relaxed' (-FQ4), and 'Direct' (-FN) could equally be due to a greater degree of confidence in one's opinions and ability to get things done being a consequence of greater cognitive ability (P. Englert, personal communication, December 29, 2002; Moutafi et al., 2003).

As with the first four, Hypotheses 5, 6, and 7 were formulated on the basis of the personality traits 'Flexible', 'Conform', and 'Phlegmatic' combing to form the second-order personality dimension 'Conscientious' (FFM). Thus, confirmation of Hypotheses 5, 6, and 7 can also be explained in terms of the above-expounded coping strategies employed by the less intelligent, lack of adherence to such strategies by the more intelligent, or both (P. Englert, personal communication, December 29, 2002; Moutafi et al., 2003).

An environmentally driven explanation for the relationship between the personality trait 'Conscientious' (FFM) and intelligence is supported by developmental theories of personality traits. One group of researchers (Eaves, Eysenck, & Martin, 1989) who reviewed a considerable amount of research involving identical twins, fraternal twins, and other family members in Australia, Great Britain, the United States, and Sweden during various periods of life found that environmental influences explained half of the measured variations in personality. The environmentally (rather than innately) focused explanation for the development of behaviour characterising high scorers on the personality trait 'Conscientious' (FFM)

is consistent with both Eaves et al.'s findings and findings suggesting "quite low heritability" for the development of the trait 'Conscientious' (Cattell, 1982, p. 355).

The weak positive relationship between the personality trait 'Intuitive' (FI) and Verbal reasoning (crystallised intelligence), and the weak positive relationship between the personality trait 'Conceptual' (FM) and Verbal reasoning (crystallised intelligence) can both be explained in terms of the "abstract thought" characteristic of the personality traits 'Intuitive' (FI) and 'Conceptual' (FM). The personality traits 'Intuitive' (FI) and 'Conceptual' (FM) are both conceptualised as dimensions concerned with issues related to abstract thinking, particularly those of a creative, imaginative bent, such as having an interest in literature, aesthetics, and philosophical questions (see Appendix A). The personality trait 'Open-to-Ideas' (FFM) - characterised by people with abstract thinking styles that "live in a world of ideas"- is comprised of the personality traits 'Intuitive' (FI) and 'Conceptual' (FM) (OPRA, 2003, p. 115). That the relationships for the personality traits 'Intuitive' (FI) and 'Conceptual' (FM) were restricted to Verbal reasoning (crystallised intelligence) could indicate that the strong imaginative and innovative components that characterise these traits promote the ability to manipulate words and language, which is associated with crystallised intelligence, and consistent with models of language acquisition (Field, 1978; Harman, 1970; Putnam, 1981).

The weak negative relationship between the personality trait 'Suspicious' (FL) on the one hand, and the intelligence variables of *g*, Numerical and Verbal reasoning (crystallised intelligence) on the other, and weak positive relationship between the personality trait 'Self-sufficient' (FQ2) on the one hand, and *g* and Numerical reasoning on the other, can both be clarified by noting their adaptive significance (Austin et al., 2002). Characteristics such as the pessimistic expectations of the motives and intentions of others towards oneself associated with the personality trait 'Suspiciousness' (FL), and the reliance on others associated with the personality trait 'Group-Orientated' (-FQ2), may be functionally maladaptive when taken to extremes. Although the relationships in question concern *g*, not social intelligence, many researchers have found *g* and social intelligence mutually inclusive (Austin et al., 2002; Barchard, 2003; Carroll, 1993; Sternberg, 1990; Sternberg el al., 2003; Wechsler, 1950). Another potential explanation for the positive relationship between

g and the personality trait 'Self-sufficient' (FQ2) is that the characteristic enjoyment of solitary activities may encourage behaviours likely to enhance *g* (Ferguson & Maccoby, 1966; Hakstian & Cattell, 1978).

The weak positive relationship between the personality trait 'Trusting' (OPP) on the one hand, and the intelligence variables of *g* and Verbal reasoning (crystallised intelligence) on the other, can be seen in the same functional-adaptive light as that proposed for the equivalent 15FQ result. As can the weak negative relationship between the personality trait 'Contesting' (OPP) on the one hand, and *g*, Numerical, and Verbal reasoning (crystallised intelligence) on the other - the strongest for which was for crystallised intelligence. The personality trait 'Contesting' (OPP) shares many of its conceptual features with the personality trait 'Tense-driven' (FQ4), and thus is also open to the explanation that its characteristic drive may be a coping strategy employed by the less intelligent, or that more intelligent people are more likely to act in keeping with a belief in their own ability to get things done without too much effort.

The weak positive relationship between the personality trait 'Persuasive' (OPP) and the intelligence scales measured was marginally stronger for Verbal reasoning (crystallised intelligence) and *g* than any other subscales. The negative relationship between the personality trait 'Pragmatic' (OPP) and intelligence scales was considerably stronger for Verbal reasoning (crystallised intelligence) than any other subscales. These findings suggest that it is the crystallised component of intelligence that varied most strongly with both the personality traits 'Persuasive' (OPP) and 'Pragmatic' (OPP). One possible explanation for the positive relationship between the personality trait 'Persuasive' (OPP) and crystallised intelligence falls in the rubric of adaptive behaviours. For example, behaving in a manner likely to persuade others that you, or what you have to say, is of value and worth pursuing is likely to led to desired outcomes, such as advancement within the workplace. The comparative strength of the negative relationship between the personality trait 'Pragmatic' (OPP) and Verbal reasoning (crystallised intelligence), is perhaps better explained in terms of the importance of abstract concept formation for the acquisition of the ability to manipulate words and language (e.g. Harman, 1970).

The strongest relationship among additional findings was between the personality trait 'External locus of control' (OPP) and intelligence. While demonstrating comparatively strong negative relationships across all intelligence scales, the personality trait 'External locus of control' (OPP) was related with greatest strength to crystallised intelligence. Of all the relationships explained in terms of functional adaptability, this is the most clear-cut. An external locus of control is by definition due to a belief in one's inability to influence outcomes, reinforcing a predisposition to give up on (or not engage in) tasks that one would be likely to profit from in terms of intellectual growth (Rotter, 1966). People who believe they can control their own lives will put forth the effort to gain competencies and skills enhancing their crystallised intelligence. Similarly, people who are successful at using their abilities come to believe in their capacity to control their destiny (Zeidner, 1995). Behaviours characterising high scorers on the personality trait 'External locus of control' (OPP) are thus adaptive in terms of developing the necessary skills to perform well on psychometric tests of intelligence.

Multiple regressions

The finding that combinations of OPP dimensions were stronger predictors of *g* and its subscales than 15FQ dimensions suggests that due to design differences the 15FQ is a more refined measure of personality than the OPP. This is based upon the idea that because factor analysis separately clustered traits consistent with *g* for the 16PF, 15FQ dimensions can be considered less contaminated by inter-domain crossover with intelligence than OPP dimensions (Hall & Gardner, 1978). The comparative advantage of OPP trait combinations in the prediction of intelligence is also explicable in terms of a greater degree of unique variance in intelligence scales being accounted for by the OPP combinations of personality traits than 15FQ combinations of traits.

A greater predictive power of personality traits on crystallised intelligence suggests that the personality/intelligence interaction is more decisive for the type of knowledge development associated with crystallised intelligence than the innate skills of fluid intelligence. The fact that larger "combinations" of variables can yield more accurate predictions of variance in intelligence scores than smaller combinations of

variables is most readily explicable in terms of the fact that the addition of more variables to multiple regression models is prone to result in slight increases in predictive strength, but with diminishing returns (Cohen et al., 2003; P. Englert, personal communication, April 12, 2003).

4.2: Integration of Findings with Past Literature

4.2.1: Convergent Findings

Explanations of Convergence

Past studies have often found the relationship between intelligence and the personality trait 'Conscientious' negligible (Ackerman & Heggestad, 1997). The findings of Hypotheses 1, 2, 5, 6, and 7 are however, consistent with recent research supporting the negative relationship between the personality trait 'Conscientious' (FFM) and intelligence (Furnham et al., as cited in Moutafi et al., 2003; McCrae, 1989; Moutafi et al.). Cattell and Cattell's (1995) research can also be extrapolated. It showed a strong negative factor loading on the global personality trait 'Self-Control' (equivalent of 'Conscientious' FFM) for the 16PF personality traits 'Abstract' (M) and 'Openness to Change' (Q1), both of which had strong correlations with intelligence (Cattell et al., 1970).

These findings (excluding that for Hypothesis 6) corroborate research that examined the relationship between intelligence and value orientations comparable to the inhibitive contents of the personality traits 'Disciplined' (FQ3), 'Conscientious' (FG), 'Conform' (OPP), and 'Detail-Conscious' (OPP) (internalisation of external sources of rigid authority) (Colby, Kohlberg, Gibbs, and Lieberman, 1983). Consistent with Kohlberg's (1984) levels of moral development, people who have adopted, or follow, or are oriented toward externally dictated value systems tend to be less intelligent than those who have adopted a value system based upon autonomously derived values. Further support is lent through research by Dollinger and La Martina (1998) demonstrating a negative correlation between the personality trait 'Conscientious' (FFM) and moral values; and McCrae and Costa (1997b) reporting modest neutral-negative factor loadings for inhibitory facets of the personality trait

'Conscientious' on the personality trait 'Openness-to-Experience' (NEO-PI-R). Maslow's (1970) conceptualisation of the self-actualising individual is also consistent with the negative correlation between rigid, externally derived value systems and intelligence. Maslow conceptualised the self-actualiser as having both high intelligence, and "codes of ethics that are relatively autonomous and individual rather than conventional" (p.158).

The negative relationship between the personality trait 'Conform' (OPP) and both crystallised and fluid intelligence is also in line with research by Furnham (2002). Furnham's research examined the relationship between the big three Eysenckian personality factors, and test taking style on tests of crystallised and fluid intelligence. He found negative correlations between a dissimulation scale on the personality questionnaire comparable to the personality trait 'Conform' (OPP) and crystallised and fluid intelligence.

The positive relationship between intelligence and the personality trait 'Phlegmatic' (OPP) for Hypothesis 6 is also convergent with previous research. The conceptual features of the personality trait 'Emotional' (OPP) - with which intelligence was negatively related by virtue of its positive relationship with the personality trait 'Phlegmatic' (OPP) - include a propensity towards anxiety. The negative relationship between the personality trait 'Anxiety' and intelligence is one of the best documented of relationships between personality traits and intelligence (Baron, 1982; Frank, 1970; Hembree, 1988; Matarazzo, 1972; Samuel, 1980; Scipp, 1991 etc.). One explanation for the negative relationship between intelligence and the personality trait 'Anxiety' that has gained popularity, is that the trait 'Anxiety' is not inherently negatively related to intelligence, but rather impairs the functions of attention and working memory, both of which are important in terms of test taking success (Eysenck, 1982, 1992; Matthews & Dorn, 1995; Necka, 2003; Wells & Matthews, 1994; Zeidner & Matthews, 2000). That the negative relationship with the personality trait 'Emotional' (OPP) is not limited to one aspect of intelligence, but is consistent across crystallised and fluid intelligence, appears to support this explanation.

The weak positive relationships between the personality traits 'Intuitive' (FI), and 'Conceptual' (FM) on the one hand, and Verbal reasoning (crystallised intelligence) on the other, continue a line of prior research; particularly studies that differentiate fluid and crystallised intelligence (Austin et al., 2000; Bates & Shieles, 2003; Kanfer et al., 1995; Van der Zee et al., 2003). Robust support is offered by research demonstrating a positive relationship between the personality trait 'Openness-to-Experience' (FFM) and intelligence (see for reviews Ackerman & Heggestad, 1997; Holland et al., 1995; Ackerman & Rolfhus, 1999). This is pertinent as the personality traits 'Intuitive' (FI) and 'Conceptual' (FM) are primary order traits from which the personality trait 'Openness-to-Ideas' (FFM) is derived (15FQ equivalent of 'Openness-to-Experience').

The weak negative relationship between the personality trait 'Suspicious' (FL) and intelligence, and positive relationship between the personality trait 'Trusting' (OPP) and intelligence seems novel. However, it is possible to extrapolate from previous findings demonstrating a negative relationship between intelligence and the personality trait 'Neuroticism', or the personality trait 'Psychoticism', of which the characteristic of suspiciousness (at the extreme end) forms a part (Ackerman & Heggestad, 1997; Austin et al., 2002; Furnham et al., 1998; Messick, 1987). This linkage is made more likely by a functional-adaptive explanation for the findings, viz., polar suspiciousness is generally maladaptive, whereas trusting behaviour is generally adaptive.

The positive relationship between the personality trait 'Self-sufficient' (FQ2) and intelligence is unambiguous in view of previous research (Cattell & Horn, 1963; Cattell, Horn & Butcher, 1962; Horn & Cattell, 1966c). It is also supported by research that found a positive relationship between intelligence and the personality trait 'Introversion' (Cattell, 1971; Furnham et al., as cited in Moutafi et al., 2003) - self-sufficiency being a component of the trait 'Introversion' (Budd, 1992).

The negative relationship between the personality trait 'Pragmatic' (OPP) on the one hand, and *g* and crystallised intelligence on the other, reaffirms results that show a positive relationship between intelligence and the 'Abstract' – 'Pragmatic' (OPP) personality trait continuum (Ackerman & Heggestad, 1997; Austin et al., 2000;

Bates & Shieles, 2003; Kanfer et al., 1995; Holland et al., 1995; Van der Zee et al., 2003). Such convergence lends additional support for the underlying importance of trait(s) linked to abstract concept formation for developing an ability to manipulate words and language, associated with crystallised intelligence (Harman, 1981).

The strong negative relationship for the personality trait 'External locus of Control' on the one hand, and all tested variables of intelligence on the other (particularly crystallised intelligence), replicates a body of prior research (Austin et al., 2002; Baron, 1982; Judge & Bono, 2001; Lent, Brown, & Hackett, 1994; Matthews & Deary, 1998; Samuel, 1980; Spector, 1992; Zeidner, 1995). It can also be reconciled with theory and research by Bandura and others into the relationship between success on cognitive ability tasks and individual beliefs about one's ability to influence such outcomes (for reviews, see Ackerman et al., 1995; Bandura, 1986; Feltz, 1994; Ford, Quinones, Sego, & Sorra, 1992; Isen & Daubman, 1984; Isen, Daubman, & Nowicki, 1987; Sadri & Robertson, 1993). Findings corroborate the purported explanation for relationships between locus of control and intelligence expounding the functional significance of perception in the pursuit of knowledge enhancing behaviours.

Multiple regressions

The finding that personality traits can be utilised to predict intelligence enhances earlier suggestions in Moutafi et al. (2003). However, results concerning the greater predictive power of personality traits for crystallised intelligence do not appear to have been reported elsewhere. The convergence between this research and Moutafi et al.'s finding can be understood in light of their respective findings concerning relationships among personality traits and intelligence. Both studies found similar correlations between intelligence and personality traits utilised as "predictors" of intelligence in the multiple regression models. In particular, while some of the variance in intelligence scores explained by personality traits was unique, much of the variance was explicable in terms of intercorrelations among personality traits (Cohen et al., 2003).

Implications of Convergence

Corroboration of a negative relationship between intelligence and the personality trait 'Conscientious' with a N.Z sample implies the negative relationship between intelligence and the trait 'Conscientious' is not restricted to the United Kingdom. Corroboration for a positive relationship between intelligence and the personality trait 'Phlegmatic' (OPP) implies the negative relationship between trait anxiety and intelligence is not limited to pathological anxiety (Baron, 1982; Frank, 1970; Hembree, 1988; Matarazzo, 1972; Samuel, 1980; Seipp, 1991), but also anxiety of a lesser degree.

The coherent results in previous research and this investigation for a positive relationship between the personality trait 'Intuitive' (FI) and crystallised intelligence, a positive relationship between the personality trait 'Conceptual' (FM) and crystallised intelligence, and a negative relationship between the personality trait 'Pragmatic' (OPP) and intelligence (especially crystallised intelligence) (Ackerman & Heggestad, 1997; Austin et al., 2000; Bates & Shieles, 2003; Holland et al., 1995; Kanfer et al., 1995; Van der Zee et al., 2003) support the relationship between abstract thinking and intellectual development. These characteristics are beneficial in the development of crystallised intelligence, and thus adaptive in the acquisition of knowledge. Potential use of abstract thinking style in the enhancement of crystallised intelligence is another plausible inference.

The convergence between this project and previous research regarding a positive relationship between the personality trait 'Self-sufficient' (FQ2) on the one hand, and *g* and Numerical reasoning on the other (Cattell & Horn, 1963; Cattell et al., 1962; Hakstian & Cattell, 1978; Horn & Cattell, 1966c) may invite a re-consideration of Ferguson and Maccoby's (1966), and Hakstian and Cattell's (1978) suggestion. These authors suggested that the relationship between the personality trait 'Self-sufficient' and intelligence is due to the promotion of individualistic behaviour such as reading. The force of this explanation (Ferguson & Maccoby, 1966; Hakstian & Cattell, 1978) is reduced by the lack of an observed significant positive relationship with Verbal reasoning (crystallised intelligence) on the current sample (Tirre, 1995).

New findings corroborating prior research on locus of control and intelligence, particular crystallised intelligence (Austin et al., 2002; Baron, 1982; Matthews & Deary, 1998; Samuel, 1980; Zeidner, 1995), shed light on the role of perception in intellectual activity. A longer-term implication is the potential for perception modification to enhance cognitive task performance (either due to effort expended on tests, the effort expended developing crystallised intelligence in the first place, or both). They also support the focus upon self-efficacy beliefs in social cognitive models of education and employment (Bandura, 1986, 1993; Bandura & Wood, 1989).

Multiple regressions

Convergence with Moutafi et al.'s (2003) research for the finding that combinations of personality traits can be utilised to predict more variance in intelligence scores than individual personality traits implies that some of the variance in intelligence scores explained by personality traits was unique variance. However, that combinations of personality traits were only marginally better than certain individual personality traits in predicting intelligence score variance implies that much of the variance between different personality traits and intelligence is shared among personality traits (Cohen et al., 2003). This convergence also suggests further investigation into the prediction of intelligence scores will be fruitful. Particularly, in terms of how the addition of demographic characteristics such as gender, age, ethnicity, and level of education to personality traits may, or may not further contribute to the prediction of variance in intelligence scores.

4.2.2: Divergent Findings

Explanations of Divergence

The disconfirmation of Hypothesis 3's prediction of a positive relationship between intelligence and the personality trait 'Tense-driven' (FQ4) was unexpected in light of prior research by McCrae and Costa (1997b), wherein the personality dimension of 'Striving for Achievement' demonstrated modest positive secondary

factor loading on the personality trait 'Openness-to-Experience' (NEO-PI-R). Like Hypothesis 3, the disconfirmation of a positive relationship between intelligence and the personality trait 'Restrained' (FN) (Hypothesis 4) was unexpected in light of prior research (Colby et al., 1983). This research had demonstrated that more autonomous, contextually driven, and thus flexible systems of values characterised by the diplomacy of the personality trait 'Restrained' tended to have a positive relationship with intelligence. The disconfirmations of Hypotheses 3 and 4 also runs against Lievens, Coetsier, De Fruyt, and De Maeseneer, (2002), with a moderate positive correlation between facet levels of the personality trait 'Conscientious' (FFM) and academic performance of medical students. For academic performance is strongly positively correlated with intelligence (Shen & Comrey, 1997).

Although the disconfirmation of Hypotheses 3 and 4 fails to replicate prior research regarding academic achievement (Busato, Prins, Elshout, & Hamaker, 2000; Lievens et al., 2002; Sternberg, Conway, Ketron, & Bernstein, 1981; Veroff, McClelland, & Marquis, 1971; Xiao, 2002) and the personality trait 'Openness-to-Experience' (McCrae & Costa, 1997b), it is consistent with Moutafi et al.'s (2003) findings. Revealing a considerable negative relationship between intelligence and the personality trait 'Conscientious' (FFM), Moutafi et al. found non-significant, yet negative predictive value for intelligence between some sub-factors of the trait 'Conscientious' ('Striving for Achievement' and 'Deliberation'), which resemble the personality traits 'Tense-driven' (FQ4) and 'Restrained' (FN) for the 15FQ. This divergent/convergent ambiguity is potentially explicable in terms of positive relationships with academic performance, and/or the personality trait 'Openness-to-Experience', involving aspects of these respective domains that are not accounted for by *g*, and thus not present in purer measures of *g*.

Another potential explanation for the positive relationship for the personality trait 'Conscientious' and intelligence on the one hand, and academic performance on the other (e.g., Lievens et al., 2002), yet negative relationship between the personality trait 'Conscientious' and intelligence found in this research is variance in participant demographics. Participants from this study comprised a sample for which the mean and standard deviation for intelligence was consistent with N.Z. norms provided by the test distributor (OPRA, 2002). However, participants from the above quoted

research into the relationships with intelligence and the personality trait 'Conscientious' on the one hand, and academic performance on the other, were derived from samples of medical school students, which are likely to contain disproportionately bright individuals (Shen & Comrey, 1997). Thus, the positive relationships involving academic performance on the one hand, and the personality trait 'Conscientious' and intelligence on the other, could be explained as a function of high intellectual ability in a context of higher education. This is potentially explicable by at least some of the behaviours that tend to characterise a person who has a high score on the personality trait 'Conscientious', such as adhering to procedural guidelines, which may be beneficial in higher education settings and thus a valuable adaptation in medical school students.

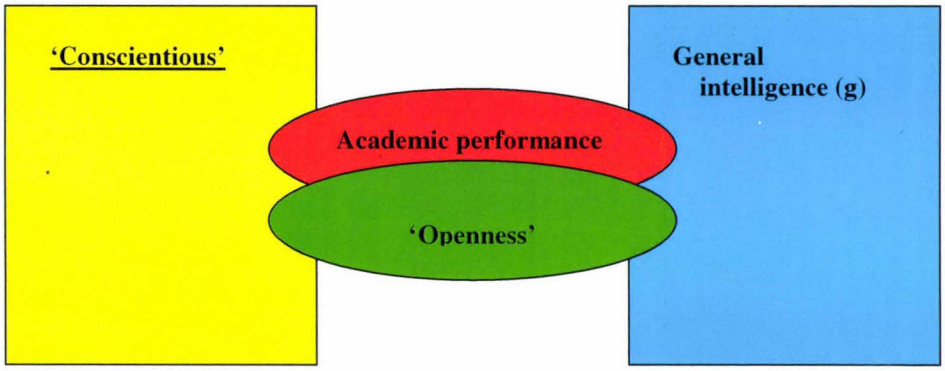

Figure 1.

Hypothesised overlapping domains accounting for negative correlations between the personality trait 'Conscientious' and *g*, yet positive relationships between the personality traits 'Conscientious' and 'Openness-to-Experience', *g* and the trait 'Openness-to-Experience', the trait 'Conscientious' and academic performance, and *g* and academic performance.

The positive relationship between the personality trait 'Persuasive' (OPP) and intelligence was marginally stronger for crystallised intelligence and *g* than fluid intelligence or Numerical reasoning. This is contrary to early research by Adkins and Kuder (1940), which found characteristics indicative of the personality trait 'Persuasive' negatively related to intelligence. This divergence in findings can be due to methodology. Moreover, an intuitively appealing explanation for why the personality trait 'Persuasive' (OPP) may be related to intelligence, particularly crystallised intelligence, is that the trait 'Persuasive' (OPP) presupposes "calculated"

behaviour. Such behaviours - in order to have been conditioned as rewarding behaviour – are likely to have been utilised with some degree of success, and are more likely to have been successful, and thus conditioned for those persons who are better equipped intellectually for "calculated" behaviour.

Implications of Divergence

That Hypotheses 3 and 4 turned out contrary to predictions reinforces the need for further investigation into the relationships between primary-order personality traits and intelligence. However, the convergence with Moutafi et al.'s (2003) findings points to possible benefits of improved methodology, and better samples in such investigations. It also lends further support to Ackerman and Rolfhus' (1999) suggestion that the personality trait 'Conscientious' (FFM) is more about "plodding," than "dedicated" kinds of behaviours.

The divergence of the positive relationship between the personality trait 'Persuasive' (OPP) and intelligence encourages extended research into this particular relationship. In doing so, it increases confidence in parallel results. The proposed explanation for this relationship can then be scrutinised further.

4.3: Contribution of Findings

One of the important aspects of this project has been its ability to confirm the existence of significant relationships between the measured personality traits and intelligence within the context of NZ workplace testing. This justifies further, in-depth research into specific relationships. It also indicates how higher accuracy can be achieved in workplace selection decisions even when intelligence test information is unavailable, or the construction of specific job-related ability tests is not feasible. In this respect the identification of the best combinations of personality traits in the prediction of intelligence would potentially be of practical value in locations, such as many states in the U.S.A., where the use of non-specific intelligence testing is prohibited. In such cases the development of job specific ability tests is generally considered acceptable (Kelman, 1991); however, for smaller businesses such development is often prohibitively expensive (Herrnstein & Murray, 1994). In such

cases knowledge of the predictive ability of personality traits for intelligence could be beneficial in selection decisions. And while the legal prohibition of general intelligence testing is not at present an issue in New Zealand, the social consequences of using general intelligence tests in selection decisions appears to be an issue with some momentum (Guenole et al., 2003).

Another issue is signalled by the claim by Tett et al. (1991), supported by Hough (1992), and Paunonen and Jackson (1996) that the elements of the Five-Factor Model personality trait 'Conscientious' do not fit together to define a single personality factor. The findings of this research do not, as hoped, support this position. All primary dimensions from which the Five-Factor Model personality trait 'Conscientious' were derived, across two distinct personality measures, demonstrated consistent relationships with intelligence.

4.4: Implications of Findings

4.4.1: Theoretical Implications

Different theoretical positions regarding aspects of the relationship between personality and intelligence are well documented, but there is not yet a coherent theory of these interactions (Lowman, 1991). One relatively thorough theory is the "whole person approach" to personality and intelligence (for reviews see, Cattell, 1987d; Magnusson & Torestad, 1993). This position advocates a view of personality that encompasses how and why individuals think, feel, act, and react as they do. The whole person theory examines personality from the perspective of the individual as a total, integrated organism. A fundamental proposition of this theory is that an individual functions as an integrated whole. That an individual functions as a totality and that each aspect of the structures and processes (perceptions, cognitions, plans, values, goals, motives, biological factors, conduct, and other aspects) takes on meaning from the role it plays in the total functioning of the individual. The whole picture has an information value that is beyond what is encompassed in its specific parts, and requires a holistic analysis.

The Cattellian "whole person approach" (Madsen, 1977) correctly predicted observed relationships in this investigation would be stronger for the OPP subsample due to the OPP's lack of convincing factor-analytical results to separate personality (non-ability) and intelligence (i.e., due to higher inter-domain cross-over with intelligence than the 15FQ subsample). However, due to the inherent difficulty of manipulating personality traits and intelligence, this, like other theoretical approaches, has been unable to yield an empirically supported, falsifiable causal theory regarding this relationship.

Another theoretical approach related to the relationship between personality and intelligence is that proffered by Ackerman and his colleagues (Ackerman & Goff, 1995; Ackerman & Heggestad, 1997). Ackerman has developed a theory of intelligence that endeavours to integrate literature regarding the relations among personality, interest and intellectual development. The theory is known as PPIK. Unlike the whole person approach, PPIK is focused upon the relationship among personality, interest and intellectual development in terms of their interaction, within a relatively narrow focus. On the other hand, the whole person approach is focused upon the gestalt results of all factors related to individual differences and the way in which such factors interact as an organised system (Magnusson & Torestad, 1993).

PPIK is made up of four components: Intelligence-as-process, Personality, Interest, and Intelligence as knowledge. The construct of intelligence as typical performance is fundamental in PPIK (Ackerman, 1994). According to Ackerman, one reason why intelligence tests do not show a correlation higher than 0.5 or 0.6 for academic performance or job performance is that intelligence is measured with a "maximal" paradigm while academic and occupational performance takes place in a "typical" environment (Ackerman & Goff, 1995).

According to PPIK a measure of intelligence as typical performance should be more highly correlated with crystallised abilities (e.g., knowledge) and intelligence as maximal performance with fluid abilities (e.g., abstract reasoning). The personality trait measures used in this investigation measured typical performance. That this investigation found those personality traits related to intelligence, which were

measured in terms of typical performance, most highly correlated with crystallised intelligence appears to support this prediction.

This investigation supports the "whole person approach" assumption that intelligence and personality traits co-vary. It also supports the PPIK's prediction that typical behaviours will be more highly correlated to crystallised intelligence. However, further work is necessary to establish a more complete theoretical framework within which to explain the relationship between intelligence and personality (Austin et al., 2002; Cattell, 1987d; Sternberg et al., 2003).

4.4.2: Research Implications

An interesting result, with the hierarchical model of intelligence adopted, was the distinctive presence of crystallised intelligence in relationships with personality traits. This exemplifies the importance of being able to discriminate between fluid and crystallised intelligence to better understand the relationship between intelligence and personality traits. The same distinction was recognised by previous research into relationships between personality traits and intelligence (Austin et al., 2002).

4.4.3: Implications for Practice

An important practical application of this research concerns the additive use of personality traits and intelligence to improve the accuracy of selection decisions in predicting job performance (Kanfer et al., 1995). A standard practice within organisational psychology has been adding personality trait and intelligence test scores to increase accuracy of predictions in workplace selection. These calculations have being made on the basis of a non-association between personality and intelligence, creating the expectation that using personality variables conjoined with intelligence, or vice versa, will result in increased predictive validity. The findings of this research once again demonstrate, that the association between intelligence and personality is not zero, and it is consistently stronger and *negative* for the personality trait 'Conscientious'. Due to its ranking as the single best personality trait predictor

of job performance (Barrick & Mount, 1991), the trait 'Conscientious' is a commonly used personality dimension in such calculations (e.g., Barrick et al., 1993; Black, 2000). The implication of this finding is that organisational psychologists need to exercise caution when developing calculations designed to increase predictive validity that are based upon the nil covariance between intelligence and the personality trait 'Conscientious', or other personality variables found significantly related to intelligence (Kanfer et al., 1995).

Another possible implication is the ability to use individuals' ratings on certain combinations of personality traits to predict variance in intelligence scores (particularly crystallised intelligence). This has the potential to affect the practice of organisational psychology and human resource selection in a number of ways. For example, it could potentially affect the future design of test batteries by allowing a greater focus on the inclusion of "culture-fair" measures of fluid intelligence, instead of having to so heavily focus upon the crystallised aspect. While providing information on the current level of intellectual ability of an applicant, crystallised intelligence has also been targeted by criticism (e.g., Blits, & Gottfredson, 1990).

Another area already touched upon (see Section 4.3) of potential future relevance to the use of personality measures to predict variance in intelligence is in locations where the use of non-specific intelligence testing is prohibited. Non-specific intelligence testing is intelligence testing of a general nature that is not specifically designed to test intelligence tasks that are specific to the task requirements of the job being applied for. As it is expensive for most companies to develop job-specific ability tests, there could be great utility in paying more attention to those dimensions of the apparently less controversial personality inventories that correlate with intelligence.

The research underscores the need to address the question of how intelligence, which is considered the overall best predictor of job performance (Guenole et al., 2003; Herrnstein & Murray, 1994; Ones & Viswesvaran, 2001; Schmidt & Hunter, 1998; Schmidt et al., 1981; Schmidt et al., 1992, Thorndike, 1986 etc.), could be negatively related to the personality trait 'Conscientious', when the trait 'Conscientious' is considered the single best personality predictor of performance

(Barrick & Mount, 1991; Hough, 2001). A simple, and well-supported explanation for these apparently paradoxical relationships is that job performance is not a single construct, and thus cannot be consistently measured. Job performance is not a generic concept. Appraisals of job performance lead to assessing a conglomerate of different components, not always congruent (e.g., Avis, 2002; Campbell, 1990; Campbell, Dunnette, Arvey, & Hellervik, 1973; Hough, 2001; LePine & Van Dyne, 2003).

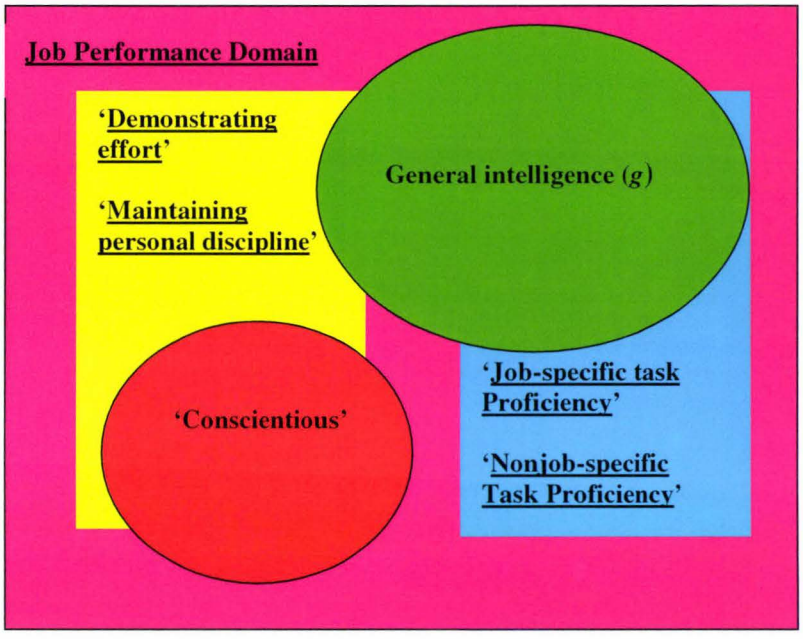

Figure 2.

The hypothesised (oversimplified) relationships accounting for negative correlations between the personality traits 'Conscientious' and Intelligence, but similarly positive correlations for both the trait 'Conscientious' and Intelligence when individually measured against job performance.

Our culture values self-control, order, and conformity. In fact "adjustment to society is usually defined in terms of at least minimal control and compliance" (Buss & Plomin, 1975, p. 207). Consistent with such values, Campbell's (1990) model of job performance includes components of 'Demonstrating Effort' and 'Maintaining Personal Discipline', which are consistent with the characteristics of the personality trait 'Conscientious' (FFM). However, Campbell's (1990) model also includes the components of 'Job-specific task Proficiency' and 'Nonjob-specific Task Proficiency', both of which correlate highly with intelligence (Herrnstein & Murray,

1994). Although these components are not exhaustive of Campbell's model, they are the most illustrative of the differences between job performance components. The component distinctions between 'Demonstrating Effort' and 'Maintaining Personal Discipline', and 'Job-specific task Proficiency' and 'Nonjob-specific Task Proficiency' are consistent with the different intellectual requirements of many jobs. While the intellectual fluidity associated with intelligence in the higher-end of employment such as management is certainly beneficial in this sphere (Gottfredson, 1997; Snow & Snell, 1993; Spencer & Spencer, 1993), so is the type of compliance and adherence to procedure characterised by the personality trait 'Conscientious' in what is generally seen as "subordinate" roles (Emler & Cook, 2001). This is further supported by research suggesting an absence of relationship between the personality trait 'Conscientious' and performance in managers, and a negative relationship between the trait Conscientious' and rated promotability (Robertson et al., 2000).

Campbell's (1990) model can serve as an example of performance scaling shedding some light on the mutual positive relationship between the personality trait 'Conscientious' and intelligence for job performance, yet negative relationship with each other. These apparently paradoxical relationships are explicable through different areas of performance impacting on each respective relationship (see Figure 2.). The example is a reminder that job performance, its composite scores, and the criteria with which performance is assessed, are part of a more complex domain than is often portrayed in meta-analyses (Campbell, 1990).

4.5: Limitations

4.5.1: Design and Internal Validity

This research did not rely on a design with clear-cut independent and dependent variables. It does not permit making causal statements about the relationships between variables. This increased the possibility that third-variable, or reciprocal/circular causation was responsible for observed relationships. Another design limitation was the use of a cross-sectional instead of a longitudinal approach. This resulted in the inability to determine whether observed results had a transitory

age-related existence, or were pervasive across age cohorts or the lifespan (Bordens & Abbott, 1996; Pedhazur & Schmelkin, 1991).

Given the fact that archival data was used the researcher was not in a position to make decisions on creating data sets. For example, it was not possible to examine, item by item, the responses from which an individual's scores were derived; only total scores were represented in the data file. This had the major limitation of ruling out the use of Numerical reasoning scores on the GRT2 as determinants of crystallised, or fluid intelligence. The Numerical reasoning subscale comprises both items that test quantitative reasoning that are representative of crystallised intelligence, and items determining numerical patterns that are representative of fluid intelligence (Ashton et al., 2000). However, as it was impossible to determine which items made up an individual's Numerical reasoning score as only total scores were available, it was impossible to determine which relationships between an individual's personality characteristics and Numerical reasoning were for crystallised and which were for fluid intelligence.

Another limitation imposed by use of archival data was that it did not include second-order dimensions of personality. As a result current findings solely concern primary dimensions of personality. While considered in Five-Factor Model combinations, such second-order factors could not be directly examined. This is particularly problematic as general consensus over the use of Five-Factor Models means that studies of the relationships between ability and personality trait constructs should include measures of second-order dimensions for comparative, and applied purposes (Lohman & Rocklin, 1995).

4.5.2: Generalisability

The capacity to make generalised statements about the results of this investigation to any greater population was reduced by use of archival data. In order to have confidence in generalisations made from investigative findings the participants from which the results were derived must have a distribution of characteristics that are representative of the population to which generalisations are

directed. Normally this is achieved by identifying the population of interest and all cases of interest. Then determining the specific characteristics of the population's members. Once the population and its characteristics have been identified a subset of individuals are extracted from the population utilising random selection procedures that adhere to the principles of probability theory. The use of probability theory in the random selection of individuals from an identified population provides confidence that the characteristics of the subset, or sample, will be representative of the population as a whole. Thus, providing confidence in the generalisation of results from a sample to a population (Shaughnessy, Zechmeister, & Zechmeister, 2003).

The sample of this investigation was not selected randomly, but rather on the basis of available archival data, which renders the participants of this research a sample of convenience. Because the sample was selected nonrandomly there is no way to estimate the probability of members of a greater population having being included in the sample. As a result it is not possible to guarantee members of a population had the same chance of inclusion in the sample. This leads to the problem of potential selection bias having occurred in the sample. Bias in this context refers to the potential for the distribution of characteristics in a sample to be systematically different from the distribution of a population of which a sample may have been considered representative. So selection bias refers to the possibility that the characteristics contained within the research sample may be over- or under-representations of the distributions of those characteristics contained in a wider population of relevance. As a result of the potential bias of this investigation's sample generalised statements to any greater population are inappropriate, for without being able to estimate sampling errors, it is impossible to claim participants were representative of a greater population (Pedhazur & Schmelkin, 1991).

However, the limitation of using archival data in this research for making generalisations is somewhat balanced by this investigation's ecological validity (Guba & Lincoln, 1994). The term ecological validity refers to the fact that as the investigation was interested in the relationships between personality traits and intelligence as a feature of workplace selection testing, by analysing archival data that was derived in the process of workplace selection it is a realistic account of the relationships between personality traits and intelligence in a "real-life" context. As a

result this research provides a more "real" representation of psychometric testing within the New Zealand workplace than research utilising participants who weren't undertaking these tests in a realistic setting (Stuart-Hamilton, 1995). For example, participants taking part on a university campus in research investigating relationships between personality trait and intelligence measures designed for use in workplace selection would be unlikely to experience the same motivations as those taking part in a "real-life" setting. Another benefit of the archival data used in this investigation was that participant numbers were large in both subsamples (Ashton et al., 2000), which is particularly important in the evaluation of weak relationships (Austin et al., 2002).

4.5.3: Analyses and Statistical Power

A statistical issue in this research relates to the hazards of interpreting results (e.g. correlation coefficients) that are highly significant due to large sample sizes, but reflect a relationship of questionable strength. Caution was necessary in order to ensure most emphasis was given to those results considered of greatest interest. It also ensured that those coefficients that were most comprehensively discussed were not in any way limited in terms of power. The Bonferroni correction was used to increase the likelihood of focusing upon key statistically significant results (Winer et al., 1991).

4.5.4: Measurement

Very few standardised tests have near-perfect reliability. It is useful to note that the personality instruments used had reliability figures in the range of *r* .64-85 (15FQ), and *r*.65–85 (OPP) (Boyle et al., 1995). Another assessment issue is encountered when examining the relationships between intelligence and personality. This is the issue of legitimacy when comparing intelligence tests, designed to measure a maximum performance capability, and personality inventories, designed to measure typical performance (Goff & Ackerman, 1992; Most & Zeidner, 1995). Also, while the GRT2 was an adequate operationalisation of psychometric intelligence, the fact

that its dimensions were designed to be heavily loaded on fluid ability (including its Verbal reasoning scale; Budd, 1993) meant that it may not have been a measure of crystallised intelligence as "clean" as one would hope for.

Another problem with the GRT2 is that it is designed for the general population. It does not discriminate finely enough among higher-level scorers. This limitation is exacerbated by the use of archival data based upon test results generally from individuals applying for pre-management jobs, or lacking in university qualifications. The issue is serious as variations in the strength of an association between personality traits in subgroups of different ability level are likely (Austin et al., 2002).

The concern in personnel selection that individuals will misrepresent themselves when using self-report measures was largely addressed through the use of scales for response set, response style, dissimulation, and the exclusion of extreme scorers thereon (see Appendix D). The response set of using the middle or "uncertain" category refers to individual's propensity to choose the middle category, denoting uncertainty of response (Kline, 2000), and potentially indicating an unwillingness to provide personal information (OPRA, 2003). This response set was labelled throughout this research as the distortion scale of 'Central Tendency'. Response style refers to a general tendency to either agree or disagree with statements without attending to their actual content (Edwards, 1970). The tendency to agree has been labelled acquiescence, and according to Guilford (1959) is most likely to occur when items are vague rather than specific.

Dissimulation refers to an individual's propensity to endorse items on an inventory in such a manner as to appear unrealistically healthy (faking good) or unrealistically disturbed (faking bad) (Kline, 1993). Due to the voluntary nature of most job applications the response set of faking bad tends to be of little concern in the context of workplace selection (Cattell et al., 1970). The response set of social desirability is the tendency to endorse items depending upon how socially desirable it is to do so. The difference between social desirability and faking good is that whilst faking good is presumed a conscious decision, such a presumption is not implicit in social desirability (Kline, 2000). The issue of concern surrounding social desirability

on personality measures revolves around its effect on validity. Christian, Goffin, Johnson and Rothstein (1994) found that social desirability distortion of answers in the 16PF had no effect on its validity. Barrick and Mount (1996) also demonstrated that although impression management response distortion of personality items occurred in their participant sample, the validity of responses was not adversely affected.

Although response distortion does not appear to have a major impact on the validity of personality measures in a selection context, and extreme scorers on dissimulation, response set, and response style were identified and excluded from analysis, undetected distortion must still remain a concern (Kline, 1993, 1995), and its potential influence on findings is worthy of consideration. Research by Lao (2001) suggests more intelligent subjects may attend to the aversive consequences of self-derogatory reports by being less likely to report negatively about their own behaviour. High scores on neuroticism and anxiety questionnaires, for example, are obtained to the extent that subjects express complaints and admit deviant or socially undesirable behaviour. Rather than any "real" relationship between lack of intelligence and the personality trait 'Anxiety', this response bias could impact on findings that intelligence is negatively related to the personality traits 'Emotional' (OPP), 'Suspicious' (FL), and 'Tense-driven' (FQ4) (Mischel, 1968).

4.6: Future Directions

An important goal of this investigation was to provide direction for future research enabling organisational psychology to better determine what roles are played by individual differences (e.g. intelligence, personality traits) in the determination of job performance, and how such knowledge can be utilised to improve predictions of "person/job fit" (Kanfer et al., 1995). No conclusions from a given set of data can be considered definitive: Replication is essential to scientific progress, and as such the first course of future research should be the confirmation, or otherwise of these results (Cohen et al., 2003). Although the likelihood of Type I and Type II errors was reduced by the use of a restrictive probability value and the equally acceptable power of the β, it is still recommended that the reliability of results is supported via the

replication of this research (Cook & Campbell, 1979). A replication of the results of this research is also recommended as the best possible evidence of the external validity of the results of this investigation. This is particularly relevant in light of this investigations limitation in the generalisation of its results as a consequence of nonprobability sampling (Shaughnessy et al., 2003).

An important direction for future research will be to verify the more precise pattern of relationships between personality traits and intelligence for crystallised versus fluid intelligence. Findings that the personality trait 'Conscientious', the characteristics of which have been found to be negatively related to moral development in previous research, was negatively related to intelligence, which has also been found to be negatively related to moral development (cf. Sackett & Wanek, 1996), suggests future research could profit from extending knowledge of the dynamics between personality traits, intelligence, and moral development. This could lead to a better interpretation of the results of personality, intelligence, and integrity tests within an organisational context. In doing so it could assist the development of measures, tools, or test batteries based upon knowledge of such a dynamic. This is especially true considering the shared positive relationship between moral reasoning and other important workplace behaviours, such as prosocial behaviour (Brief, 1986), and leadership (Emler & Cook, 2001).

As indicated in the discussion of limitations and explanations of divergence sections, an important area for future research will involve determining the relationship between intelligence and personality traits across demographics. Scant research has examined demographics in relation to their influence on correlations between personality traits and intelligence. Cross-cultural research is likely to be of particular interest in this regard due to some fundamental cultural differences in the paternal encouragement of various behaviours during early development. For example, the parenting skills of ethnic Chinese generally stem from Confucian principles that are far more encouraging of behaviour consistent with the personality trait 'Conscientious' than their European counterparts who are far more encouraging of behaviours characteristic of individualism (Jose, Huntsinger, Huntsinger, & Liaw, 2000). On the basis of such cultural differences in socialisation it would not be

unreasonable to hypothesise that there may be differences between the finding for predominantly European samples of a negative relationship between the personality trait 'Conscientious' and intelligence, and those of an ethnic Chinese sample.

Demographic differences in ability will also be an important area of focus for future research. Research examining the influence of intellectual ability on relationships between personality traits and intelligence would test the hypothesised explanation for a negative relationship between the personality trait 'Conscientious' and intelligence, but positive relationships for both the trait 'Conscientious' and academic achievement, and intelligence and academic achievement. It could establish if the negative relationship between the personality trait 'Conscientious' and intelligence holds across levels of intelligence, or whether as the adaptive explanation would predict, in high-end academic situations the behaviours indicative of the trait 'Conscientious' become sufficiently functional for smarter individuals to alter this relationship. By future research also encompassing demographic differences in educational levels it would become possible to determine whether there is a progressive reinforcement of behaviours that tend to characterise a person who has a high score on the personality trait 'Conscientious' throughout the educational system, or the educational range in which the trait 'Conscientious' is rewarded. It would also test if behaviour indicative of the personality trait 'Conscientious' remains functional as a coping strategy for comparatively less intelligent people throughout the educational system.

Research examining the relationships between personality traits and intelligence when intelligence is examined in terms of Sternberg's triarchic theory of intelligence would also be of value. Such research could examine the relationships between componential and contextual intelligence on the one hand, and personality traits on the other. This could determine whether people who score high on the personality trait 'Conscientious' are high in contextual intelligence yet low in componential intelligence. It would thus test the hypothesis that individuals scoring less well in intelligence tests (componential intelligence) may be more competent in practical intelligence (contextual intelligence), and using behaviour indicative of the personality trait 'Conscientious' (FFM) as a coping strategy, which is supported by findings that contextual intelligence is unrelated to IQ, yet a moderate predictor of job

performance (Sternberg & Wagner, 1993; Sternberg et al., 2000; Wagner & Sternberg, 1986). Understanding this relationship is important due to the practical consequences for individuals scoring high on the personality trait 'Conscientious', yet low on intelligence tests that fail to discriminate among Sternberg's subtheories of intelligence. If a significant correlation is found between tacit knowledge (contextual intelligence) and the personality trait 'Conscientious', a lower score in general intelligence than other applicants for a job could become less detrimental in selection decisions for many jobs. This could in fact be seen as a positive outcome due to the high turnover for high scorers on general intelligence in many jobs (Rosse & Noel, 1996).

The results contained in Appendix E.2 suggest that an examination of the influence of gender on relationships between personality traits and intelligence would be fruitful. Although quite a lot is known about gender differences between fluid and crystallised intelligence (for reviews see Stankov et al., 1995; Hyde & Linn, 1988 etc.), like other demographics, scant research has examined the influence of gender on relationships between personality traits and intelligence. The correlation coefficients contained in Appendix E.2, which were generated for relationships between personality traits and intelligence on the basis of gender, indicate that there are differences in which personality traits correlate with intelligence among males and females. Intriguingly, these differences appear in keeping with gender schema stereotypes of male/female characteristics. For example, there is a positive relationship between intelligence and the personality trait 'Persuasive' for females that is absent in males, and there is a positive relationship between intelligence and the personality trait 'Phlegmatic' for males that is absent in females. As these gender schema stereotypes are potentially more prominent in Western society than some other societies, the influence of gender on relationships between personality traits and intelligence may be another area in which cross-cultural research would be beneficial.

Examining differences in relationships between personality traits and intelligence, as a function of age differences would also be of value. On the basis of widely recognised differences in fluid and crystallised intelligence as a function of age (e.g., Bates, 1993; Salthouse, 1998), correlation coefficients in Appendix E.1 were developed on the basis of differences in age range. These coefficients show

various differences in the relationships among personality traits and intelligence scales as an influence of age. However, due to statistical and methodological limitations in the development of the matrices in Appendix E, such results are limited to providing impetus for future research into the influence of age upon relationships between personality traits and intelligence.

There are other closely allied areas in which future research is envisaged. Some of these directions are implicit in suggested explanations for some of the findings of this research. Further empirical support would be especially important in attempting to understand the positive relationships between the personality trait 'Conscientious' and job performance, and intelligence and job performance; yet negative relationship between the trait 'Conscientious' and intelligence. Future research could investigate the accuracy of the purported explanation that this relationship is accounted for by the complexity and/or inconsistency of criteria by which job performance is often assessed.

The explanation provided for the finding that the personality trait 'Anxiety' is negatively related to intelligence also provides direction for future research. The explanation of the negative relationship between intelligence and the personality trait 'Anxiety' was that the trait 'Anxiety' is not inherently negatively related to intelligence, but rather impairs the functions of attention and working memory, which are both important components of test taking success (e.g. Necka, 2003). That the negative relationship between personality dimensions representative of the personality trait 'Anxiety' and intelligence was not limited to any one aspect of intelligence, but was consistent across fluid and crystallised intelligence, supported this explanation. Future research could test this hypothesis by conducting research involving the use of anti-anxiety medication and/or relaxation techniques prior to intelligence testing on individuals' scoring high on the personality trait of 'Anxiety'. If the use of anxiety reducing medication and/or relaxation techniques was found to positively influence outcomes on intelligence tests this would be of practical relevance for anxiety suffers who may not have done as well as they were capable of doing in past testing, particularly in academic and job application situations.

The explanation for the positive relationship between the personality trait 'Intuitive' (FI) and Verbal reasoning (crystallised intelligence), and positive relationship between the personality trait 'Conceptual' (FM) and Verbal reasoning (crystallised intelligence) were explained in terms of their "abstract thought" component. Implicit in this explanation was the suggestion that the strong imaginative and innovative components that are conceptual features of the personality traits of 'Intuitive' (FI) and 'Conceptual' (FM) promoted intellectual development. It was proposed that the use of abstract thinking style development could potentially be used to enhance crystallised intelligence. If true, this could potentially benefit educational and training programmes. It would therefore be of benefit to conduct research testing this hypothesis. Another area in which knowledge of the relationship between abstract thought and intelligence could be extended would be that involving morality. Moral development and abstract thought are each positively correlated with intelligence (e.g., Colby et al., 1983; Bates & Shieles, 2003). It would be interesting to determine the extent to which variance in intelligence is shared or unique between abstract thought and morality. Particularly as principles considered in higher stages and levels of moral development are generally abstract in nature (Kohlberg, 1984; Hinman, 1998, etc.).

The negative relationships between the personality trait 'Suspicious' (FL) and intelligence, and the personality trait 'Group-Orientated' (-FQ2) and intelligence were both explained in terms of adaptive significance (Austin et al., 2002). Characteristics such as the pessimistic expectations of the motives and intentions of others towards oneself associated with the personality trait 'Suspicious' (FL), and the reliance on others associated with the personality trait 'Group-Orientated' (-FQ2), were hypothesised as functionally maladaptive when taken to extremes. Empirical support for this hypothesis was derived from research suggesting a positive relationship between intelligence and social intelligence (e.g., Austin et al.; Barchard, 2003). Future research examining relationships between personality traits and social/emotional intelligence would be of benefit not only in testing this hypothesis, but also in providing information regarding other potential relationships between personality traits and E.Q. (emotional intelligence).

The relationship between one's locus of control and intelligence was also explained in terms of adaptability. The implication of this explanation was that perception modification could potentially enhance cognitive task performance (either due to effort expended on tests, the effort expended developing crystallised intelligence in the first place, or both). This supports the focus upon self-efficacy beliefs in social cognitive models of education (Bandura, 1986, 1993; Bandura & Wood, 1989) and the importance of perception in work related outcomes, such as training success (Cannon-Bowers, Salas, Tannenbaum & Mathieu, 1995; Noe, 1986; Noe & Schmitt, 1986), performance, effort, and satisfaction (Spector, 1982). Future research would be well served to focus upon determining the most effective way such modifications could be undertaken for those of varying personality dispositions.

The positive relationship between the personality trait 'Persuasive' (OPP) and intelligence was explained within the paradigm of operant conditioning. The personality trait 'Persuasive' (OPP) was related to intelligence, particularly crystallised, because the trait 'Persuasive' (OPP) presupposes "calculated" behaviour. Such behaviour - in order to have been conditioned as rewarding behaviour – is likely to have been utilised with some degree of success, and is more likely to have been successful, and thus conditioned for those persons who are better equipped intellectually for "calculated" behaviour. Future research testing this explanation could be conducted both to test the gender specific implications for positive relationships between the personality trait 'Persuasive' (OPP) and intelligence discussed previously, and to shed light on the developmental nature of personality traits.

CONCLUSION

This investigation set out to examine the relationship among personality traits and intelligence with a number of goals in mind. One such goal was to increase the knowledge that the computation of incremental validity requires regarding intercorrelations among the predictors of personality traits and intelligence (e.g., Ones & Viswesvaran, 2001). This was an important goal due to the prevalence of combining personality and intelligence scores for greater predictive validity in personnel selection. In doing so it tested and refuted the commonly held supposition

that intelligence and personality traits do not co-vary (Kanfer et al.). The hypotheses tested represented a particular interest in the intercorrelations among the personality trait of 'Conscientious' (FFM) and intelligence due to their putative value in selection decisions, and hence their common combination in attempting to increase predictive validity (Black, 2000; Yoon, 1998 etc.). The results of hypothesis testing demonstrated that each of the primary dimensions of the personality trait 'Conscientious' (FFM) is negatively related to intelligence. The testing of primary dimensions was important in addressing concerns regarding potential obscuration of relationships among personality traits and intelligence due to imprecision in second-order dimensions, especially that of the personality trait 'Conscientious' (FFM), for which the homogeneity of primary dimensions has been questioned (e.g., Paunonen & Jackson, 1996).

The results of this investigation also demonstrated other significant relationships between some personality traits and intelligence within a "real-life" New Zealand workplace context. It suggested that the relationships among personality traits and intelligence are more in evidence with crystallised than fluid intelligence. Furthermore, it demonstrated that combinations of personality traits accounted for sufficient unique variance in intelligence, particularly crystallised intelligence, to justify further investigation into their utility as predictors of intelligence.

These results had a number of implications. For example, an implication of determining that relationships between personality traits and intelligence (particularly those for the personality trait 'Conscientious' (FFM) and intelligence) do in fact co-vary, is the necessity of a more complicated analysis in the development of calculations for incremental validity. This is when those calculations involve gains in predictive validity that are derived from the addition of personality trait and intelligence scores (Kanfer et al., 1995).

Various explanations as to how the personality trait 'Conscientious' (FFM) and intelligence could be negatively related to each other, yet both positively related to third variables such as job performance or academic achievement, were also proffered. For example, a suggested explanation for the negative correlation between the personality trait 'Conscientious' (FFM) and intelligence, yet mutual positive

relationship with job performance, was that the general criteria for determining job performance lacks consistency in respect to the area of job performance domain covered by intelligence and personality traits (see Figure 2.). This is supported theoretically by Campbell's performance model (1990 etc.). It is also supported empirically by research suggesting the personality trait 'Conscientious' may not be an asset in all occupational roles (Robertson et al., 2000). The shared positive relationship with academic achievement for both the personality trait 'Conscientious' and intelligence (Busato et al., 2000 etc.) was likewise explained in terms of domain coverage (see Figure 3.).

Explanations for many of the relationships supported previous findings suggesting an important link between the functional adaptability of traits and their relationship with intelligence (e.g., Austin et al., 2002). For example, the negative relationships between primary dimensions of the personality trait 'Conscientious' (FFM) and intelligence, yet positive relationship for the trait 'Conscientious' (FFM) with job performance, were explained in terms of compensatory coping strategies employed by the less intelligent, and/or a lack of adherence to such strategies by the more intelligent (P. Englert, personal communication, December 29, 2002; Moutafi et al., 2003). Some important applied implications of the role of functional adaptability for such relationships were also examined. For example, the relationship between locus of control and intelligence test scores further support the focus upon self-efficacy beliefs in social cognitive models of education and employment (Bandura & Wood, 1989 etc.).

The results of this investigation also indicated various profitable directions for future research. For example, support for externally dictated value systems, such as those characterised by some dimensions of the personality trait 'Conscientious' (FFM), being negatively related to intelligence (Colby et al., 1983 etc.), indicates potential benefit in organisational psychology extending its knowledge of the dynamics between personality, intelligence, and integrity tests. This could potentially assist in the development of superior measures, and/or test batteries involving personality traits, intelligence, and integrity tests. Results also indicated the importance of determining the relationship between intelligence and personality traits across demographics, such as varying cognitive ability levels, gender, and ethnicity.

Although not without design limitations this investigation managed to address many of the methodological concerns that plagued much of the previous research in this area. This is particularly true for methodological issues concerning the exhaustive examination of all personality traits contained within the personality measures utilised, using a sufficiently large sample size, and using measures of known and acceptable validity and reliability. Through the use of a hierarchical model of intelligence this investigation was also able to confirm the importance of discriminating between fluid and crystallised intelligence to better understand the relationship between intelligence and personality traits.

In summary, this investigation has provided direction for various lines of future research. This research identified applied and theoretical implications of its findings, and acknowledged design limitations profitably addressed in future research.

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APPENDICES

Appendix A: 15FQ dimensions

Budd (1993) provides the following descriptions of the characteristics and behaviours that make up the 15FQ primary factors:

Factor A: Reserved – Outgoing:

Reserved: will prefer their own company, prefer avoiding social situations, and are likely to see themselves as loners. They are associated with being: retiring, aloof, self-contained, cool and formal, impersonal, not requiring the company of others, and taking a long time to get to know others.

Outgoing: they are likely to be genuinely interested in others, enjoy lively parties, and be good at putting others at ease; and are typically associated with being: participating, warm/familiar, gregarious, affiliative, personable, in need of social contact, and quick to get to know new people.

Factor C: Temperamental – Calm/Stable

Temperamental: likely to blame themselves when things go wrong, are generally concerned with what others think of them, and are prone to mood swings and tension headaches. They are associated with being: emotional and emotionally volatile, easily flustered, suffering from self doubt, readily expressing their emotions, having difficulty coping with pressure, and potentially reacting in an unpredictable manner.

Calm/Stable: will be confident in what they want from life and the course their life is taking, they will have a sense of achievement and handle crises well. They are characteristically: emotionally stable, able to cope well under pressure, self-assured and confident, emotionally unmoved and unruffled, and likely to react in a calm and stable manner.

Factor E: Accommodating – Assertive

Accommodating: will be concerned with the wishes of others and describe themselves as cautious and tactful. They are associated with being: accommodating, deferential, unassertive, uncompetitive, passive and mild, likely to prefer others to take the lead, and concerned with the needs of others.

Assertive: high scorers see themselves assuming positions of authority, don't take no for an answer, know what they want, and get what they want. They are associated with being: forceful, dominant, controlling, confrontational, competitive, taking the lead in group situations, and being insensitive to the feelings of others.

Factor F: Cautious – Enthusiastic

Cautious: will generally avoid dangerous activities and prefer to plan and anticipate events. They will typically be: deliberate, inhibited, sober and serious, cautious, dependable and predictable, formal and restrained, and consider all the alternatives before deciding on a course of action.

Enthusiastic: tend to be the life of the party, actively seek out new and exciting challenges, and take risks. High scores are associated with being: spontaneous, uninhibited, lively, playful, unpredictable, impulsive, carefree, and jovial.

Factor G: Expedient – Conscientious

Expedient: will describe themselves as flexible and tolerant, preferring to focus on the broader aims and objectives of an undertaking rather than being too worried about the detail. Are associated with being: flexible, expedient, somewhat lax, tolerant, unencumbered by rules and regulations, unsteady in progress, unstructured, and comfortable cutting corners.

Conscientious: People who score highly on Conscientious will tend to be: structured, persevering, Conscientious, rigid, perfectionists concerned with details, exacting and meticulous, and do things by 'the book'.

Factor H: Retiring – Socially bold

Retiring: people who will tend to be: socially restrained, reserved, uncomfortable as the centre of attention, prefer avoiding involvement in social situations, rarely initiate getting to know people, and be shy and withdrawing.

Socially bold: high scorers tend to describe themselves as sociable people who are very outgoing, never lost for words, and often the centre of attention. A high score is associated with being: self-confident, enjoying social occasions, being the centre of attention, socially venturesome, and often the one to instigate contact with new people.

Factor I: Factual – Intuitive

Factual: these individuals describe themselves as being interested in subjects such as Engineering and Chemistry, and failing to understand other people's interest in subjects such as Philosophy and Art. They are associated with being: utilitarian, unsentimental, hard-headed, objective, tough-minded, interested in technical and scientific spheres, good at coping with emotionally charged situations, and making decisions based on concrete evidence.

Intuitive: will have preferred art and literature at school and are more likely to describe themselves as concerned with whether something works as opposed to how it works. They are associated with being: sentimental, creative, subjective, tender-minded, aesthetically and emotionally sensitive, interested in the creative sphere, finding emotionally charged situations hard to cope with, and basing decisions on feelings and emotions.

Factor L: Trusting – Suspicious

Trusting: will describe themselves as likely to let people get on with the job and be happy to accept compliments and flattery. They will tend to be: accepting, open, adaptable, accommodating, tolerant of other peoples faults and limitations, open in their interactions with others, and likely to expect the best from people.

Suspicious: a high score on this factor is associated with being: cynical, guarded, doubting, vigilant, questioning the motives of others, critical of the limitations of others, guarded in their dealings with others, and expecting the worst from other people.

Factor M: Practical – Conceptual

Practical: will generally describe themselves as uninterested in the performing arts or academic debate, and consider it important to raise children to be practical and realistic. They are associated with being: pragmatic, attentive to practical realities, concrete, to have their 'feet on the ground', engage in practical 'down to earth' thinking, realistic and practical problem solvers, not concerned with theoretical principles, but ideas that have a practical utility.

Conceptual: will describe themselves as liable to get so involved in their work that they may lose track of time, and believers in the importance of raising children to be creative and imaginative. They will typically be: abstract, imaginative, absorbed in thought, have their 'head in the clouds', have little time for practical principles, not be greatly worried about the practical utility of their ideas, be abstract and imaginative thinkers and thus creative problem solvers.

Factor N: Direct – Restrained

Direct: describe themselves as unconcerned about telling people things they don't want to hear, and say that others may describe them as tactless and blunt. They are associated with being: forthright, artless, unpretentious, informal, unrestrained, forthright and direct in their dealings with others, unconcerned with the impression they make, willing to express their feelings forcefully, and often speaking and acting without taking into account the effects of their actions on others.

Restrained: Those who score high on Restrained are considered: cautious, diplomatic, formal, socially polished, tactful, cautious and Restrained in their dealings with other people, concerned with making the 'right' impression, having a tendency to hide their true feelings, and being concerned with the impact of their behaviour on others.

Factor O: Confident – Self doubting

Confident: will tend to describe themselves as having no difficulty putting the day's problems behind them and bouncing back from adversity. Are associated with being: secure, self-assured, unperturbed, self-satisfied, high in self-esteem, believing they will succeed in anything they do, blaming failure on circumstances instead of themselves, and unlikely to experience guilt when things go wrong.

Self doubting: high scorers regularly feel ill at ease and restless, tend to take unfair criticism to heart, and are likely to vividly remember any past faux pas. They are associated with: lacking self confidence, worrying, being insecure, apprehensive, having low self esteem, not generally expecting to succeed in their tasks, blaming themselves instead of circumstances for failure, and being prone to feeling guilty when things go wrong.

Factor Q1: Conventional – Radical

Conventional: will typically feel that people attach too little importance to convention and tradition. Are viewed as: conforming, traditional, conservative, preferring the familiar, accepting and respectful of the status quo, respecting traditional values, resistant to change, and likely to avoid situations outside of their range of experience.

Radical: high scorers will describe themselves as having views that are very distinct from most people and often as interested in philosophical questions. They are associated with being: innovative, open to new ideas, free-thinking, willing to experiment, liberal in their attitudes, critical and questioning of the status quo and traditional values, looking for new ways of doing things, and actively seeking out situations outside their range of experience.

Factor Q2: Group orientated – Self sufficient

Group-orientated: people who score highly on being group oriented typically describe themselves as being drawn towards group activities, enjoying the company of others, and valuing the support of others in making decisions and in taking action on significant issues. They are associated with being: affiliative, group dependent, having a preference for both group decisions and activities, likely to work with other people and valuing the support of others.

Self sufficient: describe themselves as likely to avoid becoming involved in social groups or organisations especially where they know few people, and not feeling close to a great deal of people.

They are associated with being: solitary, self reliant, individualistic, preferring solitary pursuits, their own decisions, working independently, and not to require the support of other people.

Factor Q3: Informal – Disciplined

Informal: will tend to typically be: unconventional, lax, uncontrolled, not worried about social conventions, unconstrained by other's expectations. They will also pay little attention to the status of others, have an expedient self image, not put a lot of effort into exercising control over their emotions, and allow their inner urges to determine their behaviour.

Disciplined: A high score on Disciplined is associated with being: controlled, compulsive, conventional, status-conscious, rigid in terms of self-image, having behaviour that is determined by external values, being highly concerned with social conventions, controlling their emotions, and feeling constrained by other's expectations of them.

Factor Q4: Relaxed – Tense driven

Relaxed: will describe themselves as relaxed and easy-going. Are associated with being: patient, unperturbed, composed, easily able to ignore minor inconveniences, not easily frustrated, easily relaxed and unwound, having low levels of tension and nervous energy, and unlikely to lose their temper.

Tense-driven: high scorers describe themselves as being hard-driving, always rushing around, and feeling that life's requirements are often accompanied with an unhealthy high level of stress. They are associated with being: frenetic, irritable, impatient, having high levels of tension and nervous energy, being easily upset by minor inconveniences, tending to become frustrated quickly, finding it difficult to unwind and relax, and being prone to lose control of their temper.

15FQ FFM dimensions

Based upon the combined contributions of primary factors from the 15FQ Budd (1992) provides the following general summations of high and low scorers on the above second order factors as follows:

- **Extroversion:**

  High scorers are people persons. They are associated with being most content in situations where they are surrounded by others and can engage in social interaction. Their behaviour will typically be uninhibited and socially confident. They will enjoy initiating and developing personal relationships.

  Low scorers will generally feel discomfort in social situations and will thus typically prefer to withdraw from them. They are happiest when occupied in solitary activities without having to continuously interact with others. They will not typically feel the urge to swap opinions with others.

- **Anxiety:**

  High scorers confess to an array of difficulties in coping with daily challenges. They are dissatisfied with past achievements, nervous about the future, and likely to be stressed in the present. Due to past experiences of being let down by others they are also likely to be questioning of others.

  Low scorers will portray themselves as satisfied with their life and their ability to cope with its day-to-day hassles. They will also describe themselves as calm and composed.

- **Tough minded:**

High scorers will be practical, realistic, and conservative in outlook and attitude. Typically unemotional with both their own and others feelings playing little part in their lives. They are likely to reject abstract solutions to problems in favour of more concrete approaches. They are also often better at putting solutions and ideas into practice than coming up with them.

Low scorers are intellectually oriented, enjoy the freedom to find novel solutions to problems, and typically live in a world of ideas. They will often express an interest in aesthetics and appreciate good design.

- **Independence:** The main contributors to Independence are 'Assertive' and 'Direct' with 'Enthusiastic', 'Self-confident' and 'Radical' making lesser contributions.

  High scorers will describe themselves as alert, challenging, uncompromising, self-assured, lacking deliberation, and quick to respond. They are unlikely to take no for an answer and will question the status quo. Their behaviour is typically determined by their own values and principles rather than the expectations of others.

  Low scorers are drawn to people, deliberating, cautious, empathic, sensitive, passive, accommodating, and likely to be more concerned with the needs of others than the need to complete a task expeditiously. Their reactions to situations will often be influenced by concerns about what others will perceive to be the most appropriate course of action.

- **Control:** The main contributors to Control are 'Conscientious' and 'Disciplined', with 'Tense-driven' and 'Restrained' making a more minor contribution.

  High scorers will be conscious of group standards of behaviour and generally conform to social expectations. Being bound by an internalised moral framework based upon an external source of authority, which provides a strong sense of right and wrong, their behaviour is typically highly structured and demanding in adherence to rules and high standards.

  Low scorers will consider themselves free of constrains imposed by social rules and mores so keenly felt by high scorers. They will often lack the self-discipline to see tedious tasks through to the finish. They are tolerant and open in their attitudes towards others.

Appendix B: OPP dimensions

Budd (1991) provides the following description of the characteristics and behaviours that make up the OPP primary factors:

Accommodating – Assertive

Accommodating: Sensitive to the need's of others and will usually avoid criticising others for fear of upsetting them. Sensitive and unassuming they are likely to feel uncomfortable being forceful and assertive. They are associated with being: Empathic, people oriented, accepting, sensitive to people's feelings, and likely to avoid confrontation.

Assertive: Inclined to be forceful and brash. Concerned with getting results; however, not generally overly concerned with the feelings of others. Will push others to agree with their position and are likely to get their own way. They are associated with being: Dominant, task oriented, challenging, insensitive to the feelings of others', and confrontational.

Detail Conscious – Flexible

Detail Conscious: Meticulous in their dealings with others, with a great respect for authority and a concern with the maintenance of the status quo. Feel most comfortable when following accepted procedures and conventions. They are associated with being: Deliberating, controlled, rigid, detail conscious, and Conscientious.

Flexible: Likely to act in unplanned, impromptu ways and take life as it comes. Likely to harbour informal and causal attitudes, and be inclined to act in radical, unconventional ways. They are associated with being: Spontaneous, ill disciplined and controlled, flexible, disinterested in detail, and disregarding of rules and obligations.

Cynical – Trusting

Cynical: Possess a fundamentally cynical view of human nature they believe that most people are only motivated by self-interest. They tend to be cautious and guarded in their dealings with others. They are associated with being: Suspicious, cynical, questioning of others, sceptical, and distrustful.

Trusting: believe that people are basically good-hearted and sincere, and will expect others to be reliable and trustworthy. They are associated with being: Trusting, philanthropic, likely to take people at face value, likely to have faith in others' honesty, and sometimes a little credulous.

Emotional – Phlegmatic

Emotional: Prone to suffer form feelings of anxiety and self-doubt they may have difficulty coping under pressure. Labile and inclined to mood swings they will at times feel full of energy and on other occasions feel flat and lifeless for no obvious reason. They are associated with being: Moody, anxious, prone to worry, and easily offended.

Phlegmatic: Not easily upset and take most things in their stride. Possessing a mature outlook on life and being able to take constructive criticism without viewing it as a personal attack. They are associated with being: Self-assured, emotionally stable, socially confident, secure, and resilient.

Reserved – Gregarious

Reserved: introspective with little need for the company of others. Reticent when talking with strangers, they are likely to avoid jobs that require constantly meeting new people. They are associated with being: reserved, cool and introspective, aloof and detached, likely to prefer working alone and enjoying one's own company.

Gregarious: Having a strong need for the company of others they will prefer to be surrounded by warm and supportive people. Will seek occupations likely to bring them into regular contact with others. They are associated with being: outgoing and sociable, lively and talkative, high in their need for affiliation, warm and participating, and likely to most enjoy working with others.

Genuine – Persuasive

Genuine: unable to hide their true feelings they cannot easily convince people of views, which they do not believe in. They are unlikely to be influenced in their behaviour by the differing demands of situational contexts. They are associated with being: Forthright, honest and open, genuine and sincere, potentially lacking in tact and diplomacy, and basing their behaviour on their own feelings and attitudes.

Persuasive: tending to be good actors and influential speakers, and acutely aware of the demands of the situation and able to tailor their behaviour to match such demands. They are associated with being: Diplomatic, manipulative and expedient, shrewd and calculating, sensitive to "political" issues, and behaving in ways determined by the demands of the situation.

Composed – Contesting

Composed: tend to dislike having to continually meet close deadlines, and preferring to take things at a steady pace. They are not aggressive or competitive, and are unlikely to be easily irritated. They are associated with being: Calm and composed, tolerant, able to delegate, likely to keep work separate from home life, and be able to distance themselves from work pressures.

Contesting: expect things to be done instantly, they are likely to be intolerant of slow, indecisive people. They are unlikely to delegate work. They are associated with being: Ambitious and competitive, impatient, likely to take work home, work long hours, have difficulty relaxing, be prone to illness, and take on too much work.

Internal/External Locus of Control

Internal: generally approach problems in a constructive way, and actively strive to overcome difficulties they are likely to anticipate success in most things. They are associated with being: Optimistic, achieving and striving, likely to believe that outcomes are determined by their own behaviours, have a positive approach to set-backs, and believe they are in control of their own destiny.

External: Not believing that their actions will shape future events they may feel resigned and helpless when things go wrong. They are associated with being: resigned, prone to feelings of helplessness, inclined to pessimism, fatalistic, and having little faith in their ability to determine events.

Abstract – Pragmatic

Abstract: more concerned with their own thoughts and designs than with practical realities, they will want to have the ideas and let others put them into practice. They are associated with being: Imaginative, aesthetically sensitive, creative and artistic, abstract and intellectual, and having a theoretical orientation.

Pragmatic: they are not interested in artistic, creative activities and have little awareness of aesthetic issues. They are associated with being: down to earth, concrete, practical and realistic, pragmatic, not interested in artistic matters, and more concerned with how than why.

OPP FFM dimensions

Based upon the combined contributions of primary factors from the OPP Budd (1991) provides the following general summations of high and low scorers on OPP second order factors as follows:

- **Anxiety:**

  High scorers are prone to worry. They are associated with being likely to question their own ability to cope with life's problems, be concerned about the future, and feel anxious about things that could go wrong. They are likely to have a tendency towards fatalism or pessimism, and tend to feel that events are outside of their control.

  Low scorers will generally be calm, composed and confident in their ability to cope with life's daily challenges. They will tend to be resilient under pressure and will normally bounce back after setbacks. Their optimism will tend to support them in striving to find solutions where others may give up.

- **Extroversion:**

  High scorers are people persons. They are associated with being most content in situations where they are surrounded by others and can engage in social interaction. Their behaviour will typically be uninhibited and socially confident. They will enjoy initiating and developing personal relationships.

  Low scorers will generally feel discomfort in social situations and will thus typically prefer to withdraw from them. They are happiest when occupied in solitary activities without having to continuously interact with others. They will not typically feel the urge to swap opinions with others.

- **Openness to Ideas:**

  High scorers will be people who live in the world of ideas, are intellectually oriented and enjoy situations where they have the freedom to approach problems in new and innovative ways. They will be aesthetically sensitive and believe art enriches life.
  Low scorers are practical, realistic, and conservative in outlook and attitude. Typically unemotional with both their own and others feelings playing little part in their lives. They are likely to reject abstract solutions to problems in favour of more concrete approaches. They are also often better at putting solutions and ideas into practice than coming up with them.

- **Agreeableness**:

  High scorers are drawn to people, deliberating, cautious, empathic, sensitive, passive, accommodating, and likely to be more concerned with the needs of others than the need to complete a task expeditiously. Their reactions to situations will often be influenced by concerns about what others will perceive to be the most appropriate course of action.

  Low scorers will describe themselves as alert, challenging, uncompromising, self-assured, lacking deliberation, and quick to respond. They likely to be cynical, are unlikely to take no for an answer and will question the status quo. Their behaviour is typically determined by their own values and principles rather than the expectations of others.

- **Conscientious:**

  High scorers will be conscious of group standards of behaviour and generally conform to social expectations. Being bound by an internalised moral framework based upon an external

source of authority, which provides a strong sense of right and wrong, their behaviour is typically highly structured and demanding in adherence to rules and high standards.

Low scorers will consider themselves free of constrains imposed by social rules and mores so keenly felt by high scorers. They will often lack the self-discipline to see tedious tasks through to the finish. They are tolerant and open in their attitudes towards others.

Appendix C: Administrative guidelines

Preliminary guidelines require testing takes place in a well-lit and ventilated room with sufficient space to work; that there are no interruptions during the testing process; and that prior to introducing the test all the necessary materials are available to participants.

The following eight guidelines are then utilised to ensure standardisation is achieved (OPRA, 2000):

1. Participants are welcomed and informed in general terms the purpose of the test (i.e., whether it is part of the selection process or a function of workplace assessment, development, training etc.). At which stage the benefits each participant could expect from completing these exercises are also made clear.
2. The need to work as quickly as possible to complete each test is reiterated.
3. It is ensured that each participant has correctly completed any details required on the answer sheet(s) before the test begins.
4. The administrator's manual for instructions on test completion is followed. Confirmation from the participant that they understand is sort, but no further help beyond what is indicated in the manual as permissible is given.
5. The participant is allowed to complete any examples prior to starting the test itself. It is checked that these have been completed correctly and any questions the individual may have are answered – without giving them any undue advantage.
6. For the GRT2, which is a timed test, the participant is asked to "stop" precisely when their time is up. Participants are given 10 minutes to complete the Abstract reasoning section; 10 minutes to complete the Numerical reasoning section; and 8 minutes to complete the Verbal reasoning section. For the 15FQ, the participant is allowed to work until they are finished. If as sometimes happens, an individual is exceedingly slow or attempts to read too much into the question, the administrator encourages a more speeded response.
7. All test materials are collected before the participant leaves their desk. It is then again checked that their name is clearly written on all answer sheets.
8. The participant is thanked for completing the assessment programme and either informed of the next stage in the selection procedure and if, how and when they will receive feedback on their assessment results.

Appendix D: Data Editing

Upon receipt of the data the first step undertaken was the editing process. The raw set for Subsample 1 encompassed data on 2575 individuals whom had completed the 15FQ, a general or specific cognitive ability measure, or both the 15FQ and a general or specific cognitive ability measure.

The first stage of editing the data entailed removing the data regarding cognitive ability measures other than the GRT2. Once this was accomplished the next step was to go through the material and remove data on those individuals who had not completed the GRT2. This reduced the data set to 1631. The next step in the editing process involved removing from the data set anyone who had not completed all three dimensions of the GRT2. This further reduced the data set to 1579 individuals. Next individuals who scored four or more Standard Deviations above the mean on 15FQ distortion scales were removed - consistent with Leong and Austin's (1996) recommendations. This further reduced the subsample to 1576 individuals. The ability to simply remove those who failed to fully meet the selection criterion for the research was very much a luxury of such large participant numbers, and was consistent with Smith, Budzeika, Edwards, Johnson and Bearse's (1986) guidelines for cleaning data to ensure the accuracy of later analysis.

The next stage in editing the data set involved re-encoding some of the participant characteristics into a more usable form in terms of analysis. This process involved recoding nominal data into a numerical format. The recoded data included participant demographics for gender, ethnicity, education, and applicant or incumbent status. Though already interval data, information pertaining to the age of participants was also recoded to facilitate correlational analysis within specific age ranges; firstly 17-29 and 30-61, then 17-39 and 40-61.

These steps were then repeated with the raw data set for Subsample 2. The data set was reduced from 3001 to 2544 individuals.

Appendix E: Demographics

N.B.: Extreme care must be taken in any attempt at drawing conclusions regarding demographic comparisons from the following matrices. Many contain severe statistical limitations due to factors such as the paucity of demographic information that was available during their calculation.

E.1: Age ranges

I): 15FQ

Variance in correlation coefficients among personality traits measured by the 15FQ and GRT2 intelligence scales on the basis of age range differences is initially examined in tables eight and nine. The first correlation matrix examined is for participants who were younger than 30 years old (N=628). The second is that for participants who were older than 30 years old (N=667). The rationale for this distinction is based on research into the decline of intelligence in adulthood. This research has with some consistency demonstrated a decline in fluid intelligence around the age of 30 (e.g., Horn & Donaldson, 1977, 1980a; Stankov et al., 1995; Salthouse, 1998).

The next groups of correlation coefficients measured by the 15FQ and GRT2 intelligence scales on the basis of age range differences are examined in tables 10 and 11. The correlation matrix examined in table 10 is for participants less than 40 years of age (N=1078). The participants for table 11 were over 40 years of age (N=213). The rationale for this distinction is also based upon prior research into age and intelligence. This research found that crystallised intelligence increases until fairly late in life (e.g., Horn, 1982; Horn & Donaldson, 1980a). However, due to a huge disparity in sample sizes between the groups in tables 10 and 11 caution is advised in drawing conclusions from the results.

Table 8.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Under 30 yrs

	Abstract	Numerical	Verbal	g
15FQ_FA	.0282	.0199	-.0059	.0161
	p=.481	*p*=.618	*p*=.882	*p*=.687
15FQ_FC	.0507	.0673	-.0312	.0338
	p=.204	*p*=.092	*p*=.435	*p*=.398
15FQ_FE	.0688	.0328	-.0069	.0357
	p=.085	*p*=.413	*p*=.863	*p*=.372
15FQ_FF	.0469	.0088	-.0182	.0126
	p=.240	*p*=.827	*p*=.648	*p*=.752
15FQ_FG	-.1156	**-.1659***	**-.2108***	**-.2043***
	p=.004	*p*=.000	*p*=.000	*p*=.000
15FQ_FH	-.0362	-.0558	-.0613	-.0636
	p=.365	*p*=.163	*p*=.125	*p*=.111
15FQ_FI	-.0630	-.0634	**.1618***	.0200
	p=.115	*p*=.112	*p*=.000	*p*=.617
15FQ_FL	-.1200	**-.1433***	-.0977	**-.1471***
	p=.003	*p*=.000	*p*=.014	*p*=.000
15FQ_FM	.1104	.0595	**.2023***	**.1525***
	p=.006	*p*=.137	*p*=.000	*p*=.000
15FQ_FN	-.0989	-.1081	-.0343	-.0969
	p=.013	*p*=.007	*p*=.391	*p*=.015
15FQ_FO	-.0930	-.1145	.0163	-.0758
	p=.020	*p*=.004	*p*=.684	*p*=.058
15FQ_FQ1	.1108	.0531	.0727	.0939
	p=.005	*p*=.184	*p*=.069	*p*=.019
15FQ_FQ2	.0611	.0836	.0417	.0761
	p=.126	*p*=.036	*p*=.297	*p*=.057
15FQ_FQ3	-.1051	**-.1632***	**-.1857***	**-.1886***
	p=.008	*p*=.000	*p*=.000	*p*=.000
15FQ_FQ4	**-.1839***	**-.2119***	-.1125	**-.2061***
	p=.000	*p*=.000	*p*=.005	*p*=.000

Note. *Marked correlations are significant at $p < .001$, N=628 (Casewise deletion of missing data).

Table 9.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Over 30 yr olds

	Abstract	Numerical	Verbal	g
15FQ_FA	.0435	.0008	.0317	.0298
	p=.262	*p*=.984	*p*=.413	*p*=.443
15FQ_FC	.0964	.0700	.0665	.0934
	p=.013	*p*=.071	*p*=.086	*p*=.016
15FQ_FE	.1206	.0746	.0902	.1143
	p=.002	*p*=.054	*p*=.020	*p*=.003
15FQ_FF	.0473	-.0091	.0301	.0263
	p=.222	*p*=.815	*p*=.438	*p*=.498
15FQ_FG	**-.1506***	**-.1987***	**-.2333***	**-.2396***
	p=.000	*p*=.000	*p*=.000	*p*=.000
15FQ_FH	-.0539	-.0898	-.0734	-.0893
	p=.165	*p*=.020	*p*=.058	*p*=.021
15FQ_FI	-.0956	-.0993	.1154	-.0273
	p=.013	*p*=.010	*p*=.003	*p*=.481
15FQ_FL	-.1194	-.1100	**-.1767***	**-.1662***
	p=.002	*p*=.004	*p*=.000	*p*=.000
15FQ_FM	-.0090	-.0777	.1090	.0106
	p=.817	*p*=.045	*p*=.005	*p*=.784
15FQ_FN	-.0686	-.0756	-.1041	-.1019
	p=.076	*p*=.051	*p*=.007	*p*=.008
15FQ_FO	-.1108	-.0414	-.0614	-.0843
	p=.004	*p*=.286	*p*=.113	*p*=.030
15FQ_FQ1	.0327	-.0213	.0575	.0276
	p=.399	*p*=.583	*p*=.138	*p*=.477
15FQ_FQ2	.0913	.1200	.1029	**.1285***
	p=.018	*p*=.002	*p*=.008	*p*=.001
15FQ_FQ3	**-.1714***	**-.1806***	**-.2610***	**-.2514***
	p=.000	*p*=.000	*p*=.000	*p*=.000
15FQ_FQ4	-.0692	-.0848	-.1090	-.1081
	p=.074	*p*=.028	*p*=.005	*p*=.005

Note. *Marked correlations are significant at $p < .001$, N=667 (Casewise deletion of missing data).

Tables 8 & 9: Age ranges 17-30 yrs/ 30-61 yrs

A number of differences in statistically significant relationships between personality traits and intelligence scales were identified between participants of less than 30 yrs of age (N = 628) and those over 30 yrs of age (N = 667). Firstly, there was a significant negative relationship between 'Conscientious' (FG) and Abstract reasoning that was present for over 30's, but absent for less than 30's. Secondly, a positive relationship between 'Intuitive' (FI) and Verbal reasoning present for less than 30's was absent in those over 30. Thirdly, there was a significant negative correlation between

'Suspicious' (FL) and Numerical reasoning for less than 30's that was absent in over 30's; and a negative relationship between 'Suspicious' (FL) and Verbal reasoning present for over 30's that was absent in less than 30's. Fourthly, there were positive relationships between 'Conceptual' on the one hand, and Verbal reasoning and *g* on the other that were present for the less than 30's, yet absent for over 30's. Fifthly, there was a negative relationship between 'Disciplined' (FQ3) and Abstract reasoning that was present for the over 30's, but absent in less than 30's. Lastly, those over 30 lacked significant relationships between 'Tense-driven' (FQ4) on the one hand, and *g*, Abstract, and Numerical reasoning on the other that were present for the less than 30's.

Table 10.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Under 40 yr olds

	Abstract	Numerical	Verbal	g
15FQ_FA	.0127	.0044	-.0025	.0054
	p=.677	*p*=.885	*p*=.936	*p*=.860
15FQ_FC	.0537	.0445	-.0189	.0303
	p=.078	*p*=.145	*p*=.535	*p*=.321
15FQ_FE	.0804	.0467	.0282	.0613
	p=.008	*p*=.125	*p*=.354	*p*=.044
15FQ_FF	.0395	.0034	-.0107	.0110
	p=.195	*p*=.910	*p*=.725	*p*=.719
15FQ_FG	**-.1285***	**-.2044***	**-.2080***	**-.2250***
	p=.000	*p*=.000	*p*=.000	*p*=.000
15FQ_FH	-.0454	-.0651	-.0755	-.0773
	p=.136	*p*=.033	*p*=.013	*p*=.011
15FQ_FI	-.0552	-.0661	**.1564***	.0197
	p=.070	*p*=.030	*p*=.000	*p*=.519
15FQ_FL	-.0801	**-.1066***	-.0927	**-.1151***
	p=.009	*p*=.000	*p*=.002	*p*=.000
15FQ_FM	.0743	.0062	**.1780***	**.1067***
	p=.015	*p*=.838	*p*=.000	*p*=.000
15FQ_FN	-.0371	-.0821	-.0423	-.0673
	p=.223	*p*=.007	*p*=.165	*p*=.027
15FQ_FO	-.0810	-.0710	.0184	-.0518
	p=.008	*p*=.020	*p*=.547	*p*=.089
15FQ_FQ1	.0873	.0376	.0854	.0847
	p=.004	*p*=.217	*p*=.005	*p*=.005
15FQ_FQ2	.0880	**.1257***	.0872	.1238
	p=.004	*p*=.000	*p*=.004	*p*=.000
15FQ_FQ3	**-.0967***	**-.1673***	**-.2031***	**-.1954***
	p=.001	*p*=.000	*p*=.000	*p*=.000
15FQ_FQ4	**-.1079***	**-.1323***	-.0696	**-.1262***
	p=.000	*p*=.000	*p*=.022	*p*=.000

Note. **Marked correlations are significant at p < .001, N=1078 (Casewise deletion of missing data).*

Table 11.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Over 40 yr olds

	Abstract	Numerical	Verbal	g
15FQ_FA	.0810	.0121	.0768	.0658
	p=.239	*p*=.861	*p*=.265	*p*=.339
15FQ_FC	.1950	.1914	.1912	**.2300***
	p=.004	*p*=.005	*p*=.005	*p*=.001
15FQ_FE	.1356	.0939	.1058	.1319
	p=.048	*p*=.172	*p*=.124	*p*=.055
15FQ_FF	.0136	-.0424	.0846	.0226
	p=.844	*p*=.538	*p*=.219	*p*=.743
15FQ_FG	-.0927	-.0784	**-.2595***	-.1753
	p=.178	*p*=.254	*p*=.000	*p*=.010
15FQ_FH	-.1340	-.1307	-.0485	-.1226
	p=.051	*p*=.057	*p*=.482	*p*=.074
15FQ_FI	-.1855	-.1577	.0424	-.1136
	p=.007	*p*=.021	*p*=.538	*p*=.098
15FQ_FL	**-.2251***	-.2079	**-.2961***	**-.2919***
	p=.001	*p*=.002	*p*=.000	*p*=.000
15FQ_FM	-.0876	-.0969	.0384	-.0554
	p=.203	*p*=.159	*p*=.577	*p*=.421
15FQ_FN	-.1436	-.1190	-.1661	-.1707
	p=.036	*p*=.083	*p*=.015	*p*=.013
15FQ_FO	-.1877	-.0972	-.2000	-.1913
	p=.006	*p*=.157	*p*=.003	*p*=.005
15FQ_FQ1	-.0323	-.1008	-.0148	-.0602
	p=.640	*p*=.143	*p*=.829	*p*=.382
15FQ_FQ2	.0845	.0339	.0353	.0588
	p=.219	*p*=.623	*p*=.608	*p*=.393
15FQ_FQ3	**-.2445***	-.1797	**-.3087***	**-.2920***
	p=.000	*p*=.009	*p*=.000	*p*=.000
15FQ_FQ4	-.1881	-.2048	**-.2779***	**-.2699***
	p=.006	*p*=.003	*p*=.000	*p*=.000

Note. *Marked correlations are significant at $p < .001$, N=213 (Casewise deletion of missing data).

***Tables 10 & 11: Age ranges* 17-40 yrs/ 40-61 yrs**

A number of clear differences were identified between these age ranges and correlations between intelligence scales and personality traits. For people younger than 40 there was a significant negative correlation between 'Conscientious' (FG) on the one hand, and Abstract, Numerical, Verbal reasoning, and *g* on the other. Whereas, the only significant coefficient present for over 40's was a negative relationship between 'Conscientious' (FG) and Verbal reasoning.

Participants under 40 were also identified as having significant correlations absent for participants over 40. These included: a positive correlation between the personality trait of 'Intuitive' (FI) and Verbal reasoning; a positive relationship between 'Conceptual' (FM) on the one hand, and *g* and Verbal reasoning on the other; and a positive relationship between 'Self-sufficient' (FQ2) and Numerical reasoning.

Participants over 40 also differed from those less than 40 in a number of other respects. Over 40's had a positive relationship between 'Calm/Stable' (FC) and *g* that was absent for less than 40's. Over 40's also differed in their relationship between 'Suspicious' (FL) on the one hand, and Abstract, Numerical, and Verbal reasoning on the other. For while under 40's had a negative correlation with Numerical reasoning for 'Suspicious' (FL), such a relationship was absent for over 40's; yet over 40's had significant negative relationships between 'Suspicious' (FL) on the one hand, and Abstract and Verbal reasoning on the other that were absent for under 40's. Under 40's also significantly correlated between 'Disciplined' (FQ3) and Numerical reasoning, which over 40's did not.

Correlations between 'Tense-driven' (FQ4) on the one hand, and intelligence scales on the other, also differed according to age differences. For whereas participants younger than 40 years of age correlated negatively between 'Tense-driven' (FQ4) on the one hand, and Abstract and Numerical reasoning on the other, over 40's did not. Over 40's correlated significantly between 'Tense-driven' (FQ4) and Verbal reasoning, which less than 40's did not.

II): OPP

Variance in correlation coefficients between personality traits measured by the OPP and GRT2 intelligence scales on the basis of age range differences are initially examined in tables 12 and 13. The first correlation matrix examined is for participants who were younger than 30 years old (N=1227). The second is for participants who were older than 30 years old (N=1019). Like that of the 15FQ matrices, the rationale for this distinction is based on research into the decline of intelligence in adulthood. This research demonstrated a decline in fluid intelligence around the age of 30 (e.g., Horn & Donaldson, 1977, 1980a; Stankov et al., 1995; Salthouse, 1998).

Further groups of correlation coefficients measured by the OPP and GRT2 intelligence scales on the basis of age range differences are examined in tables 10 and 11. The correlation matrix examined in table 10 is for participants less than 40 years of age (N=1844). The participants in table 11 are over 40 years of age (N=402). Again, like the 15FQ, the rationale for this distinction is based upon prior research into age and intelligence. This research found that crystallised intelligence increases until fairly late in life (e.g., Horn, 1982; Horn & Donaldson, 1980a). However, also like the comparable 15FQ matrices, due to a huge disparity between sample sizes in these last two matrices caution is advised in drawing conclusions from the results.

Table 12.

Coefficient & probability levels between OPP & GRT2 dimensions for Under 30 yr olds

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0195	.0195	-.0272	.0040
	p=.494	*p*=.496	*p*=.342	*p*=.890
OPP_FLEXIBLE	**.2308***	**.2237***	**.3425***	**.3142***
	p=.000	*p*=.000	*p*=0.00	*p*=0.00
OPP_TRUSTING	.0738	.0194	**.1257***	.0849
	p=.010	*p*=.497	*p*=.000	*p*=.003
OPP_PHLEG	.0780	.0777	.0700	.0885
	p=.006	*p*=.006	*p*=.014	*p*=.002
OPP_GREGAR	-.0376	-.0474	-.0152	-.0393
	p=.188	*p*=.097	*p*=.594	*p*=.169
OPP_PERSUAS	.0678	.0770	**.1072***	**.0998***
	p=.018	*p*=.007	*p*=.000	*p*=.000
OPP_CONTEST	-.0932	**-.1541***	**-.1845***	**-.1728***
	p=.001	*p*=.000	*p*=.000	*p*=.000
OPP_EXTERNAL	**-.2690***	**-.2558***	**-.3380***	**-.3392***
	p=0.00	*p*=0.00	*p*=0.00	*p*=0.00
OPP_PRAGMATIC	-.0196	.0087	**-.2388***	**-.1003***
	p=.492	*p*=.760	*p*=.000	*p*=.000

Note. *Marked correlations are significant at $p < .001$, N=1227 (Casewise deletion of missing data).

Table 13.

Coefficient & probability levels between OPP & GRT2 dimensions for Over 30 yr olds

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0814	.0683	.0694	.0858
	p=.009	*p*=.029	*p*=.027	*p*=.006
OPP_FLEXIBLE	**.2027***	**.1877***	**.3035***	**.2737***
	p=.000	*p*=.000	*p*=0.00	*p*=.000
OPP_TRUSTING	.1012	**.1229***	**.1963***	**.1669***
	p=.001	*p*=.000	*p*=.000	*p*=.000
OPP_PHLEG	**.1515***	**.1353***	**.1123***	**.1562***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_GREGAR	-.0432	-.0350	-.0479	-.0495
	p=.168	*p*=.265	*p*=.126	*p*=.114
OPP_PERSUAS	**.1167***	**.1120***	**.1544***	**.1510***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_CONTEST	-.0772	**-.1582***	**-.1584***	**-.1576***
	p=.014	*p*=.000	*p*=.000	*p*=.000
OPP_EXTERNAL	**-.2674***	**-.2749***	**-.3622***	**-.3570***
	p=.000	*p*=0.00	*p*=0.00	*p*=0.00
OPP_PRAGMATIC	-.0488	.0302	**-.1811***	-.0783
	p=.120	*p*=.336	*p*=.000	*p*=.012

Note. *Marked correlations are significant at $p < .001$, N=1019 (Casewise deletion of missing data)

Tables 12 & 13: Age ranges 17-30 yrs/ 30-61 yrs

Differences in correlations between personality traits and intelligence scales were also identified for these age ranges with the OPP. Participants over 30 demonstrated significant correlations between 'Trusting' on the one hand, and Numerical reasoning and *g* on the other, which was a relationship absent for participants less than 30 years of age. Over 30's also positively correlated across all intelligence scales for 'Phlegmatic', whereas no such significant correlations were present for less than 30's. Over 30's also positively correlated for all intelligence scales with 'Persuasive', whereas significant correlations for less than 30's were limited to Verbal reasoning and *g*. However, over 30's lacked the significant negative relationship between 'Pragmatic' and *g* exhibited by under 30's.

Table 14.

Coefficient & probability levels between OPP & GRT2 dimensions for Under 40 yr olds

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0492	.0248	.0010	.0279
	p=.035	*p*=.288	*p*=.965	*p*=.231
OPP_FLEXIBLE	**.2246***	**.2103***	**.3224***	**.2972***
	p=0.00	*p*=0.00	*p*=0.00	*p*=0.00
OPP_TRUSTING	**.0821***	.0491	**.1368***	**.1046***
	p=.000	*p*=.035	*p*=.000	*p*=.000
OPP_PHLEG	**.1001***	**.0955***	**.0857***	**.1097***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_GREGAR	-.0099	-.0287	.0028	-.0144
	p=.669	*p*=.218	*p*=.903	*p*=.537
OPP_PERSUAS	**.0945***	**.0910***	**.1329***	**.1250***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_CONTEST	**-.0932***	**-.1518***	**-.1675***	**-.1642***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_EXTERNAL	**-.2795***	**-.2594***	**-.3397***	**-.3439***
	p=0.00	*p*=0.00	*p*=0.00	*p*=0.00
OPP_PRAGMATIC	-.0436	.0089	**-.2216***	**-.1012***
	p=.061	*p*=.702	*p*=0.00	*p*=.000

Note. *Marked correlations are significant at $p < .001$, N=1844 (Casewise deletion of missing data)

Table 15.

Coefficient & probability levels between OPP & GRT2 dimensions for Over 40 yr olds

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	-.0056	.1096	.0784	.0758
	p=.910	*p*=.028	*p*=.116	*p*=.129
OPP_FLEXIBLE	**.2082***	**.1921***	**.3271***	**.2879***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_TRUSTING	.1304	.1341	**.2324***	**.1974***
	p=.009	*p*=.007	*p*=.000	*p*=.000
OPP_PHLEG	.1248	.1325	.0939	.1381
	p=.012	*p*=.008	*p*=.060	*p*=.006
OPP_GREGAR	-.0999	-.0460	-.1117	-.1004
	p=.045	*p*=.357	*p*=.025	*p*=.044
OPP_PERSUAS	.0486	.1127	.1249	.1154
	p=.331	*p*=.024	*p*=.012	*p*=.021
OPP_CONTEST	-.0788	-.1545	**-.1661***	-.1604
	p=.115	*p*=.002	*p*=.001	*p*=.001
OPP_EXTERNAL	**-.1889***	**-.2779***	**-.3764***	**-.3370***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_PRAGMATIC	-.0283	.0306	**-.2001***	-.0789
	p=.572	*p*=.541	*p*=.000	*p*=.114

Note. *Marked correlations are significant at $p < .001$, N=402 (Casewise deletion of missing data)

***Tables 14 & 15: Age ranges* 17-40 yrs/ 40-61 yrs**

A number of clear differences are identifiable between correlations in these age ranges among intelligence scales and personality traits. For example, participants less than 40 yrs-old demonstrate significant correlations among 'Phlegmatic' and 'Persuasive' on the one hand, and all intelligence scales on the other; whereas, no such significant relationships are present for these variables with over 40 yr-olds. Less than 40's also demonstrate significant relationships between 'Contesting' and all intelligence scales, whereas over 40's only exhibit significant relationships between 'Contesting' and Verbal reasoning. Less than 40's also demonstrate significant relationships between 'Trusting' and Abstract reasoning, and 'Pragmatic' and *g*, both of which are absent in over 40's.

E.2: Gender differences

I): 15FQ

Table 16.

Coefficient between 15FQ & GRT2 dimensions for Females

	Abstract	Numerical	Verbal	g
15FQ_FA	.0727	.0256	.0933	.0779
	p=.057	p=.503	p=.014	p=.041
15FQ_FC	.0139	.0760	-.0169	.0297
	p=.716	p=.046	p=.659	p=.437
15FQ_FE	.1004	.0285	.0738	.0808
	p=.008	p=.455	p=.053	p=.034
15FQ_FF	.0705	-.0024	.0369	.0408
	p=.065	p=.951	p=.334	p=.285
15FQ_FG	-.0910	**-.1571***	**-.1624***	**-.1699***
	p=.017	p=.000	p=.000	p=.000
15FQ_FH	-.0277	-.0748	-.0418	-.0597
	p=.469	p=.050	p=.274	p=.118
15FQ_FI	-.0634	-.0140	.1114	.0193
	p=.097	p=.714	p=.003	p=.614
15FQ_FL	-.0357	**-.1345***	-.0929	-.1100
	p=.350	p=.000	p=.015	p=.004
15FQ_FM	.0881	.0758	**.2095***	**.1551***
	p=.021	p=.047	p=.000	p=.000
15FQ_FN	-.0430	-.0563	-.0662	-.0682
	p=.260	p=.140	p=.083	p=.074
15FQ_FO	-.0405	-.0543	-.0052	-.0399
	p=.289	p=.155	p=.891	p=.296
15FQ_FQ1	.1027	.0527	.0877	.0978
	p=.007	p=.167	p=.022	p=.010
15FQ_FQ2	-.0081	.0257	-.0350	-.0074
	p=.832	p=.501	p=.360	p=.847
15FQ_FQ3	-.1343*	-.2246*	-.2308*	-.2438*
	p=.000	p=.000	p=.000	p=.000
15FQ_FQ4	-.1105	**-.1550***	**-.1298***	**-.1620***
	p=.004	p=.000	p=.001	p=.000
15FQ_FMD	-.0017	.0175	-.0662	-.0220
	p=.964	p=.648	p=.083	p=.564
15FQ_MID	.1041	.0458	.0329	.0717
	p=.006	p=.230	p=.390	p=.061
15FQ_INF	.0331	-.0249	-.0445	-.0177
	p=.386	p=.515	p=.244	p=.644

Note. *Marked correlations are significant at $p < .001$, N=687 (Casewise deletion of missing data)

Table 17.

Coefficient between 15FQ & GRT2 dimensions for Males

	Abstract	Numerical	Verbal	g
15FQ_FA	.0328	-.0041	-.0400	-.0069
	p=.331	p=.903	p=.236	p=.838
15FQ_FC	.0357	.0032	.0162	.0210
	p=.291	p=.925	p=.632	p=.534
15FQ_FE	.0431	.0377	.0129	.0369
	p=.202	p=.265	p=.703	p=.274
15FQ_FF	.0621	-.0020	-.0140	.0155
	p=.066	p=.952	p=.679	p=.645
15FQ_FG	**-.1317***	**-.1733***	**-.3055***	**-.2501***
	p=.000	p=.000	p=0.00	p=.000
15FQ_FH	-.0829	-.0883	-.0904	-.1055
	p=.014	p=.009	p=.007	p=.002
15FQ_FI	-.0544	-.0030	**.1120***	.0266
	p=.107	p=.930	p=.001	p=.432
15FQ_FL	-.0822	-.1018	**-.1150***	**-.1214***
	p=.015	p=.003	p=.001	p=.000
15FQ_FM	.0396	-.0196	.0814	.0403
	p=.241	p=.562	p=.016	p=.232
15FQ_FN	-.0886	**-.1105***	**-.1224***	**-.1305***
	p=.009	p=.001	p=.000	p=.000
15FQ_FO	-.0861	-.0717	-.0586	-.0861
	p=.011	p=.034	p=.083	p=.011
15FQ_FQ1	.0800	.0463	.0821	.0831
	p=.018	p=.170	p=.015	p=.014
15FQ_FQ2	**.1360***	**.1481***	**.1679***	**.1827***
	p=.000	p=.000	p=.000	p=.000
15FQ_FQ3	**-.1277***	**-.1532***	**-.2396***	**-.2122***
	p=.000	p=.000	p=.000	p=.000
15FQ_FQ4	-.0746	-.0961	-.1023	**-.1109***
	p=.027	p=.004	p=.002	p=.001
15FQ_FMD	.0198	-.0166	-.0608	-.0256
	p=.558	p=.623	p=.072	p=.448
15FQ_MID	.0612	-.0159	.0155	.0218
	p=.070	p=.638	p=.647	p=.519
15FQ_INF	-.0604	-.0737	-.0791	-.0864
	p=.073	p=.029	p=.019	p=.010

Note. *Marked correlations are significant at $p < .001$, N=879 (Casewise deletion of missing data)

Tables 16 & 17: Gender

In terms of gender a number of significant differences between personality trait and intelligence scale correlations were identified. A number of significant correlations present for females are lacking in males. These include: a negative relationship between 'Suspicious' (FL) and Numerical reasoning; positive relationships among 'Conceptual' (FM) on the one hand, and Verbal reasoning and *g* on the other; and negative relationships between 'Tense-driven' on the one hand, and Numerical and Verbal reasoning on the other.

There are also a variety of significant relationships present for males which are absent, or differ in females. For example, males correlate for 'Conscientious' with all intelligence scales, whereas females do not do so significantly with Abstract reasoning. Male relationships between 'Conscientious' on the one hand, and Verbal reasoning and *g* on the other, are also noticeably stronger than those for females. Male correlations between 'Suspicious' (FL) on the one hand, and Verbal reasoning and *g* on the other, are absent in females. There is also a positive correlation between 'Intuitive' (FI) and Verbal reasoning with males that is absent in females. Another such difference between genders is the positive correlations between 'Self-sufficient' (FQ2) on the one hand, and all intelligence scales on the other, which while present in males is completely absent in females. Finally, males have significant negative correlations between 'Restrained' (FN) on the one hand, and *g*, Verbal, and Numerical reasoning on the other, which are absent in females.

II): OPP

Table 18.

Coefficient between OPP & GRT2 dimensions for Females

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0707	.0460	.0585	.0682
	p=.010	*p*=.095	*p*=.034	*p*=.013
OPP_FLEXIBLE	**.1874***	**.2072***	**.3419***	**.2910***
	p=.000	*p*=.000	*p*=0.00	*p*=0.00
OPP_TRUSTING	.0596	**.0910***	**.1796***	**.1314***
	p=.030	*p*=.001	*p*=.000	*p*=.000
OPP_PHLEG	**.1013***	.0695	.0774	**.0966***
	p=.000	*p*=.012	*p*=.005	*p*=.000
OPP_GREGAR	.0227	.0372	.0071	.0263
	p=.410	*p*=.178	*p*=.797	*p*=.340
OPP_PERSUAS	**.1093***	.0793	**.1340***	**.1263***
	p=.000	*p*=.004	*p*=.000	*p*=.000
OPP_CONTEST	-.0245	-.0876	-.1583	-.1086
	p=.375	*p*=.001	*p*=.000	*p*=.000
OPP_EXTERNAL	**-.2743***	**-.2692***	**-.3897***	**-.3672***
	p=0.00	*p*=0.00	*p*=0.00	*p*=0.00
OPP_PRAGMATIC	**-.0947***	-.0222	**-.2302***	**-.1365***
	p=.001	*p*=.421	*p*=.000	*p*=.000

Note. *Marked correlations are significant at $p < .001$, N=1318 (Casewise deletion of missing data).

Table 19.

Coefficient between OPP & GRT2 dimensions for Males

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	-.0020	-.0234	-.0336	-.0242
	p=.943	*p*=.415	*p*=.242	*p*=.400
OPP_FLEXIBLE	**.2157***	**.2090***	**.3076***	**.2890***
	p=.000	*p*=.000	*p*=0.00	*p*=0.00
OPP_TRUSTING	.0689	.0757	**.1547***	**.1192***
	p=.016	*p*=.008	*p*=.000	*p*=.000
OPP_PHLEG	**.1010***	**.1213***	**.1089***	**.1305***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_GREGAR	.0134	-.0581	-.0314	-.0320
	p=.640	*p*=.043	*p*=.274	*p*=.265
OPP_PERSUAS	.0687	.0312	**.1205***	.0867
	p=.017	*p*=.278	*p*=.000	*p*=.002
OPP_CONTEST	-.0418	**-.1663***	**-.1796***	**-.1570***
	p=.146	*p*=.000	*p*=.000	*p*=.000
OPP_EXTERNAL	**-.2155***	**-.2312***	**-.3162***	**-.3016***
	p=.000	*p*=.000	*p*=0.00	*p*=0.00
OPP_PRAGMATIC	-.0726	-.0387	**-.2068***	**-.1267***
	p=.011	*p*=.178	*p*=.000	*p*=.000

Note. Marked correlations are significant at $p < .001$, N=1214 (Casewise deletion of missing data)

Tables 18 & 19: Gender

The OPP identified a number of significant differences between personality trait and intelligence scales between genders. A number of significant correlations present for females are lacking in males. These include: a positive relationship between 'Trusting' and Numerical reasoning; positive relationships between 'Persuasive' on the one hand, and Abstract reasoning and *g* on the other; and a negative relationship between 'Pragmatic' and Abstract reasoning.

A number of significant relationships identified for males, were found to be absent in females. These include: positive relationships between 'Phlegmatic' on the one hand, and Numerical and Verbal reasoning on the other; and negative correlations between 'Contesting' on the one hand, and *g*, Numerical, and Verbal reasoning on the other.

E.3: Ethnicity

I): 15FQ

Table 20.

Coefficient between 15FQ & GRT2 dimensions for Maori

	Abstract	Numerical	Verbal	g
15FQ_FA	.0272	.1517	-.0450	.0548
	p=.847	*p*=.278	*p*=.749	*p*=.697
15FQ_FC	-.0359	.1900	.0042	.0677
	p=.799	*p*=.173	*p*=.976	*p*=.630
15FQ_FE	-.1673	-.1235	-.3680	-.2679
	p=.231	*p*=.378	*p*=.007	*p*=.052
15FQ_FF	.1159	-.0204	-.1413	-.0242
	p=.408	*p*=.885	*p*=.313	*p*=.863
15FQ_FG	-.0826	-.0939	-.2329	-.1674
	p=.556	*p*=.503	*p*=.093	*p*=.231
15FQ_FH	-.0744	-.0327	-.1242	-.0934
	p=.597	*p*=.816	*p*=.375	*p*=.506
15FQ_FI	.3224	.1132	.3222	.3025
	p=.019	*p*=.420	*p*=.019	*p*=.028
15FQ_FL	-.2761	-.3577	-.3634	-.4046
	p=.045	*p*=.009	*p*=.007	*p*=.003
15FQ_FM	.4157	.0987	.2938	.3194
	p=.002	*p*=.482	*p*=.033	*p*=.020
15FQ_FN	.1215	-.0358	.0550	.0534
	p=.386	*p*=.799	*p*=.696	*p*=.704
15FQ_FO	.0547	-.0129	.0117	.0200
	p=.697	*p*=.927	*p*=.933	*p*=.887
15FQ_FQ1	-.1760	-.3406	-.3158	-.3401
	p=.207	*p*=.013	*p*=.021	*p*=.013
15FQ_FQ2	.1677	.1063	.0933	.1461
	p=.230	*p*=.449	*p*=.506	*p*=.296
15FQ_FQ3	-.0858	-.1753	-.2138	-.1947
	p=.541	*p*=.209	*p*=.124	*p*=.162
15FQ_FQ4	-.1015	-.2754	-.3026	-.2795
	p=.469	*p*=.046	*p*=.028	*p*=.043
15FQ_FMD	.0183	.2590	-.0117	.1102
	p=.896	*p*=.061	*p*=.934	*p*=.432
15FQ_MID	.1746	.0686	.1208	.1444
	p=.211	*p*=.625	*p*=.389	*p*=.302
15FQ_INF	-.0784	-.1511	-.0410	-.1096
	p=.577	*p*=.280	*p*=.771	*p*=.435

Note. N=53 (Casewise deletion of missing data).

Table 21.

Coefficient between 15FQ & GRT2 dimensions for Europeans

	Abstract	Numerical	Verbal	g
15FQ_FA	-.0877	-.0743	-.0397	-.0842
	p=.241	*p*=.322	*p*=.597	*p*=.261
15FQ_FC	-.0678	.0855	.0247	.0263
	p=.366	*p*=.254	*p*=.742	*p*=.726
15FQ_FE	.0110	.0432	.0745	.0570
	p=.883	*p*=.565	*p*=.320	*p*=.447
15FQ_FF	.0103	.0129	-.0241	-.0008
	p=.890	*p*=.863	*p*=.748	*p*=.992
15FQ_FG	-.0782	-.1702	-.1608	-.1790
	p=.297	*p*=.022	*p*=.031	*p*=.016
15FQ_FH	-.1408	-.0129	-.0144	-.0635
	p=.059	*p*=.864	*p*=.847	*p*=.397
15FQ_FI	-.0530	-.1260	.1618	-.0070
	p=.480	*p*=.092	*p*=.030	*p*=.926
15FQ_FL	-.0355	-.1357	-.1168	-.1280
	p=.636	*p*=.069	*p*=.118	*p*=.087
15FQ_FM	.1063	.0079	**.2861***	.1684
	p=.156	*p*=.917	*p*=.000	*p*=.024
15FQ_FN	-.1006	-.0750	-.0372	-.0881
	p=.179	*p*=.317	*p*=.620	*p*=.240
15FQ_FO	-.0718	-.0610	.0673	-.0250
	p=.338	*p*=.416	*p*=.369	*p*=.739
15FQ_FQ1	.0165	.0391	.0670	.0538
	p=.826	*p*=.602	*p*=.372	*p*=.473
15FQ_FQ2	.1959	.1831	.0782	.1915
	p=.008	*p*=.014	*p*=.297	*p*=.010
15FQ_FQ3	-.1714	-.2109	-.1214	-.2146
	p=.021	*p*=.004	*p*=.105	*p*=.004
15FQ_FQ4	-.1302	-.0709	-.1648	-.1532
	p=.081	*p*=.344	*p*=.027	*p*=.040
15FQ_FMD	.0339	.0550	-.1334	-.0207
	p=.652	*p*=.463	*p*=.074	*p*=.782
15FQ_MID	-.0432	-.1149	-.0935	-.1107
	p=.565	*p*=.125	*p*=.212	*p*=.139
15FQ_INF	**-.2424***	-.1420	-.1382	-.2155
	p=.001	*p*=.057	*p*=.064	*p*=.004

Note. *Marked correlations significant at $p < .001$, N=180 (Casewise deletion of missing data).

Tables 20 & 21: Ethnicity

On the basis of differences in ethnicity little difference in correlations among personality traits and intelligence scales were identified. In fact, only two differences were identified. One difference was a significant relationship between 'Intuitive' (FM) and Verbal reasoning for those of European descent (N = 180) that was absent for Maori (N = 53). The other was a significant negative correlation between 'Random responding' (INF) and Abstract reasoning that was again present for those of European descent (N = 180) and absent for Maori (N = 53).

II): OPP

Table 22.

Coefficient between OPP & GRT2 dimensions for Maori

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.1293	.0313	-.1410	-.0038
	p=.253	*p*=.783	*p*=.212	*p*=.973
OPP_FLEXIBLE	.0998	.1411	.2447	.1926
	p=.378	*p*=.212	*p*=.029	*p*=.087
OPP_TRUSTING	.0615	.1467	.2333	.1775
	p=.588	*p*=.194	*p*=.037	*p*=.115
OPP_PHLEG	.2787	**.3710***	.2238	.3360
	p=.012	*p*=.001	*p*=.046	*p*=.002
OPP_GREGAR	.1414	.0850	.1217	.1320
	p=.211	*p*=.454	*p*=.282	*p*=.243
OPP_PERSUAS	.0679	.0551	.0694	.0738
	p=.549	*p*=.627	*p*=.541	*p*=.515
OPP_CONTEST	-.0775	-.1161	-.2157	-.1630
	p=.495	*p*=.305	*p*=.055	*p*=.149
OPP_EXTERNAL	-.2791	**-.4068***	**-.4191***	**-.4325***
	p=.012	*p*=.000	*p*=.000	*p*=.000
OPP_PRAGMATIC	-.2076	-.0886	-.2732	-.2188
	p=.065	*p*=.435	*p*=.014	*p*=.051

*Note**Marked correlations are significant at p < .001, N=80 (Casewise deletion of missing data).

Table 23.

Coefficient between OPP & GRT2 dimensions for Pacific Islanders

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	-.2475	-.1091	-.3502	-.2658
	p=.213	*p*=.588	*p*=.073	*p*=.180
OPP_FLEXIBLE	.0990	.1779	.2026	.1815
	p=.623	*p*=.375	*p*=.311	*p*=.365
OPP_TRUSTING	.0207	-.1596	.1211	-.0041
	p=.918	*p*=.427	*p*=.547	*p*=.984
OPP_PHLEG	-.0110	.0279	.1038	.0482
	p=.956	*p*=.890	*p*=.606	*p*=.811
OPP_GREGAR	.0833	.0924	-.0569	.0403
	p=.679	*p*=.647	*p*=.778	*p*=.842
OPP_PERSUAS	.1260	.1901	-.2299	.0222
	p=.531	*p*=.342	*p*=.249	*p*=.913
OPP_CONTEST	-.2867	-.2176	-.2420	-.2764
	p=.147	*p*=.276	*p*=.224	*p*=.163
OPP_EXTERNAL	-.3499	-.5305	-.3836	-.4719
	p=.074	*p*=.004	*p*=.048	*p*=.013
OPP_PRAGMATIC	-.4053	-.1943	-.3857	-.3658
	p=.036	*p*=.332	*p*=.047	*p*=.061

Note. N=27 (Casewise deletion of missing data).

Table 24.

Coefficient between OPP & GRT2 dimensions for Europeans

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.1763	.1622	.1726	.1946
	p=.128	*p*=.162	*p*=.136	*p*=.092
OPP_FLEXIBLE	.2944	.3251	.3577	**.3739***
	p=.010	*p*=.004	*p*=.002	*p*=.001
OPP_TRUSTING	.1142	-.1023	.0542	.0232
	p=.326	*p*=.379	*p*=.642	*p*=.842
OPP_PHLEG	.3228	.1294	.1040	.2067
	p=.004	*p*=.265	*p*=.371	*p*=.073
OPP_GREGAR	.1331	.2366	.1283	.1900
	p=.252	*p*=.040	*p*=.269	*p*=.100
OPP_PERSUAS	.2283	.1797	.1233	.2001
	p=.047	*p*=.120	*p*=.289	*p*=.083
OPP_CONTEST	-.0622	-.0988	-.1511	-.1210
	p=.593	*p*=.396	*p*=.193	*p*=.298
OPP_EXTERNAL	**-.3975***	-.3244	**-.3880***	**-.4225***
	p=.000	*p*=.004	*p*=.001	*p*=.000
OPP_PRAGMATIC	-.1492	-.0156	-.2413	-.1563
	p=.198	*p*=.894	*p*=.036	*p*=.178

Note. *Marked correlations are significant at p < .001, N=76 (Casewise deletion of missing data).

Tables 22, 23, & 24: Ethnicity

Two main differences were identified between personality traits and intelligence scales on the basis of ethnicity; however, due to inadequate sample sizes caution should be taken in any interpretation. Differences included a positive significant relationship between 'Phlegmatic' and Numerical reasoning for Maori that was absent for both Polynesians and those of European descent. The only other difference concerned the personality scale of 'External locus of control'. Significant negative correlations between 'External locus of control' on the one hand, and *g*, Numerical and Verbal reasoning on the other, were identified for Maori. Significant negative correlations between 'External locus of control' on the one hand, and *g* and Verbal reasoning on the other were also identified for those of European descent. However, Europeans were also identified with a significant negative relationship between 'External locus of control' and Abstract reasoning, and lacked the significant relationship with Numerical reasoning. Alternatively, Polynesians lacked any significant relationships between 'External locus of control' and intelligence scales.

E.4: Educational demographics

I): 15FQ

Table 25.

Coefficient & probability levels between 15FQ & GRT2 dimensions for University graduates

	Abstract	Numerical	Verbal	g
15FQ_FA	.0877	-.0821	-.1103	-.0646
	p=.502	*p*=.530	*p*=.398	*p*=.621
15FQ_FC	-.1077	.0171	-.1036	-.0915
	p=.409	*p*=.896	*p*=.427	*p*=.483
15FQ_FE	.1293	.1596	-.0734	.0955
	p=.321	*p*=.219	*p*=.574	*p*=.464
15FQ_FF	.1843	-.0667	-.2051	-.0676
	p=.155	*p*=.609	*p*=.113	*p*=.605
15FQ_FG	.0773	-.1247	-.0517	-.0592
	p=.554	*p*=.338	*p*=.692	*p*=.650
15FQ_FH	-.0319	-.1249	-.0494	-.1033
	p=.807	*p*=.338	*p*=.706	*p*=.428
15FQ_FI	-.0441	-.2998	.1306	-.1009
	p=.736	*p*=.019	*p*=.316	*p*=.439
15FQ_FL	.0733	-.1159	.0442	-.0049
	p=.574	*p*=.374	*p*=.735	*p*=.970
15FQ_FM	.0395	-.2219	.1296	-.0271
	p=.762	*p*=.086	*p*=.320	*p*=.836
15FQ_FN	-.1002	-.0969	.0221	-.0790
	p=.442	*p*=.457	*p*=.866	*p*=.545
15FQ_FO	-.1763	-.2060	.1908	-.0756
	p=.174	*p*=.111	*p*=.141	*p*=.563
15FQ_FQ1	-.0430	.0442	-.0819	-.0393
	p=.742	*p*=.735	*p*=.530	*p*=.764
15FQ_FQ2	-.1657	.0909	.0296	-.0065
	p=.202	*p*=.486	*p*=.821	*p*=.960
15FQ_FQ3	-.0699	-.2166	.0153	-.1311
	p=.592	*p*=.094	*p*=.907	*p*=.314
15FQ_FQ4	.0210	-.0868	-.1578	-.1202
	p=.872	*p*=.506	*p*=.225	*p*=.356
15FQ_FMD	-.0734	.0077	-.0944	-.0772
	p=.574	*p*=.953	*p*=.469	*p*=.555
15FQ_MID	.0916	.0245	-.0491	.0241
	p=.483	*p*=.851	*p*=.707	*p*=.854
15FQ_INF	-.1076	.1026	.0065	.0111
	p=.409	*p*=.431	*p*=.960	*p*=.932

Note. N=61 (Casewise deletion of missing data).

Table 26.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Secondary school graduates

	Abstract	Numerical	Verbal	g
15FQ_FA	-.0935	-.0291	-.0306	-.0581
	p=.322	*p*=.758	*p*=.747	*p*=.539
15FQ_FC	-.0816	.0593	.1183	.0455
	p=.388	*p*=.531	*p*=.210	*p*=.631
15FQ_FE	.0473	-.0233	-.0032	.0046
	p=.617	*p*=.806	*p*=.973	*p*=.961
15FQ_FF	.0248	.0764	-.0313	.0311
	p=.793	*p*=.419	*p*=.741	*p*=.742
15FQ_FG	-.1307	-.2703	-.2531	-.2695
	p=.166	*p*=.004	*p*=.007	*p*=.004
15FQ_FH	-.0838	.0430	-.0595	-.0332
	p=.375	*p*=.650	*p*=.529	*p*=.725
15FQ_FI	-.0112	-.0003	.1795	.0671
	p=.905	*p*=.998	*p*=.056	*p*=.478
15FQ_FL	.0307	-.1505	-.1727	-.1265
	p=.746	*p*=.110	*p*=.066	*p*=.180
15FQ_FM	.0978	.0123	.1987	.1185
	p=.300	*p*=.897	*p*=.034	*p*=.209
15FQ_FN	-.1544	-.0909	-.1065	-.1377
	p=.101	*p*=.336	*p*=.259	*p*=.144
15FQ_OF	-.1218	.0135	-.0288	-.0478
	p=.197	*p*=.887	*p*=.761	*p*=.613
15FQ_FQ1	.0472	-.0400	.0608	.0223
	p=.618	*p*=.673	*p*=.520	*p*=.814
15FQ_FQ2	.2643	.1415	.1988	.2358
	p=.004	*p*=.133	*p*=.034	*p*=.012
15FQ_FQ3	-.2430	-.2905	-.2010	**-.2973***
	p=.009	*p*=.002	*p*=.032	*p*=.001
15FQ_FQ4	-.1688	-.0975	-.2452	-.2007
	p=.073	*p*=.302	*p*=.009	*p*=.032
15FQ_FMD	.0150	.0563	-.0422	.0142
	p=.874	*p*=.552	*p*=.656	*p*=.880
15FQ_MID	.0091	-.2000	-.1037	-.1293
	p=.923	*p*=.033	*p*=.272	*p*=.170
15FQ_INF	-.1081	-.2767	-.2046	-.2453
	p=.252	*p*=.003	*p*=.029	*p*=.009

Note. *Marked correlations are significant at $p < .001$, N=114 (Casewise deletion of missing data).

Table 27.

Coefficient & probability levels between 15FQ & GRT2 dimensions for Alternative post-secondary qualifications

	Abstract	Numerical	Verbal	g
15FQ_FA	.0068	.0206	.1415	.0743
	p=.967	*p*=.900	*p*=.384	*p*=.649
15FQ_FC	-.0673	.2084	-.0577	.0414
	p=.680	*p*=.197	*p*=.723	*p*=.800
15FQ_FE	-.1142	-.1329	.0715	-.0674
	p=.483	*p*=.414	*p*=.661	*p*=.679
15FQ_FF	.0690	-.0208	.1322	.0744
	p=.672	*p*=.898	*p*=.416	*p*=.648
15FQ_FG	.0079	-.0622	-.2309	-.1269
	p=.961	*p*=.703	*p*=.152	*p*=.435
15FQ_FH	-.0859	-.0940	-.0087	-.0758
	p=.598	*p*=.564	*p*=.958	*p*=.642
15FQ_FI	-.2197	-.2313	.1443	-.1160
	p=.173	*p*=.151	*p*=.374	*p*=.476
15FQ_FL	-.0465	-.2644	-.3487	-.2872
	p=.776	*p*=.099	*p*=.027	*p*=.072
15FQ_FM	.1969	-.0133	.1178	.1172
	p=.223	*p*=.935	*p*=.469	*p*=.471
15FQ_FN	.1616	.0787	-.1206	.0389
	p=.319	*p*=.629	*p*=.459	*p*=.811
15FQ_OF	.3237	.0663	-.0174	.1375
	p=.042	*p*=.684	*p*=.915	*p*=.397
15FQ_FQ1	-.1081	-.1284	-.0693	-.1257
	p=.507	*p*=.430	*p*=.671	*p*=.439
15FQ_FQ2	.1959	.1321	.0924	.1692
	p=.226	*p*=.416	*p*=.571	*p*=.297
15FQ_FQ3	.3370	.1067	-.1909	.0829
	p=.033	*p*=.512	*p*=.238	*p*=.611
15FQ_FQ4	.0766	-.0311	-.0675	-.0160
	p=.639	*p*=.849	*p*=.679	*p*=.922
15FQ_FMD	-.0034	.1106	-.0896	.0074
	p=.983	*p*=.497	*p*=.583	*p*=.964
15FQ_MID	-.1352	-.1289	-.0396	-.1225
	p=.405	*p*=.428	*p*=.808	*p*=.451
15FQ_INF	-.2886	-.2045	-.1856	-.2755
	p=.071	*p*=.206	*p*=.251	*p*=.085

Note. N=40 (Casewise deletion of missing data).

Tables 25, 26, & 27: Education

As with other matrices developed on the basis of demographic differences, results from those concerning educational differences must be considered in light of their very limited sample sizes and other statistical limitations. The only difference identified between educational differences for relationships between personality traits and intelligence scales is a significant negative correlation between 'Disciplined' (FQ3) and *g* for secondary school graduates, which is absent in university graduates or those with an alternative post-secondary qualification.

II): OPP

Table 28.

Coefficient & probability levels between OPP & GRT2 dimensions for University graduates

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	-.0847	.0387	.1040	.0335
	p=.539	*p*=.779	*p*=.450	*p*=.808
OPP_FLEXIBLE	.1008	-.0848	.2681	.1079
	p=.464	*p*=.538	*p*=.048	*p*=.433
OPP_TRUSTING	-.0903	-.2251	.0640	-.1060
	p=.512	*p*=.098	*p*=.642	*p*=.441
OPP_PHLEG	-.1044	-.0727	.0489	-.0473
	p=.448	*p*=.598	*p*=.723	*p*=.732
OPP_GREGAR	.0625	.2088	.0924	.1554
	p=.650	*p*=.126	*p*=.502	*p*=.257
OPP_PERSUAS	-.2740	-.1229	-.1574	-.2137
	p=.043	*p*=.372	*p*=.251	*p*=.117
OPP_CONTEST	.1333	.1649	-.0029	.1185
	p=.332	*p*=.229	*p*=.983	*p*=.389
OPP_EXTERNAL	.0542	.0490	-.2774	-.0768
	p=.694	*p*=.723	*p*=.040	*p*=.578
OPP_PRAGMATIC	.2088	.2578	-.1322	.1315
	p=.126	*p*=.057	*p*=.336	*p*=.339

Note. N=55 (Casewise deletion of missing data).

Table 29.

Coefficient & probability levels between OPP & GRT2 dimensions for Secondary school graduates

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0875	.0001	-.0240	.0185
	p=.226	*p*=.999	*p*=.740	*p*=.798
OPP_FLEXIBLE	**.3199***	**.3609***	**.3975***	**.3982***
	p=.000	*p*=.000	*p*=.000	*p*=.000
OPP_TRUSTING	.1362	.1412	.2323	.1901
	p=.059	*p*=.050	*p*=.001	*p*=.008
OPP_PHLEG	.2160	.2105	.2028	.2301
	p=.003	*p*=.003	*p*=.005	*p*=.001
OPP_GREGAR	.2142	.1907	.1952	.2190
	p=.003	*p*=.008	*p*=.007	*p*=.002
OPP_PERSUAS	.2239	.2258	.1938	.2348
	p=.002	*p*=.002	*p*=.007	*p*=.001
OPP_CONTEST	-.2005	**-.2593***	**-.2406***	**-.2587***
	p=.005	*p*=.000	*p*=.001	***p***=.000
OPP_EXTERNAL	**-.4960***	**-.5266***	**-.5778***	**-.5896***
	p=.000	***p***=.000	***p***=.000	***p***=0.00
OPP_PRAGMATIC	-.2307	-.2331	**-.3389***	**-.2978***
	p=.001	***p***=.001	***p***=.000	***p***=.000

Note. *Marked correlations are significant at $p < .001$, N=193 (Casewise deletion of missing data).

Table 30.

Coefficient & probability levels between OPP & GRT2 dimensions for Alternative post-secondary qualifications

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.1991	.2825	.2624	.2927
	p=.161	*p*=.045	*p*=.063	*p*=.037
OPP_FLEXIBLE	.1301	.1002	.2450	.1783
	p=.363	*p*=.484	*p*=.083	*p*=.211
OPP_TRUSTING	-.1260	-.1406	-.1458	-.1610
	p=.378	*p*=.325	*p*=.307	*p*=.259
OPP_PHLEG	.2286	.2799	.1614	.2682
	p=.107	*p*=.047	*p*=.258	*p*=.057
OPP_GREGAR	.0667	.0700	-.0164	.0513
	p=.642	*p*=.626	*p*=.909	*p*=.721
OPP_PERSUAS	.2776	.2075	.2091	.2705
	p=.049	*p*=.144	*p*=.141	*p*=.055
OPP_CONTEST	.1175	.0794	.0157	.0858
	p=.411	*p*=.580	*p*=.913	*p*=.549
OPP_EXTERNAL	-.3066	-.2716	-.2187	-.3137
	p=.029	*p*=.054	*p*=.123	*p*=.025
OPP_PRAGMATIC	-.0933	-.1082	-.2259	-.1614
	p=.515	*p*=.450	*p*=.111	*p*=.258

Note. N=51 (Casewise deletion of missing data).

Table 31.

Coefficient & probability levels between OPP & GRT2 dimensions for Less than secondary qualifications

	Abstract	Numerical	Verbal	g
OPP_ASSERTIVE	.0035	-.0492	-.2091	-.0971
	p=.985	*p*=.789	*p*=.251	*p*=.597
OPP_FLEXIBLE	.0598	.1523	.3702	.2252
	p=.745	*p*=.405	*p*=.037	*p*=.215
OPP_TRUSTING	-.1074	.0659	.2013	.0646
	p=.559	*p*=.720	*p*=.269	*p*=.725
OPP_PHLEG	.1656	.1878	.2738	.2444
	p=.365	*p*=.303	*p*=.129	*p*=.178
OPP_GREGAR	.1003	.0488	.3198	.1743
	p=.585	*p*=.791	*p*=.074	*p*=.340
OPP_PERSUAS	-.0293	.0949	.1343	.0815
	p=.874	*p*=.605	*p*=.464	*p*=.658
OPP_CONTEST	-.0372	-.1523	-.3803	-.2208
	p=.840	*p*=.405	*p*=.032	*p*=.225
OPP_EXTERNAL	-.1077	-.1394	-.4709	-.2731
	p=.558	*p*=.447	*p*=.007	*p*=.131
OPP_PRAGMATIC	-.0623	-.3198	-.4610	-.3354
	p=.735	*p*=.074	*p*=.008	*p*=.061

Note. N=32 (Casewise deletion of missing data).

Tables 28, 29, 30 & 31: Education

A number of differences in personality trait relationships with intelligence scales between secondary school graduates and the other educational groups examined were identified. However, the importance of keeping statistical limitations in mind when considering these results must again be reiterated. The secondary school graduates matrix identified a number of significant relationships among personality traits and intelligence scales. These included: positive relationships between 'Flexible' and all intelligence scales; negative relationships between 'Contesting' on the one hand, and *g*, Numerical, and Verbal reasoning on the other; negative relationships between 'External locus of control' and all intelligence scales; and negative relationships between 'Pragmatic' on the one hand, and Verbal reasoning and *g* on the other. Matrices for university graduates, those with alternative post-secondary qualifications, and for those with less than a secondary education all demonstrated an absence of significant relationships between personality traits and intelligence scales.

Appendix F: Unadjusted R regression table

Table 32.

β values for multiple regression coefficients of 15FQ & OPP on GRT2 intelligence scales (Multiple R)

	Abstract β	**Numerical** β	**Verbal** β	**Total (*g*)** β
15FQ_FG	-0.08*	-0.13*	-0.16*	-0.16*
15FQ_FQ3	-0.09*	-0.12*	-0.17*	-0.16*
Regression model	*F*(2,1576)=17.15	*F*(2,1576)=37.58	*F*(2,1576)=67.12	*F*(2,1576)=59.22
Multi. *R*	**0.14**	**0.22**	**0.28**	**0.24**
15FQ_FG	-0.09*	-0.14*	-0.15*	-0.16*
15FQ_FI	-0.14*	-0.11*	0.06*	-0.07*
15FQ_FL	-0.03	-0.08*	-0.06*	-0.07*
15FQ_FM	0.107*	0.019	0.087*	0.084*
15FQ_FN	-0.01	-0.02	0.021	-0.00
15FQ_FQ2	0.104*	0.143*	0.117*	0.149*
15FQ_FQ3	-0.07*	-0.09*	-0.14*	-0.13*
15FQ_FQ4	-0.05	-0.06*	-0.04	-0.06*
Regression model	*F*(8,1570)=10.38	*F*(8,1570)=18.07	*F*(8,1570)=23.60	*F*(8,1570)=22.22
Multi. *R*	**0.22**	**0.29**	**0.32**	**0.29**
OPP_ FLEXIBLE	0.123*	0.114*	0.179*	0.155*
OPP_TRUSTING	-0.04	-0.05*	0.005	-0.04
OPP_CONTEST	0.064*	-0.05*	-0.01	-0.01
OPP_EXTERNAL	-0.26*	-0.26*	-0.27*	-0.30*
OPP_PRAGMATIC	0.00	0.08*	-0.13*	-0.02
OPP_CONFORM	-0.09*	-0.10	-0.13*	-0.11*
Regression model	*F*(6,2555)=46.41	*F*(3,2595)=55.90	*F*(6,2600)=108.79	*F*(6,2617)=84.80
Multi. *R*	**0.31**	**0.34**	**0.45**	**0.40**
OPP_ FLEXIBLE	0.129*	0.124*	0.179*	0.158*
OPP_TRUSTING	-0.04	-0.05*	0.011	-0.03
OPP_PHLEG	0.059*	0.032	-0.00	0.042
OPP_PERSUAS	0.044*	0.08*	0.042*	0.066*
OPP_CONTEST	0.067*	-0.06*	-0.02	-0.02
OPP_EXTERNAL	-0.23*	-0.22*	-0.26*	-0.27*
OPP_PRAGMATIC	0.010	0.108*	-0.12*	0.001
OPP_CONFORM	-0.11*	-0.11*	-0.13*	-0.13*
OPP_MIDRESP	-0.01	-0.04	0.005	0.000
Regression model	*F*(9,2552)=32.63	*F*(9,2592) = 0.24	*F*(9,2597) = 73.12	*F*(9,2614) = 58.8
Multi. *R*	**0.32**	**0.35**	**0.45**	**0.41**

Note. β s' marked * significant at $p< 0.05$ (table adapted from Moutafi et al., 2003).