

# **Air Traffic Control: To what extent can we predict performance based on personality?**

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## **Abstract**

**Purpose** – This research looked into the validity of personality in predicting air traffic controller performance and identified which function (curvilinear or linear) was the best fit for each given relationship.

**Design/methodology/approach** – Participants from an Air Traffic Control Provider in New Zealand completed both the OPQ Personality measure within a high stakes condition (recruitment) and low stakes condition (in the year 2014) and had managerial performance ratings completed in 2014. This data was then analysed using within sample t tests, regression and curve estimation techniques.

**Findings** – 18 relationships were found to be significant between personality traits and the performance competencies. Of these, 10 relationships displayed evidence of a curvilinear function which adds to the growing literature supporting the introduction of a curvilinear function in the personality-performance relationship.

**Research Limitations/Implications** – There is one minor limitations within the current study. This is that through the use of self-report data, there is a risk of response distortion occurring. Despite this, the current research provides evidence of the validity of personality in predicting performance and a platform for future research into the area. Furthermore, it provides valuable information to improve the successfulness of the selection process.

**Originality/value** – **The study** adds to the minimal research on personality and air traffic control performance, and is among the first to examine the idea of a curvilinear function between personality and air traffic controller performance, as opposed to the linear function that has been the only function considered in air traffic control performance research thus far.

**Keywords** – Personality, performance, air traffic control, linear, curvilinear, response distortion. Paper type – Dissertation.

## **Introduction**

### **Overview**

This dissertation reports a validation study of the personality measure used within the selection process of an Air Traffic Control Provider in New Zealand. This organisation is responsible for managing and supporting air traffic control around New Zealand, with the air traffic controllers within this organisation being responsible for ensuring the safety of aircrafts both at and between main airports around New Zealand. The selection process is made up of three components: pre-screening, assessment centre, and training centre. The personality measure used is the OPQ32 and sits within the pre-screening section of the selection process.

This research uses two samples of OPQ32 data obtained from the same air traffic controllers (ATCs). One sample is from the time of recruitment within the air traffic control selection process (high stakes) and the other sample is at a time point with no associated outcomes (low stakes). Research has identified issues of bias and data quality associated with personality testing, particularly where personality is assessed as part of recruitment. Due to this, the two personality sample have been compared to identify whether any form of distortion is occurring within the recruitment sample data. At this point in the research, all 32 traits within the OPQ32 have been analysed (can be seen in Table 1). The result of this analysis has determined which personality sample (high stakes or low stakes) was used in the validation analysis.

The validation analysis was the main focus of this dissertation and in particular the identification of the best fit/function for the relationship between personality and air traffic control performance for each personality trait. Thus curvilinear and linear functions were explored for each personality trait and performance relationship. For the function/fit analysis, the OPQ measure focus was narrowed to only include 10 traits that have been identified as

useful for air traffic control. These are shown in bold in Table 1. The criterion/outcome variable in this research is archival air traffic control performance data gathered via supervisor ratings. These consist of eight different competencies that each have multiple behavioural indicators beneath them.

The following literature review will first focus on the history of personality testing in both general and air traffic control selection including the introduction of data-driven selection. This will identify how personality has emerged and become more accepted in modern selection. Next, validation studies completed on personality measures will be analysed with a focus on how personality can add validity, in particular incremental validity, to selection processes. The validity of personality in air traffic control selection will also be explored. As stated above, there can be issues of bias and data quality with personality measures, the types of bias, their impacts and how these can be addressed will be discussed. The focus will then turn to the analysis of relationships between personality and performance for general selection and also for air traffic control in particular. The emergence of the idea of a curvilinear function in personality will be explored as well as what past researchers have found to be the best fit for specific personality traits.

Finally, specific hypotheses and research questions for the current research are outlined based on past research and validation studies.

Table 1. OPQ32 Personality Measure traits to be utilised in the current research

Category	Trait
<i>Relationships with People</i>	Persuasive
	<b>Controlling</b>
	Outspoken
	Independent Minded
	Outgoing
	Affiliative
	Socially Confident
	Modest
	Democratic
	Caring
	Data Rational
	Evaluative
	Behavioural
	Conventional
Conceptual	
<i>Thinking Style</i>	<b>Innovative</b>
	Variety Seeking
	<b>Adaptable</b>
	Forward Thinking
	<b>Detail Conscious</b>
	<b>Conscientiousness</b>
	Rule Following
	<b>Relaxed</b>
	Worrying
	Tough Minded
<i>Feelings and Emotions</i>	Optimistic
	Trusting
	<b>Emotionally Controlled</b>
	<b>Vigorous</b>
	Competitive
	<b>Achieving</b>
	<b>Decisive</b>

## **Data Driven Approach to Employee Selection**

The data-driven approach to selection has effectively replaced the common-sense method that relied upon personal judgements (Ungerson, 1970). This modern approach looks to reduce error and biases (Ungerson, 1970) and create clear job criteria to enable successful selection (Wood & Payne, 1998). The Air Traffic Control's selection process utilises a comprehensive data driven approach to selection. Job Analysis is a main facet of this approach and has been described as "a systematic process for collecting and analysing information about a job" (Prien, Goodstein & Goodstein, 2009, pg. 11). Job Analysis produces clear links between selection criteria and high employee performance which justifies selection decisions and consequently reduces guesswork (Boxall, Rudman & Taylor, 1986). The justification of selection decisions reduces the risk of discrimination which, in turn, protects the employer from legal issues (Thompson & Thompson, 1982). Boxall et al., (1986) stated that employers are more likely to make successful selections when supplied with extensive job-related information. Selection measures are then identified after the job analysis has taken place (Boxall et al., 1986). Personality measures are a type of selection measure within data-driven selection and the history of the personality measure will be discussed in the next section.

## **History of the relationship between Personality and Performance**

Personality is continuing to gain increasing research interest in selection settings (Converse & Oswald, 2014) which has increased the interest in the personality-performance relationship. In 1953, Spriegel and Dale surveyed 628 companies in the United States of America and 248 of these (40%) reported that their selection processes utilise some form of personality measure. Before the 1990s, research indicated that the use of personality measures in selection was viewed negatively by selection specialists (Hurtz & Donovan,

2000). More recently, personality has become increasingly accepted within selection for employees (Li et al., 2006).

The first personality-type measure was by Thurstone (1934) and involved a survey where participants were asked to evaluate someone they knew well on 60 specified traits. Extending upon this, Locke and Hulin (1962) created the Activity Vector Analysis with 81 words measuring four personality factors (sociability, emotional control, aggression and social adaptability). In an important personality study, Guion and Gottier (1965) performed a qualitative review of personality measures in selection and found a need for personality to successfully predict employee performance. This conclusion was despite low validities being found by Guion and Gottier (1965) and others in early research which will be discussed later in this literature review. In line with this, Day and Silvermann (1989) also determined a need for personality measures in selection when ensuring that the measures are correctly matched with the organisational values and needs. As stated earlier, the introduction of data-driven selection is said to have enabled more successful selection of employees (Boxall et al., 1986) with personality measures having a higher utility when used after a job analysis (Goodstein & Lanyon, 1999).

The creation of the Big Five Factors of personality began to answer the question posed by many researchers regarding how many traits exist and the nature of these (Goodstein & Lanyon, 1999). Early work by Cattell (1945) and Guildford (1948) first identified a five factor type model and created a platform for other researchers to continue extending upon into the idea of a five factor model. Tupes and Christal (1958) used a sample of air force cadets to find reliable results for the presence of five traits: Surgency (extroversion), Agreeableness, Conscientiousness, Emotional Stability and Culture. Alongside this, high correlations between these traits and performance measures were also found (Tupes & Christal, 1958). These correlations ranged from 0.24 for extroversion to 0.6

for conscientiousness (Tupes & Christal, 1958). Research then continued to support and extend upon the five factor model (Goldburg, 1982, Norman, 1963). McRae and Costa (1987) found that the 'Big Five' accounted for a significant portion of the variability that existed within both personality measures and self-ratings and confirmed the five traits to be: Emotional Stability, Extroversion, Openness to Experience, Agreeableness and Conscientiousness. More recently, as well as the Five Factor Model (McRae & Costa, 1987), the general factor of personality (Musek, 2007) has been introduced. This factor is said to be a higher order factor relating to self-esteem, life satisfaction and emotionality and accounts for 30-50% of variation in the big five personality factors between individuals in a sample (Musek, 2007). The general factor was also found to account for almost half of the association between the big five and overall performance which indicates that it has an influential part in predicting performance through personality (van der Linden, Bakker & Serlie, 2011). It was concluded by Oswald and Hough (2010) that personality now plays a prominent role in general employee selection processes.

Air traffic control is an intensive and challenging role that is responsible for coordinating flights arriving and departing at airports and controlling aircraft routes through controlled airspace around the world (Suresh et al., 2012). Thus, the role requires a certain type of person and skill-set to be able to successfully perform the job (Luuk, Luuk & Aluoja, 2009). Within the third stage of the selection process, the candidates enter into the training centre where they are taught air traffic control through theory and practical training. They are required to pass this training to become an air traffic controller and get posted to an ATC location. Even after successful selection into the training phase, global statistics show that 20% of trainees fail (Pecena et al., 2013). Therefore, the two sections of the selection process before the training phase are important in ensuring extensive resources are used only for

candidates who can be successful. Personality selection measures, in general, have been found to be useful in predicting training success in air traffic controllers if implemented correctly (King et al., 2003). Early on in research between personality measures and aviation employee selection, Bond et al., (1962) indicated that personality testing was an essential component for selecting aviation employees.

The idea that air traffic controllers have similar personality traits was introduced by Luuk et al., (2009) with common traits being identified. Based on this, the current research looks to solidify this personality profile and use it to encourage and help the identification and selection of successful air traffic controllers. Extending upon the findings by Luuk et al., (2009) of a common personality profile in air traffic controllers, Suresh, Ramachandran and Srivastava (2012) confirmed that adjustment, prudence and ambition predicted success among air traffic control. The research by Suresh et al., (2012) involved 87 controllers from air force bases around India and utilised a measure called the Performance Improvement characteristics and Work style attributes which identify what is required to be successful in a job (Suresh et al., 2012). In this research, air traffic controllers were asked to identify what makes them successful in their role (Suresh et al., 2012). The results showed that there were three confirmed traits that predicted ATC performance (ambition, adjustment and prudence). The current research will look to confirm whether these results are accurate through using performance data to solidify the personality-performance relationship found by past researchers.

Now that the history of personality measures in both general selection and in air traffic control specifically has been looked at, the validation studies for personality in selection will be discussed.

## **Validation of Personality Measures in Selection**

Due to the current research's focus on selection and predicting performance, this section will focus on *criterion related validity* which is defined as the ability for this measure to predict job performance (Cronbach & Meehl, 1955).

The validation of personality measures in selection appears to be separated into two distinct time points (Barrick, Mount and Judge, 2001). The first is when personality was concluded to be unrelated to employee performance (Barrick et al., 2001) and the second was when personality became increasingly accepted in recent selection methods (Barrick et al., 2001). One of the early and influential validation studies on personality and performance was conducted by Guion and Gottier (1965) who performed a meta-analysis on 17 research studies from 1952 to 1963. They concluded that only a small number of these studies indicated some form of predictive validity (37%), and even this number was deemed to be an overestimate (Guion & Gottier, 1965). Thus they concluded that no evidence was present for recommending using personality as a selection tool (Guion & Gottier, 1965).

At this point the idea was introduced that personality may be helpful in increasing incremental validity by increasing the base rate of a selection process (Sechrest, 1962; cited in Day & Silvermann, 1989). Incremental validity indicates that the measure is useful alongside other measures in increasing the validity, often predictive power, of the selection process as a whole (Sechrest, 1963). This idea may still be valid however as research continued, more criterion related validity was found. A meta-analysis was conducted by Schmidt et al., (1984) in an attempt to make sense of the research completed following the Guion and Gottier (1965) research. This research resulted in an overall criterion related validity coefficient of 0.21 when personality was related to performance and at this point, it was concluded that personality may be less valid than other selection tools within selection (Schmitt et al., 1984).

A pivotal study in the personality-performance research was the Barrick and Mount (1991) study on the five factors of personality. This study used 117 studies between 1952 and 1988 and analysed the five factors of personality across 5 different occupations (Barrick & Mount, 1991). Linear correlations were found ranging from 0.04 for openness to experience to 0.22 for conscientiousness providing an indication of some predictive validity within personality (Barrick & Mount, 1991). Despite a linear analysis being used in this analysis (as this is the default), the idea of a curvilinear analysis was identified as having the potential to be a better fit for some personality traits (Barrick & Mount, 1991). Conscientiousness was also found to have the highest criterion related validity coefficient of the personality traits in the Schmidt & Hunter (1998) study with 0.31 as well as being the only personality measure found to predict performance. Extending upon this, Tett et al., (1991) found an overall personality criterion related validity coefficient of 0.24 (linear) across 86 studies which further solidified the increasing positive perception of personality in selection.

In more recent research, Goodstein and Lanyon (1999) concluded that there is strong support for the use of personality in employee selection. As stated above, the use of job analysis can be utilised to increase the successful of a selection method (Boxall et al., 1986). Goodstein and Lanyon (1999) found that when job analysis is utilised, personality can account for 10% of variance between people in job performance. Barrick, Mount and Judge (2001) conducted a further validation analysis on the 'big five' personality factors using 40 past studies. It was concluded that there was significant correlation between both emotional stability and conscientiousness with performance which provides evidence of predictive validity (Barrick et al., 2001). This research has confirmed that there is consistency amongst meta-analyses with what personality factors are valid in predicting performance with an increase now being shown since early research (Barrick et al., 2001; Guion & Gottier, 1965; Schmitt et al., 1984). Ones et al., (2007) conducted a meta-analysis on the personality and

performance relationship and found predictive validity for self-report personality measures when the outcome was getting a job. Furthermore, a predictive validity of 0.27 was found for personality and predicting individual job performance (Ones et al., 2007).

Within the air traffic control industry specifically, Luuk et al., (2009) conducted an analysis using 60 air traffic control candidates at an aviation college in Estonia. It was found that air traffic control personnel were higher in conscientiousness and emotional stability (Luuk et al., 2009). It was also concluded that personality can add 3% incremental validity to selection processes within air traffic control (Luuk et al., 2009). There is minimal research on the incremental validity of personality measures and this requires further analysis. An interesting finding by Luuk et al., (2009) was the conclusion that the air traffic control population can be differentiated from the general population. This adds further weight to the argument that the personality-performance relationship needs to be conducted within a relevant context for air traffic control and increases the usefulness of the current study. More recently, Roe (2012) analysed the relationship between personality (specifically, a measure that measured conscientiousness, extraversion, neuroticism and altruism) through a large sample of over 3000 air traffic control candidates. This study found evidence of predictive validity between the personality measures and success in training which was expected to be replicated in operational performance (Roe, 2012).

In summary, the predictive validity of personality for performance has had mixed results and has continued to increase over time. Early research (Guion & Gottier, 1965; Schmitt et al., 1984) indicated very little utility of personality in selection however later research (Barrick & Mount, 1991; Tett et al., 1991; Schmidt & Hunter, 1998; Barrick et al., 2001; Goodstein & Lanyon, 1999) has indicated that personality has some predictive validity

in selection with a focus on the potential for incremental validity to be a main strength. Even within air traffic control, a link has been found between particular personality traits and air traffic control training success with the potential for this to be present in operational performance as well (Roe, 2012). This literature review will now take a closer look at the specific personality measure (OPQ32), including its validity, that is used in this research.

### **Occupational personality questionnaire (OPQ)**

As stated above, the selection process outlined is the tool that is used for air traffic controller selection within an Air Traffic Control Provider in New Zealand. It involves three sections with the first section, pre-screening, including the OPQ as the personality measure. The OPQ is designed to measure personality within 3 narrow categories. These categories are relationships with people, thinking style and feelings and emotions. It also includes a social desirability and consistency measure to identify any distortion issues within the data. The issue of distortion in personality measures is discussed in detail in the next section of this literature review. The OPQ Technical Manual (2014) reports the analysis of the validity and reliability of the OPQ measure. The OPQ shows a high test-retest reliability of 0.85 and high construct validity. Bartram et al., (2006) found that all scales within the OPQ32 had an internal consistency of above 0.7. There is minimal research performed on the criterion related validity of the OPQ however as stated earlier, context is extremely important for validation studies (Johns. 2006). Therefore, performing a validation type study on the OPQ within air traffic control will provide valuable information on the criterion related validity of the measure.

The personality measure detailed above has been described as reasonably valid and reliable however there are common issues that can occur with any self-report measures (Paulhus, 1991). These issues will be discussed in the next section.

### **Personality and the issue of Response Distortion**

There are often issues surrounding response biases with measures that are mainly, or solely, self-report (Paulhus, 1991), in particular, personality measures (Edwards, 1953). A response bias has been defined as a scenario when an applicant chooses an option to appear more socially desirable whilst disregarding accuracy (Paulhus, 1991). This research is interested in the difference between high stakes and low stakes personality scores. There are contrasting results for whether this distortion exists. Early research by Gordon and Stapleton (1956) displayed that there were inflated scores for students applying for a summer job (viewed as high stakes) as opposed to completing the personality measure in a career guidance program (low stakes). In contrast to this, some research has also shown a consistency amongst scores across recruitment contexts and research contexts (Abrahams, Neumann & Githens, 1971; Orpen, 1971). In support of the results by Gordon and Stapleton (1956), Boyce (2005) reported notably inflated scores for the personality measures at recruitment for a theme park job in comparison to scores solely for research purposes. Finally, Ellingson, Sackett and Connelly (2007) conducted a study involving 713 individuals from multiple organisations and roles completing the Californian Psychological Inventory within two different contexts. These time points were in a recruitment context (high stakes) and in a development context (low stakes) with results indicating that there was significant distortion present across these two contexts (Ellingson et al., 2007). Hertz & Alliger (2002) also state that for selection purposes, applicants will change responses to appear more

favourable and Dilchert, Ones, Viswesvaran & Deller (2006) concluded that all scores in 'high stakes' conditions contain some form of deception.

A detrimental effect of response distortion is that some applicants distort more than others (Ones & Viswesvaran, 1998) therefore the selection outcome will be influenced through people with large distortion gaining an advantage (Rosse et al., 1998). Regarding response distortion, the current study will look to add to research by identifying whether there is response distortion present in the high stakes and low stakes condition and then ensure that the correct personality measure is being utilised for further analysis. This will allow the chance of distortion in the study to be minimised. The literature surrounding the criterion variable will now be discussed and also the goal of point to point correspondence.

## **Criterion**

Now that the predictor variable has been reviewed, focus will turn to the criterion (performance) variable. The criterion for the current research consists of performance data that is managerial ratings of the air traffic controller over 8 different competencies (see Appendix A). The measure of job performance is common as a criterion variable with Lent, Aurbach and Levin (1971) finding that within validation studies, 63% used job performance as their criterion variable, with 90-93% of these studies using supervisor ratings (Bernadin & Beatty, 1984; Lent et al., 1971). The criterion variable can also have influence over the outcome of the validation study and also the function of the relationship (Converse & Oswald, 2014) (discussed in the next section). In particular, the Halo effect can influence and increase bias within performance ratings (Viswesvaran, Schmidt & Ones, 2005). The Halo effect indicates that people make decisions on one component which has a biasing effect on the rest of their interpretations and ratings (Viswesvaran et al., 2005). Viswesvaran et al., (2005) found evidence for the Halo effect through finding strong correlations between

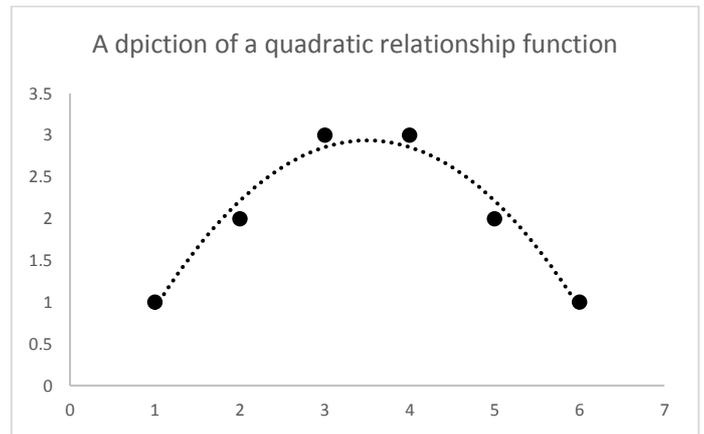
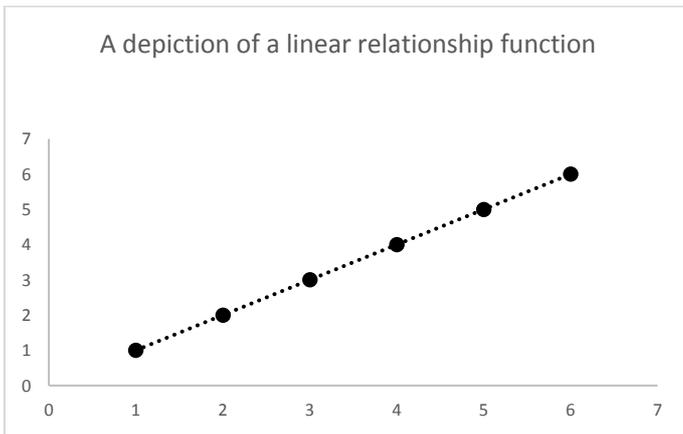
completely different performance dimensions. In their early qualitative review of personality measures, Guion and Gottier (1965) also called for more consideration to be given to the specific setting that personality measures are validated in, therefore conducting the research within the air traffic control environment is essential to the accuracy of the conclusions drawn.

Point-to-point correspondence is important in selection as the goal of selection is almost always to predict future job performance (Schmidt & Ostroff, 1986). Point-to-point correspondence refers to the amount that predictors are in line with, and therefore predict, job tasks (Schmidt & Ostroff, 1986). Therefore, validation of the selection methods within a selection process is extremely influential for the success of the process. If not taken into account, a lack of point-to-point correspondence can have detrimental effects on the productivity of the organisation as a whole (Iddekinge & Ployhart, 2008). The personality measure is deemed as a low fidelity measure however this has been said to still produce high criterion related validity if utilised correctly (Tuzinski, 2013). The air traffic control selection process consists of many aspects with personality being just one. It is important to understand firstly what traits predict job performance and then to identify what aspects of performance are predicted by personality and then validate the remainder of the selection process elements to ensure that all aspects of performance are being predicted.

### **Analysis: Linear vs Curvilinear**

There are two broad types of functions for criterion-predictor relationships. The first is linear and then second is curvilinear. There are two different types of curvilinear which are asymptotic and quadratic. In this research, the term curvilinear indicates a quadratic function. As stated above, this research will focus on the linear function and the quadratic function within curvilinear. A linear relationship indicates that as the predictor increases or decreases,

the criterion behaves in the same way (Stuart-Hamilton, 2007) (Figure 1). A quadratic function is where high personality levels are associated with high performance levels until a certain point where high personality is then associated with lower performance levels (Converse & Oswald, 2014) (Figure 2).



*Figure 1. An example of how a linear relationship between a predictor and criterion would be presented*

*Figure 2. An example of how a curvilinear relationship between a predictor and criterion would be presented*

Commonly, predictor-criterion relationships have been assumed to be linear in selection (Converse & Oswald, 2014) however more recently, evidence has been presented towards the potential for some personality traits to have a curvilinear relationship with performance (Converse & Oswald, 2014). Results by Converse and Oswald (2014) concluded that using the incorrect function of a relationship in selection can have a negative effect on the job performance of the person selected. In their study, it was found that using the wrong function involved a loss of 0.4 standard deviation (for both Conscientiousness and Emotional Stability) which moved a selected employee from having above average performance to average or below average performance (Converse & Oswald, 2014). This finding indicates the importance of using the correct function as selection decisions can be incorrectly made if not. Early research identified a linear function for the ability-performance relationship, and,

due to a lack of knowledge regarding personality, the personality-performance was assumed to be linear also (Coward & Sackett, 1990, Le et al., 2011). Despite finding solely linear relationships between personality and performance, Coward and Sackett (1990) questioned the accuracy of this function and called for further research into the possibility of a curvilinear function. Barrick and Mount (1991) hypothesised that the reason for low validities, as described earlier, was due to the function of personality-performance relationships being curvilinear and not the anticipated linear. More specifically, Murphy (1996) suggested that if a linear function was not utilised, a quadratic function may be the most accurate for relationships between non-cognitive measures (such as personality) and performance. This idea has guided the current research to compare the linear and curvilinear functions for the relationship between air traffic control performance and personality.

Many studies have found curvilinear relationships between personality traits and performance type measures such as training performance (Vasilopoulos, Cucina & Hunter, 2007), leadership performance (Benson & Campbell, 2007) and college GPA level (Cucina & Vasilopoulos, 2005). This research adds to the growing evidence that a curvilinear function has a place in personality validation however a study of specific job performance will need to be studied in order to get accurate results of the personality-performance relationship (Hurtz & Donovan, 2000). Since this research has taken place, there has been large debate amongst researchers over the function of particular traits with job performance. In particular, conscientiousness has received a lot of attention with mixed conclusions. For example; Robie and Ryan (1999) found no evidence of a non-linear relationship between conscientiousness and performance when they conducted research on a range of different occupations. In contrast to this, LaHuis (2005) found a non-linear relationship between conscientiousness and performance for clerical employees. The inconclusive results of these studies (and many others) supports the idea presented by Johns (2006) that job context can have a large

influence over the function of the relationship found. Pierce and Aguinis (2013) extend on this to conclude that all relationships may have a curvilinear relationship within specific contexts. Blickle et al., (2015) indicated that the type of non-linear relationship is determined by the job context and relevance of the personality trait to that job context. This research further enhances the need for research to be completed specifically in the air traffic control context in order to get accurate results.

After reviewing the literature relating to both the predictor and criterion variables, several hypotheses are relevant to the direction of this research and are outlined in detail below.

### **Hypotheses: Specific personality/ performance relationships**

The first hypothesis relates to distortion within the personality data. Based on the literature by Paulhus (1991) and Edwards (1953) stating that there is commonly distortion found in personality (self-report measures), the hypothesis is as follows

H<sub>1</sub>: A difference will exist between the scores in the low stakes personality and the high stakes personality condition for majority of the OPQ traits.

Of the 32 OPQ traits, 10 of these will be hypothesised within this research. Some of these traits have much clearer hypotheses and some not so depending on the amount of past research that has been conducted. These hypotheses were generated as a result of a review of the literature and of the validation studies completed by the Air Traffic Control Provider in New Zealand. It is important to note that when conducting their validation studies, the organisation considered only a linear relationship between the personality traits and air traffic control performance and did not consider the possibility of a curvilinear relationship. This

study looks at performance broken into 8 different competencies. For the purpose of these hypotheses, the phrase ‘performance’ refers to all 8 performance competencies (i.e. all performance competencies are expected to have the same relationship with a given personality trait). The hypotheses are outlined in detail below.

#### *Detail Conscious*

From the organisation’s validation studies, detail conscious was identified to have a positive linear relationship with air traffic control performance. Whetzel et al., (2010) found no significant differences between the fit of a quadratic and linear function of the detail conscious and performance of financial service people therefore a linear function assumed. Perfectionism literature has also been used to shape the hypothesis for the detail conscious trait. A quadratic relationship was shown to exist between perfectionism and performance by Wigert et al., (2012). This idea was supported by Shoss, Callison and Witt (2014) who found a curvilinear relationship with perfectionism and organisational citizenship behaviour performance. The hypothesis for the detail conscious trait was generated based on the evidence displayed by more recent research showing that it is likely for a curvilinear relationship with performance to exist. The hypothesis for this trait is as follows.

H<sub>2</sub>: Detail Conscious will show a better fit with a curvilinear function than a linear function with air traffic control job performance

#### *Conscientiousness*

Past research has produced mixed results for the function of the conscientiousness and performance relationship. In early research, Robie and Ryan (1999) found evidence for a linear relationship with employees in both the public and private sector. Le et al., (2011) supported this through finding a linear relationship for the performance within complex jobs. Job Complexity has been referred to as jobs that involve a lack of routine work and requires

high intellectual demands (Oswald et al., 1999). These results fall in line with the results from the organisation's validation studies where a positive linear relationship was found with air traffic control performance. In contrast, La Huis, Martin and Avis (2005) found non-linear relationships between conscientiousness and clerical employee performance. For non-complex jobs, jobs that are more routine/repetitive (Oswald et al., 1999), Le et al., (2011) found curvilinear relationships. Through comparison of the linear and quadratic function, Whetzel et al., (2010) found strong evidence of a quadratic function for the relationship between conscientiousness and the performance of financial service employees. Due to the results from the organisation's validation studies and the fact that air traffic control is more of a complex job, the hypothesis for the relationship between conscientiousness and air traffic controller performance is as follows.

H<sub>3</sub>: Conscientiousness will show better fit with a linear function than a curvilinear function for its relationship with air traffic controller performance

#### *Adaptable*

There is limited literature relating the adaptable trait to job performance however when using psychological flexibility as the predictor, a positive linear relationship was found with job performance for customer service entry level roles (Bond & Flaxman, 2006). These findings supported the research done by both Hayes et al., (1999) and Bond and Bunce (2003). Suresh et al., (2012) conducted a study on 87 controllers comparing scores on 7 personality factors with air traffic controller performance. It was found that there was a positive relationship between adjustment and performance however the function of this relationship was not specified (Suresh et al., 2012). Whetzel et al., (2010) found evidence for a quadratic function being a better fit than the linear function for the adaptable trait and performance of financial service people. Looking at the more research recent by Whetzel et

al., (2010) which showed evidence of a quadratic function, the hypothesis form the adaptable trait is as follows.

H<sub>4</sub>: Adaptable will show a better fit with a curvilinear function than a linear function for its relationship with air traffic controller performance.

#### *Decisive*

Minimal research exists exploring the relationship between decisiveness and job performance, however the organisation's validation studies identified a positive linear relationship between the decisiveness trait and air traffic controller performance. Whetzel et al., (2010) found no significant differences between the quadratic and linear function of decisiveness and the performance of financial employee. Assertiveness was also used to create the hypothesis for this trait and was found to have a positive relationship with team member performance (Pearsell, 2006). Due to this research leaning towards this trait having a linear relationship with job performance, and no evidence to suggest the presence of a more curvilinear relationship, the hypothesis for the decisiveness trait is as follows.

H<sub>5</sub>: Decisiveness will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

#### *Relaxed*

The relaxed trait was identified through the validation studies to have a positive linear relationship with air traffic control performance. Due to a lack of research, the phrase calmness has been used in relation to job performance and creating the hypothesis. Robinson (2009) found that a lack of calmness had a negative linear relationship with problem solving performance therefore would indicate that being calm may have a positive relationship with job performance. Minimal differences were identified by Whetzel et al., (2010) between the fit of the quadratic and liner functions for the relaxed trait and the performance of financial

services people. Based on the research by Robinson (2009) and the result of the validation study by the organisation regarding the performance of air traffic controllers, the hypothesis for the relaxed trait is as follows.

H<sub>6</sub>: Relaxed will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

### *Achieving*

Day and Silvermann (1989) found that higher scores in the achievement trait results in higher overall performance in accountants (linear relationship). Alongside this, Ones et al., (2007) showed through a meta-analytic study involving 13 past research papers that achievement predicts performance at 0.18. As mentioned earlier, Suresh et al., (2012) used a sample of air traffic controllers to identify relationships between personality factors and performance. The results indicated that ambition had a positive linear relationship with performance (Suresh et al., 2012). Using another relevant trait, Ziegler, Knogler and Buhner (2009) found that competitiveness within school work was found to have a curvilinear relationship with performance. Whetzel et al., (2012) found the two functions of linear and quadratic to be similar in their fit of the relationship between the achieving trait and performance of financial services personnel. Therefore, it appears that there is more evidence to indicate that the relationship will be a positive linear relationship with air traffic controller performance.

H<sub>7</sub>: Achieving will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

### *Controlling*

There is minimal research exploring the relationship between the controlling personality trait and job performance. The organisation's validation studies displayed a

significant positive relationship between controlling and air traffic control performance. Research between the dominant trait and job performance was also used to develop the hypothesis for the controlling trait. Krivogorsky and Burton (2011) found a positive linear relationship between dominance and the performance of the organisation. Whetzel et al., (2010) found no evidence for a difference between the linear and quadratic functions for a relationship between controlling and performance. Due to a lack of literature regarding this trait, the hypothesis has been based off the results found from the organisation's validation study.

H<sub>8</sub>: Controlling will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

#### *Emotional Control*

As with conscientiousness, the research regarding the relationship between emotional control and job performance has produced mixed conclusions. Le et al., (2011) found that emotional control/stability had a positive linear relationship with complex job performance. As stated before, a complex job encompasses no routine tasks and high intellectual strain whereas low complex jobs involve routine tasks (Oswald et al., 1999). The organisation's own validation studies supported this by finding a positive linear relationship between emotional control and air traffic controller performance. Despite this, Barrick and Mount (1991) argued that emotional control did not produce high predictive validity due to the fact that it was being represented by the wrong function and should actually be curvilinear. Le et al., (2011) also found a curvilinear relationship between emotional control/stability and non-complex job performance. When comparing the fit of a linear and quadratic function for the relationship between emotional control and job performance of financial service people, Whetzel et al., (2010) found minimal differences. Due to the fact that the air traffic control

job could be viewed as a complex job, coupled with the result of the organisation's validation studies, the hypothesis for the emotional stability trait is as follows.

H<sub>9</sub>: Emotional control will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

#### *Innovative*

There is limited literature involving the innovativeness trait however Gilson (2008) did indicate that creativity has a positive linear relationship with job performance. This falls in line with the organisation's validation studies that also found a significant positive linear relationship with air traffic controller performance. When comparing a linear and quadratic function, Whetzel et al., (2010) found minimal evidence for a quadratic fit as better than a linear for the relationship between innovativeness and the performance of financial services personnel. Based on the lack of research results indicating a curvilinear relationship, the hypothesis for this trait is as follows.

H<sub>10</sub>: Innovative will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

#### *Vigorous*

There is limited literature regarding the relationship between the vigorous trait and job performance, however it was identified as having a significant positive linear relationship with air traffic controller job performance through the organisation's validation studies. Little et al., (2011) found that higher vigour at work had a positive, linear relationship with job performance in terms of organisational citizenship behaviours. Carmeli et al., (2009) also found a significant 0.22 relationship between vigour and job performance within a sample of 290 managers from community centres. Whetzel et al., (2010) found no significant differences between the fit of the linear and quadratic functions for the relationship between vigorousness and the job performance of financial service people. Based on the

overwhelming evidence shown for a linear relationship, the hypothesis for this trait is as follows.

H<sub>11</sub>: Vigorous will show a better fit for the linear function than the curvilinear function for its relationship with air traffic controller performance.

As well as testing the hypotheses, a further aim of this research is to create *expectancy tables* to predict performance based on the personality traits that show a significant relationship with air traffic control performance at the competency. An expectancy table has been defined as a graphic display of the probabilities of successfulness of an applicant given a score within a specific data set (Lawshe & Bolda, 1958). This will look to support the selection process of the air traffic control provider in selecting the correct applicant for the air traffic control job and predicting a high level of performance from the successful candidates.

In summary, this research is focused on validating the use of personality in selection methods and identifying the most effective function for the personality-performance relationship. Relevant literature has been reviewed and multiple hypotheses proposed that will guide the direction of the research. The following sections will detail the method used for the current study, as well as outline the results found, and discuss the implications of these findings for the air traffic control industry.

## **Method**

### **Design**

This study has one set of predictor variables, personality traits, and a set of criterion variables measuring ATC performance. Both the predictor and criterion variable are broken into multiple sub-variables. The personality variable consists of 32 traits that are classified as sub-variables, whilst the performance measure has 8 different performance competencies as its sub-elements. These sub-elements are treated individually for all analyses in the current study. The study is a correlational study between personality and air traffic controller performance.

### **Participants**

The author was given access to three data sets: OPQ High Stakes, OPQ Low Stakes and Performance Ratings. The number of participants within the data sets varied. Within the high stakes personality data, the number of participants ranged from 21-60. This was due to missing data occurring in some traits where participants had missed entire sections of the OPQ measure. The low stakes personality data contained 117 participants whilst the performance data gathered had 112 participants. Matching the data resulted in a combined data set of N=90. Thus, during the second stage of analysis between personality and performance, there were 90 participants with full data for both datasets therefore the sample size for the regression analysis was 90. The missing data issue was remedied by excluding cases list wise (i.e. remove if any data was missing). The tenure of participants ranged from 2.88 years to 48.41 years as at June 20<sup>th</sup> 2016. Gender was not measured as it is not considered relevant to the current study.

The data was gathered through the author being given access to the data. This was done through gathering consent from various parties including the CEO of the organisation

and the Air Traffic Control Union. All of the data used in the current study was from people who were already employed as an air traffic controller within the Air Traffic Control provider in New Zealand.

## **Materials**

### *Personality*

The same OPQ scales were used within both the low and high stakes conditions to assess the air traffic controller's personality. The OPQ contains 104 questions/items which load onto 3 categories. Within each item, the participants were presented with 4 statements from which they had to indicate which statement most accurately described them and which was the least. Each participant received a sten score of between 1 and 10 for each personality trait.

### *Performance*

The type of performance measure being used is typical performance (Iddekinge & Ployhart, 2008) as it is taken at only one-time point. To assess air traffic control performance, eight performance competencies have been identified and are classified as second order factors. These competencies are *planning and time management, problem identification and analysis, contextual decisions, communication, customer service, positive attitude towards learning and change, teamwork and responsible and reliable*. Within each of these competencies, there are a number of behavioural indicators which are referred to as first order factors. These behavioural indicators are the areas that are being rated/assessed by the appropriate managers. An outline of these components is displayed in appendix A.

The first question within this performance measure assesses how well the manager knew the performance of the employee they were assessing. This familiarity question was measured using the scale displayed in Figure 3.

1	2	3	4	5
Not well	Somewhat well	Well	Very Well	Extremely well

Figure 3. Performance rating – familiarity scale

The remaining performance behavioural indicators were measured using the scale outlined in Figure 4.

1	2	3	4	5	6
Much worse than required	Worse than required	Slightly worse than required	Slightly better than required	Better than required	Much better than required

Figure 4. Behavioural Indicator rating scale – ATC performance

## Procedure

This study gained ethics approval from the Human Ethics Committee with the reference number HEC 2016/39/LR.

Personality was measured within both the high stakes (recruitment) and low stakes (in the year 2014) conditions using the OPQ personality measure. Within the high stakes condition, the participants completed this within the pre-screening phase of the selection process alongside aptitude testing and a screening interview. This was completed in a controlled environment and standardised instructions were displayed on the computer of which they completed the test on. In the low stakes condition, participants were asked to complete the OPQ on its own and given standardised instructions prior to beginning the test.

The participants were told they were completing this in order to help validate and improve the selection process. This has been classified as low stakes due to no outcome for the individual being dependent on the outcome. All 32 traits were measured within both conditions.

The performance data was collected in the year 2014 alongside the personality data from the same year. Each appropriate manager was asked to rate each employee on the scale above (Figure 4) against the behavioural indicators in Table 1. This was done individually without the input of the employee.

## **Data Analysis**

In order to conduct the analyses, version 22 of IBM SPSS was utilised. A detailed data analysis plan was developed to guide the results of this study. The first part of the analysis will focus on the accuracy of both the personality and the performance data. The accuracy of the personality data will be assessed through a comparison of the data from the high and low stake conditions. This will look to identify any possible response distortion and will result in a final personality data selected and used in further analysis.

The performance data descriptive statistics will then be analysed with a focus on identifying range restriction in the data. Significant correlations between any personality traits and performance competencies will be found. These significant correlations will be carried forward into a regression which will examine which function (linear or curvilinear) is a better fit for each of the personality traits against each of the performance competencies. Expectancy tables will be developed for each of the significant relationships and will identify the likelihood of an applicant producing adequate ATC performance given a certain personality score.

## Results

### Personality Data Assessment

Table 2 displays the descriptive statistics for the 32 personality traits within both the high stakes (recruitment) and the low stakes (2014-time point) conditions.

*Table 2. Means and standard deviations for the 32 personality traits at both time points*

Personality Trait	High Stakes		Low Stakes	
	Mean	SD	Mean	SD
Relaxed	7.817	1.891	5.93	2.463
Worrying	4.283	1.497	5.26	2.610
Tough Minded	6.867	1.770	6.24	2.277
Optimistic	4.950	1.419	4.99	2.119
Trusting	4.762	1.895	4.75	2.165
Emotionally Controlled	5.650	1.686	6.86	2.141
Vigorous	5.714	1.707	4.91	2.446
Competitive	4.867	1.662	4.26	1.993
Achieving	5.433	1.640	3.47	1.860
Decisive	6.783	1.887	5.15	1.977
Persuasive	4.867	1.432	5.12	2.418
Controlling	5.900	1.434	5.29	2.652
Outspoken	5.429	1.630	5.45	2.272
Independent Minded	4.128	1.569	4.99	2.002
Outgoing	4.917	1.453	5.00	2.449
Affiliative	4.917	1.629	4.91	2.444
Socially Confident	5.800	1.812	4.32	2.116
Modest	5.117	1.842	6.76	2.033
Democratic	3.750	2.005	4.59	2.237
Caring	4.467	1.501	4.64	2.090
Data Rational	7.317	1.568	4.20	2.151
Evaluative	5.907	1.556	4.04	2.238
Behavioural	4.619	2.109	3.77	2.098
Conventional	7.850	1.550	6.01	2.551
Conceptual	6.050	1.899	5.19	2.213
Innovative	4.717	1.833	4.32	2.038
Variety Seeking	3.386	1.588	4.44	2.175
Adaptable	4.886	1.920	4.61	1.969

*Table 2 continued.*

Personality Trait	High Stakes	Low Stakes	Mean	SD
	Mean	SD		
Forward Thinking	5.083	1.889	4.34	1.839
Detail Conscious	7.783	1.075	5.86	2.105
Conscientiousness	6.650	1.338	4.27	1.910
Rule Following	8.810	1.327	6.02	2.084

To test hypothesis 1 (presence of response distortion), and minimise any form of this distortion within the current study, a paired (within sample) t test was completed for each of the 32 personality traits across the two time points (high and low stakes). This aligns with the ideologies put forward by Dunlap, Cortina, Vaslow and Burke (1996) (cited in Ellingson et al., 2007) regarding using a within sample t test to avoid confounding variable issues. This will identify whether any significant differences exist between the high and low stake conditions within each of the 32 personality traits and, if significant difference are shown, displays that there is the potential for response distortion to be present. It is important to identify this prior to further analysis due to the potential for response distortion in a measure to result in inaccurate information (Barrick et al., 1996). The idea involved in distorting data is for the applicant to make themselves appear more favourable whilst compromising accuracy (Paulhus, 1991), and is particularly prominent in personality measures (Edwards, 1953). Table 3 shows the results of this analysis.

To determine any differences, a visual analysis of the means of each trait within the two conditions shown in Table 2 was conducted. From this, it appears that means are higher in the high stakes condition for positive traits (i.e. Rule following) and lower in the high stakes condition for negative traits (i.e. Worrying). This early analysis supports findings by Hurtz and Alliger (2002) and indicates that within the data, participants were attempting to display themselves more favourably by subconsciously scoring higher in the positive traits and lower in the negative traits therefore response distortion is present. Statistically, the

results of the paired t test showed significant differences between the high and low stakes condition for 17 of the traits and no significant differences in 15 traits at the 0.05 level. Due to the visual analysis displaying potential for response distortion and the fact that 17 traits are showing statistically significant differences between low and high stakes, the low stakes personality data will be used for the remainder of analysis. This will look to decrease the effect of inaccurate information (Barrick et al., 1996) that response distortion can have on the rest of the analyses. The descriptive statistics for the low stakes personality data can be found in Table 4.

Table 3. The results of the paired sample t test for the OPQ personality measure across two different time points

Personality Trait	High Stakes			Low Stakes			T	df	P=
	N	Mean	SD	N	Mean	SD			
Relaxed	60	7.82	1.89	117	5.93	2.46	2.69	45	0.010
Worrying	60	4.28	1.50	117	5.26	2.61	-2.04	45	0.047
Tough Minded	60	6.87	1.77	117	6.24	2.28	1.01	45	0.317
Optimistic	60	4.95	1.42	117	4.99	2.12	-2.19	45	0.034
Trusting	21	4.76	1.90	117	4.75	2.17	0.60	16	0.560
Emotionally Controlled	60	5.65	1.69	117	6.86	2.14	-2.72	45	0.009
Vigorous	21	5.71	1.71	117	4.91	2.45	-0.51	16	0.620
Competitive	60	4.87	1.66	117	4.26	1.99	1.28	45	0.209
Achieving	60	5.43	1.64	117	3.47	1.86	4.19	45	0.000
Decisive	60	6.78	1.89	117	5.15	1.98	4.90	45	0.000
Persuasive	60	4.87	1.43	117	5.12	2.42	-2.11	45	0.040
Controlling	60	5.90	1.43	117	5.29	2.66	-0.06	45	0.955
Outspoken	21	5.43	1.63	117	5.45	2.27	-0.84	16	0.415
Independent Minded	47	4.13	1.57	117	4.99	2.00	-0.96	35	0.345
Outgoing	60	4.92	1.45	117	5.00	2.45	-1.51	45	0.138
Affiliative	60	4.92	1.63	117	4.91	2.44	0.10	45	0.919
Socially Confident	60	5.80	1.81	117	4.32	2.12	3.93	45	0.00
Modest	60	5.12	1.84	117	6.76	2.03	-3.55	45	0.001
Democratic	60	3.75	2.01	117	4.59	2.24	-1.51	45	0.139

Table 3 continued.

Personality Trait	High Stakes			Low Stakes			T	df	Sig.
	N	Mean	SD	N	Mean	SD			
Caring	60	4.47	1.50	117	4.64	2.09	-2.06	45	0.045
Data Rational	60	7.32	1.57	117	4.20	2.151	9.36	45	0.000
Evaluative	43	5.91	1.56	117	4.04	2.24	3.89	32	0.00
Behavioural	21	4.62	2.11	117	3.77	2.10	1.45	16	0.167
Conventional	60	7.85	1.55	117	6.01	2.55	4.63	45	0.00
Conceptual	60	6.05	1.90	117	5.19	2.21	1.59	45	0.118
Innovative	60	4.72	1.83	117	4.32	2.04	1.62	45	0.113
Variety Seeking	44	3.38	1.59	117	4.44	2.18	-3.52	33	0.001
Adaptable	44	4.89	1.92	117	4.61	1.97	1.26	33	0.218
Forward Thinking	60	5.08	1.90	117	4.34	1.84	0.76	45	0.452
Detail Conscious	60	7.78	1.08	117	5.86	2.11	6.45	45	0.00
Conscientiousness	60	6.65	1.34	117	4.27	1.91	6.99	45	0.00
Rule Following	21	8.81	1.33	117	6.02	2.08	4.29	16	0.001

*Table 4. Descriptive Statistics for the low stakes personality data*

<b>Personality Trait</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>	<b>Skewness</b>	<b>Kurtosis</b>
Relaxed	5.93	2.463	1	10	-0.32	-0.66
Worrying	5.26	2.610	1	10	-0.06	-0.82
Tough Minded	6.24	2.277	1	10	-0.16	-0.61
Optimistic	4.99	2.119	1	10	0.03	-0.67
Trusting	4.75	2.165	1	10	0.21	-0.38
Emotionally Controlled	6.86	2.141	1	10	-0.18	-0.70
Vigorous	4.91	2.446	1	10	0.08	-0.88
Competitive	4.26	1.993	1	10	0.58	0.28
Achieving	3.47	1.860	1	8	0.40	-0.67
Decisive	5.15	1.977	1	10	-0.05	-0.31
Persuasive	5.12	2.418	1	9	-0.34	-1.29
Controlling	5.29	2.652	1	10	0.15	-0.98
Outspoken	5.45	2.272	1	10	-0.28	-0.46
Independent Minded	4.99	2.002	1	10	-0.01	-0.52
Outgoing	5.00	2.449	1	10	0.02	-0.95
Affiliative	4.91	2.444	1	10	0.09	-0.90
Socially Confident	4.32	2.116	1	9	0.16	-0.74
Modest	6.76	2.033	2	10	-0.13	-0.77
Democratic	4.59	2.237	1	10	0.58	0.07
Caring	4.64	2.090	1	10	0.35	-0.30
Data Rational	4.20	2.151	1	9	0.29	-0.63
Evaluative	4.04	2.238	1	9	0.43	-0.79
Behavioural	3.77	2.098	1	10	0.55	-0.23
Conventional	6.01	2.551	1	10	-0.06	-0.98
Conceptual	5.19	2.213	1	10	-0.12	-0.73
Innovative	4.32	2.038	1	9	0.15	-0.85
Variety Seeking	4.44	2.175	1	10	0.27	-0.45
Adaptable	4.61	1.969	1	10	0.33	0.08
Forward Thinking	4.34	1.839	1	9	0.19	-0.44
Detail Conscious	5.86	2.105	1	9	-0.53	-0.26
Conscientiousness	4.27	1.910	1	9	0.44	-0.25
Rule Following	6.02	2.084	1	10	-0.02	-0.40

Despite some large skewness and kurtosis statistics, after analysing the data in Table 4, it was determined that on a sten score scale of 1-10, the mean values of the personality

traits were reasonably centralised. This along with the standard deviation values being relatively large lead to a conclusion that the data is adequate in terms of the range of the data.

## **Performance Scale Assessment**

Before the analysis of the relationship between the personality measure and performance, the performance data needs to be analysed to ensure it is an accurate measure of ATC performance. The first step in this is ensuring that the performance scales and their sub elements (behavioural indicators) are contributing to the overall performance between personality and performance.

Within the performance measures there are 8 different competencies with each competency being made up of numerous behavioural indicators (see Appendix A). As part of the process for validating the performance competency scales and to reduce any redundancy in these scales, the extent to which the scales contribute to the overall relationship with the personality traits was analysed. Point-to-point correspondence will be tested and achieved through ensuring that there is a relationship between each part of the performance measure and at least one personality trait. To indicate this, the relationship between all personality traits and all behavioural indicators (as well as the overall competency) was calculated and can be seen in Tables 5-12. Overall, there were 97 significant linear relationships found between personality traits and behavioural indicators and 15 at the overall competency level. Within these tables, the overall performance competency is separated from the subsequent behavioural indicators by a black line.

Table 5. Results of validation analysis for the Planning and Time Management Competency measure

Personality Trait	Planning and Time Management	Anticipate and avoid overloads	Solve problems before are issues	Think ahead and prioritise	Plan and achieve traffic flow	Maintain continuous awareness
Relaxed	-0.01	0.05	-0.09	-0.02	0.01	-0.01
Worrying	0.02	0.03	-0.04	-0.02	0.02	0.09
Tough Minded	-0.19	-0.17	-0.24*	-0.17	-0.13	-0.18
Optimistic	-0.20	-0.22*	-0.17	-0.21	-0.16	-0.17
Trusting	0.08	0.11	0.12	0.03	-0.02	0.13
Emotionally Controlled	-0.03	-0.06	-0.03	0.01	-0.01	-0.04
Vigorous	-0.04	-0.05	-0.03	-0.09	0.06	-0.09
Competitive	0.16	0.21*	0.15	0.16	0.13	0.12
Achieving	-0.10	-0.07	-0.08	-0.04	-0.13	-0.13
Decisive	-0.11	-0.13	-0.10	-0.11	-0.17	-0.02
Persuasive	-0.25*	-0.21*	-0.21	-0.23*	-0.24*	-0.26*
Controlling	-0.11	-0.11	-0.10	-0.08	-0.02	-0.18
Outspoken	-0.09	-0.01	-0.08	-0.08	-0.04	-0.18
Independent Minded	-0.10	-0.07	-0.12	-0.12	-0.12	-0.05
Outgoing	0.00	-0.01	0.00	0.03	0.01	-0.02
Affiliative	-0.10	-0.13	-0.06	-0.06	-0.12	-0.09
Socially Confident	0.01	0.00	0.01	0.09	-0.03	-0.04
Modest	0.22*	0.15	0.27*	0.19	0.24*	0.14
Democratic	0.12	0.14	0.07	0.11	0.18	0.07
Caring	-0.20	-0.23*	-0.11	-0.16	-0.21*	-0.20

Table 5 continued.

<b>Personality Trait</b>	<b>Planning and Time Management</b>	<b>Anticipate and avoid overloads</b>	<b>Solve problems before are issues</b>	<b>Think ahead and prioritise</b>	<b>Plan and achieve traffic flow</b>	<b>Maintain continuous awareness</b>
Data Rational	0.15	0.18	0.07	0.07	0.18	0.18
Evaluative	0.19	0.20	0.15	0.17	0.17	0.20
Behavioural	-0.10	-0.18	-0.06	-0.15	-0.08	-0.01
Conventional	0.13	0.09	0.15	0.12	0.12	0.16
Conceptual	0.12	0.18	0.04	0.10	0.10	0.08
Innovative	-0.10	-0.03	-0.10	-0.07	-0.09	-0.15
Variety Seeking	-0.05	-0.01	-0.08	0.00	-0.07	-0.07
Adaptable	0.05	-0.00	0.08	0.01	-0.01	0.13
Forward Thinking	0.05	0.06	0.00	0.01	0.07	0.07
Detail Conscious	-0.08	-0.06	-0.07	-0.05	-0.13	-0.06
Conscientiousness	0.15	0.13	0.14	0.14	0.11	0.19
Rule Following	0.01	-0.04	0.02	0.01	0.07	-0.02

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 6. Results of validation analysis for the Problem Identification and Analysis Competency measure

Personality Trait	Problem Ident. & Analysis	Follow procedures	Full procedures	High accuracy	Deal with errors	Maintain vigilance	Recognise mistakes	Identify problems	Investigate issues	Bigger picture view	Identify solutions	Adapt solutions	Best judgement
Relaxed	-0.02	-0.03	-0.02	-0.08	-0.06	-0.02	0.06	0.00	-0.04	-0.06	0.08	0.02	-0.02
Worrying	0.00	-0.01	0.02	0.01	0.01	0.09	0.03	-0.14	0.05	0.02	-0.01	-0.07	0.04
Tough Minded	-0.07	-0.00	0.02	-0.07	-0.08	-0.03	-0.00	-0.06	-0.10	-0.16	-0.04	-0.10	-0.06
Optimistic	-0.20	-0.04	-0.17	-0.24*	-0.21*	-0.23*	-0.10	-0.12	-0.13	-0.17	-0.16	-0.21*	-0.21
Trusting	0.05	0.10	-0.03	0.00	-0.05	0.09	0.13	0.11	0.11	-0.04	-0.10	0.01	0.11
Emotionally Controlled	0.09	0.09	0.07	0.08	0.13	0.11	0.15	0.01	0.04	0.04	0.01	-0.01	0.10
Vigorous	-0.13	-0.18	-0.19	-0.15	-0.07	-0.13	-0.04	-0.08	-0.05	-0.06	-0.07	-0.10	-0.26*
Competitive	0.03	-0.02	0.01	-0.06	-0.00	0.02	-0.03	0.05	0.13	0.06	0.11	0.10	-0.05
Achieving	-0.15	-0.15	-0.18	-0.11	-0.07	-0.17	-0.13	-0.04	-0.07	-0.08	-0.06	-0.13	0.24*
Decisive	-0.07	0.10	-0.03	0.02	-0.11	-0.03	-0.07	-0.20	-0.14	-0.08	-0.01	-0.16	-0.02
Persuasive	-0.22*	-0.13	-0.22*	-0.18	-0.16	-0.05	-0.10	-0.19	-0.23*	-0.30**	-0.15	-0.14	-0.24*
Controlling	-0.13	-0.13	-0.10	-0.07	-0.12	-0.11	-0.09	-0.05	-0.12	-0.18	-0.12	-0.09	-0.23*
Outspoken	-0.16	-0.16	-0.11	-0.13	-0.16	-0.16	-0.18	-0.14	-0.14	-0.16	-0.04	-0.10	-0.21*
Independent Minded	-0.02	0.00	0.10	0.12	-0.03	-0.03	-0.07	-0.10	-0.05	-0.06	0.02	-0.05	0.07
Outgoing	-0.00	0.02	-0.01	0.02	-0.00	-0.02	0.00	0.08	0.00	0.00	-0.04	0.04	-0.13
Affiliative	-0.13	-0.15	-0.15	-0.15	-0.06	-0.14	-0.11	-0.06	-0.12	-0.16	-0.18	-0.00	-0.19
Socially Confident	-0.04	-0.10	-0.09	-0.06	0.07	-0.12	-0.04	0.04	-0.09	-0.03	-0.04	0.09	-0.07
Modest	0.20	0.16	0.11	0.14	0.19	0.18	0.15	0.22*	0.14	0.20	0.13	0.19	0.16
Democratic	0.10	0.06	0.17	0.11	0.06	0.04	0.15	0.05	0.14	0.06	0.11	0.09	0.08
Caring	-0.26*	-0.18	-0.29**	-0.26*	-0.20	-0.27*	-0.17	-0.25*	-0.29**	-0.13	-0.24*	-0.10	-0.32**
Data Rational	0.13	0.04	0.12	0.07	0.14	0.12	0.16	0.04	0.14	-0.18	0.19	0.15	0.04
Evaluative	0.15	0.10	0.17	0.17	0.09	0.17	0.03	0.12	0.17	0.12	0.21	0.08	0.11

Table 6 continued.

Personality Trait	Problem Ident. & Analysis	Follow procedures	Full procedures	High accuracy	Deal with errors	Maintain vigilance	Recognise mistakes	Identify problems	Investigate issues	Bigger picture view	Identify solutions	Adapt solutions	Best judgement
Behavioural	-0.05	-0.03	-0.02	-0.03	-0.06	-0.07	-0.04	0.05	-0.06	-0.15	-0.07	-0.09	0.09
Conventional	0.01	0.16	0.06	-0.04	0.01	0.05	0.08	0.06	0.09	0.19	0.11	0.07	0.12
Conceptual	0.07	0.05	0.16	0.09	0.04	0.07	0.07	0.05	0.12	0.05	0.12	0.03	-0.04
Innovative	-0.17	-0.18	-0.07	-0.14	-0.08	-0.20	-0.19	-0.12	-0.16	-0.11	-0.08	-0.08	-0.26*
Variety Seeking	-0.11	-0.08	-0.13	-0.16	-0.00	-0.03	-0.07	-0.10	-0.09	-0.11	-0.12	-0.05	-0.19
Adaptable	0.04	0.01	0.04	-0.01	0.10	0.08	0.07	-0.02	0.01	0.00	0.09	0.07	0.06
Forward Thinking	0.02	0.06	-0.03	0.04	0.10	-0.05	0.06	0.09	0.02	-0.05	0.02	0.03	-0.11
Detail Conscious	-0.05	-0.07	-0.06	0.07	-0.06	0.01	-0.04	-0.05	-0.12	-0.12	-0.01	-0.09	0.06
Conscientiousness	0.14	0.11	0.12	0.04	0.09	0.08	0.10	0.15	0.23*	0.07	0.20	0.10	0.18
Rule Following	0.01	0.03	0.00	-0.02	-0.03	0.02	0.06	-0.05	0.10	0.10	0.06	-0.09	0.01

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 7. Results of validation analysis for the Customer Service Competency measure

Personality Trait	Customer Service	Provide Best service	Effort into finding best solution	Go to all lengths	Develop good relations externally	Commercially astute in dealings
Relaxed	-0.00	0.01	0.02	0.02	-0.04	-0.06
Worrying	0.07	-0.06	-0.04	0.13	0.18	0.08
Tough Minded	-0.20	0.06	-0.08	-0.05	-0.04	-0.02
Optimistic	-0.07	-0.03	-0.01	-0.07	-0.08	-0.14
Trusting	0.23*	0.11	0.20	0.25*	0.31*	0.11
Emotionally Controlled	0.00	0.08	0.01	-0.01	-0.06	0.05
Vigorous	-0.21*	-0.15	-0.12	-0.19	-0.10	-0.30**
Competitive	-0.04	-0.05	-0.11	-0.05	-0.03	-0.11
Achieving	-0.19	-0.23*	-0.01	-0.18	-0.19	-0.16
Decisive	-0.15	-0.11	-0.11	-0.17	-0.20	-0.12
Persuasive	-0.16	-0.14	-0.19	-0.12	-0.14	-0.14
Controlling	-0.07	-0.05	-0.08	-0.04	-0.10	-0.03
Outspoken	-0.20	-0.23*	-0.09	-0.18	-0.19	-0.20
Independent Minded	-0.05	-0.06	-0.09	-0.05	-0.07	0.03
Outgoing	0.00	0.03	0.01	-0.08	0.05	-0.05
Affiliative	0.06	0.13	0.00	0.07	0.13	-0.04
Socially Confident	0.04	0.15	0.05	-0.01	0.00	0.00
Modest	0.24*	0.32**	0.23*	0.18	0.15	0.26*
Democratic	0.16	0.10	0.17	0.10	0.22	0.12
Caring	-0.10	-0.09	-0.08	-0.06	-0.13	-0.13

Table 7 continued.

Personality Trait	Customer Service	Best service	Effort into finding best solution	Go to all lengths	Develop good relations externally	Commercially astute in dealings
Data Rational	0.04	-0.07	0.14	0.00	0.03	0.02
Evaluative	0.04	-0.01	0.08	0.05	-0.20	0.07
Behavioural	0.14	0.09	-0.08	0.19	0.23*	0.12
Conventional	0.20	0.10	0.258	0.16	0.24*	0.07
Conceptual	-0.17	-0.20	-0.06	-0.22*	-0.23*	-0.11
Innovative	-0.18	-0.13	-0.12	-0.19	-0.23*	-0.11
Variety Seeking	-0.15	-0.16	-0.11	-0.18	-0.16	-0.12
Adaptable	0.10	-0.03	0.04	0.10	0.12	0.12
Forward Thinking	0.10	0.09	0.12	0.09	0.03	0.07
Detail Conscious	-0.03	-0.04	-0.11	0.00	0.00	0.06
Conscientiousness	0.09	0.03	0.06	0.13	0.11	0.07
Rule Following	0.13	0.06	0.20	0.11	0.12	0.03

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 8. Results of validation analysis for the Communication Competency measure

Personality Trait	Communication	Accuracy, clarity, concise	Standard phraseology	Diplomatic, unemotional and sensitive	Prepared to say no and justify	Document in timely manner
Relaxed	0.06	0.05	-0.01	0.07	0.02	0.08
Worrying	0.11	0.11	0.10	0.04	0.14	0.04
Tough Minded	-0.06	-0.03	0.00	-0.06	-0.17	0.00
Optimistic	-0.14	-0.09	-0.10	-0.04	-0.27*	-0.06
Trusting	0.11	0.01	0.11	0.23*	0.08	-0.04
Emotionally Controlled	0.09	0.07	0.05	0.03	0.12	0.07
Vigorous	-0.07	-0.13	-0.08	-0.04	-0.09	0.03
Competitive	0.03	-0.03	0.02	0.06	0.07	0.00
Achieving	-0.11	-0.13	-0.19	-0.06	-0.07	0.00
Decisive	-0.09	-0.18	-0.02	-0.05	-0.07	-0.02
Persuasive	-0.16	-0.07	-0.20	-0.17	-0.15	-0.05
Controlling	-0.09	-0.08	-0.11	-0.04	-0.11	-0.03
Outspoken	-0.16	-0.14	-0.17	-0.13	-0.06	-0.14
Independent Minded	0.06	0.03	0.05	-0.05	0.06	0.15
Outgoing	0.02	0.10	0.09	-0.07	0.02	-0.04
Affiliative	-0.13	-0.03	-0.16	-0.01	-0.09	-0.24*
Socially Confident	-0.18	-0.06	-0.25*	-0.09	-0.12	-0.20
Modest	0.16	0.06	0.16	0.21*	0.05	0.09
Democratic	0.16	0.16	0.04	0.12	0.20	0.11

Table 8 continued.

Personality Trait	Communication	Accuracy, clarity, concise	Standard phraseology	Diplomatic, unemotional and sensitive	Prepared to say no and justify	Document in timely manner
Caring	-0.33**	-0.29**	-0.33**	-0.18	-0.30**	-0.18
Data Rational	0.17	0.14	0.10	0.10	0.17	0.15
Evaluative	0.08	0.05	0.07	0.07	-0.03	0.13
Behavioural	0.01	0.01	0.01	0.09	-0.13	0.04
Conventional	0.10	0.07	0.17	0.12	0.07	-0.03
Conceptual	-0.03	-0.03	0.01	-0.16	0.01	0.09
Innovative	-0.22*	-0.22*	-0.29**	-0.12	-0.17	-0.05
Variety Seeking	-0.27*	-0.27*	-0.27*	-0.26*	-0.09	-0.13
Adaptable	-0.04	0.03	-0.10	-0.08	-0.08	0.08
Forward Thinking	-0.01	0.10	-0.08	-0.01	-0.10	0.06
Detail Conscious	-0.03	-0.03	-0.04	-0.02	-0.08	0.04
Conscientiousness	0.15	0.15	0.20	0.09	0.01	0.15
Rule Following	0.02	-0.01	0.14	0.09	-0.09	-0.07

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 9. Results of validation analysis for the Contextual Decisions Competency measure

<b>Personality Trait</b>	<b>Contextual Decision Making</b>	<b>Decisions under pressure</b>	<b>Relaxed, calm, collected</b>	<b>Absorb and acknowledge information</b>	<b>Analyze whole situation</b>	<b>Resolve issues smoothly</b>	<b>Decisions to facilitate performance</b>	<b>Weigh up alternatives</b>
Relaxed	0.02	0.13	0.02	0.05	0.02	0.02	-0.05	-0.04
Worrying	-0.01	-0.05	-0.10	-0.05	-0.04	0.00	0.07	0.10
Tough Minded	-0.11	0.00	-0.08	-0.11	-0.14	-0.09	-0.15	-0.09
Optimistic	-0.13	-0.10	-0.12	-0.09	-0.07	-0.15	-0.12	-0.15
Trusting	0.09	0.01	0.13	0.02	0.05	0.00	0.17	0.15
Emotionally Controlled	-0.01	-0.03	0.11	-0.08	-0.09	-0.05	0.00	0.06
Vigorous	0.00	0.04	-0.08	0.09	0.05	0.01	-0.09	-0.01
Competitive	0.02	0.10	-0.04	0.07	0.00	0.02	0.01	0.00
Achieving	-0.08	-0.04	-0.06	-0.05	-0.04	-0.06	-0.12	-0.12
Decisive	-0.20	-0.21*	-0.14	-0.15	-0.18	-0.21	-0.17	-0.16
Persuasive	-0.23*	-0.10	-0.26*	-0.20	-0.22*	-0.18	-0.25*	-0.18
Controlling	-0.11	-0.07	-0.04	-0.07	-0.14	-0.11	-0.16	-0.09
Outspoken	-0.19	-0.06	-0.26*	-0.07	-0.17	-0.14	-0.23	-0.22*
Independent Minded	-0.06	-0.14	-0.09	-0.14	-0.05	-0.05	0.01	0.08
Outgoing	0.03	0.06	-0.07	0.09	0.06	0.05	-0.03	0.06
Affiliative	-0.11	-0.11	-0.04	-0.09	-0.18	-0.11	-0.08	-0.09
Socially Confident	-0.05	0.03	-0.07	-0.11	-0.07	-0.03	-0.03	-0.05

Table 9 continued.

Personality Trait	Contextual Decision Making	Decisions under pressure	Relaxed, calm, collected	Absorb and acknowledge information	Analyze whole situation	Resolve issues smoothly	Decisions to facilitate performance	Weigh up alternatives
Modest	0.27*	0.20	0.40	0.21	0.16	0.17	0.26*	0.20
Democratic	0.16	0.24*	0.05	0.17	0.14	0.16	0.11	0.14
Caring	-0.22*	-0.27*	-0.12	-0.13	-0.16	-0.16	-0.23*	-0.30**
Data Rational	0.15	0.22*	0.00	0.18	0.14	0.16	0.12	0.11
Evaluative	0.08	0.07	-0.05	0.10	0.13	0.14	0.07	0.03
Behavioural	-0.01	-0.09	-0.08	-0.03	-0.03	0.05	0.05	0.05
Conventional	0.13	0.07	0.12	0.17	0.12	0.07	0.16	0.08
Conceptual	0.04	0.16	-0.12	0.09	0.09	0.14	-0.08	0.01
Innovative	-0.12	-0.08	-0.13	-0.08	-0.08	-0.06	-0.18	-0.12
Variety Seeking	-0.18	-0.10	-0.28**	-0.14	-0.15	-0.10	-0.16	-0.18
Adaptable	0.10	0.10	-0.02	0.05	0.11	0.12	0.10	0.11
Forward Thinking	0.04	0.09	-0.02	0.09	0.11	0.03	-0.02	-0.02
Detail Conscious	-0.05	-0.01	-0.02	-0.07	-0.04	-0.08	-0.01	-0.05
Conscientiousness	0.12	0.12	-0.02	0.03	0.13	0.12	0.18	0.15
Rule Following	0.06	0.07	0.12	0.10	0.00	0.03	0.06	-0.02

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 10. Results of validation analysis for the Positive attitude towards learning and change Competency measure

<b>Personality Trait</b>	<b>Attitude towards learning &amp; change</b>	<b>Enjoy learning</b>	<b>Respond positively to requirements</b>	<b>Happy with challenge</b>	<b>Up to date with developments</b>	<b>Positively to feedback</b>	<b>Learn from mistakes</b>	<b>Ask questions</b>
Relaxed	0.12	0.11	0.05	0.14	0.04	0.05	0.15	0.13
Worrying	0.04	0.02	0.05	0.10	0.06	-0.15	0.03	0.10
Tough Minded	-0.05	-0.03	-0.09	-0.06	0.01	0.00	-0.06	-0.05
Optimistic	-0.03	0.06	-0.05	0.02	-0.11	0.00	-0.05	-0.05
Trusting	0.06	-0.03	-0.04	0.00	-0.04	0.13	0.17	0.15
Emotionally Controlled	-0.02	-0.04	-0.04	-0.06	-0.02	0.10	0.02	-0.04
Vigorous	0.01	0.08	-0.03	0.13	-0.07	-0.02	-0.04	0.00
Competitive	0.08	0.07	0.13	0.02	0.04	0.01	0.06	0.12
Achieving	-0.05	0.04	-0.03	0.01	-0.13	0.01	-0.05	-0.14
Decisive	-0.17	-0.15	-0.15	-0.28**	-0.06	-0.05	-0.09	-0.19
Persuasive	-0.12	0.00	-0.13	-0.02	-0.05	-0.15	-0.19	-0.14
Controlling	-0.03	0.01	-0.06	0.11	-0.10	-0.06	-0.09	0.00
Outspoken	-0.17	-0.07	-0.11	-0.15	-0.14	-0.22*	-0.14	-0.12
Independent Minded	-0.04	-0.06	0.03	-0.05	0.04	-0.11	-0.07	-0.01
Outgoing	0.00	-0.04	-0.01	0.03	0.05	-0.06	0.00	0.02
Affiliative	-0.07	-0.02	0.05	-0.03	-0.13	-0.04	-0.07	-0.15
Socially Confident	-0.03	-0.03	0.06	-0.02	-0.04	-0.04	0.00	-0.08

Table 10 continued.

Personality Trait	Attitude towards learning & change	Enjoy learning	Respond positively to requirements	Happy with challenge	Up to date with developments	Positively to feedback	Learn from mistakes	Ask questions
Modest	0.24*	0.20	0.22*	0.15	0.19	0.34**	0.15	0.12
Democratic	0.11	0.17	0.03	0.16	0.16	-0.07	0.00	0.14
Caring	-0.11	0.01	-0.01	-0.03	-0.13	-0.03	-0.17	-0.27*
Data Rational	0.20	0.21	0.13	0.18	0.17	0.02	0.20	0.25*
Evaluative	0.14	0.08	0.17	0.17	0.11	-0.02	0.11	0.20
Behavioural	0.08	0.06	0.12	0.00	0.02	0.04	0.07	0.15
Conventional	0.11	0.12	0.05	0.01	0.04	0.10	0.16	0.17
Conceptual	0.03	0.06	-0.02	0.05	0.13	-0.22*	0.03	0.15
Innovative	-0.12	-0.04	-0.04	-0.04	-0.03	-0.18	-0.19	-0.15
Variety Seeking	-0.08	0.00	-0.04	-0.03	-0.06	-0.18	-0.05	-0.11
Adaptable	0.06	0.04	0.07	0.11	0.09	-0.03	0.03	0.01
Forward Thinking	0.13	0.13	0.10	0.20	0.08	0.06	0.09	0.06
Detail Conscious	-0.01	-0.14	0.07	0.09	-0.04	-0.01	-0.06	-0.02
Conscientiousness	0.20	0.10	0.16	0.14	0.14	0.13	0.20	0.28**
Rule Following	0.06	0.10	0.04	0.02	-0.05	0.08	0.06	0.09

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 11. Results of validation analysis for the Teamwork Competency measure

<b>Personality Trait</b>	<b>Teamwork</b>	<b>Identify chances to support others</b>	<b>Offer help</b>	<b>Discuss options with colleagues</b>	<b>Positive contribution to team</b>	<b>Respect all people</b>	<b>Create professional environment</b>	<b>Considerate of others</b>
Relaxed	0.07	0.08	0.05	0.12	0.04	0.04	0.04	0.04
Worrying	0.17	0.27*	0.18	0.08	0.18	0.13	0.12	0.04
Tough Minded	-0.06	-0.10	-0.07	-0.09	-0.02	-0.06	0.00	-0.01
Optimistic	-0.09	-0.04	0.01	-0.15	-0.08	-0.11	-0.12	-0.09
Trusting	0.13	0.26*	0.13	0.02	0.09	0.10	0.11	0.08
Emotionally Controlled	0.03	-0.01	-0.04	-0.09	0.06	0.02	0.10	0.12
Vigorous	-0.13	-0.23*	-0.01	-0.08	-0.17	-0.11	-0.15	-0.07
Competitive	-0.02	0.02	0.02	0.04	-0.04	-0.03	-0.05	-0.03
Achieving	-0.16	-0.21	-0.16	-0.10	-0.21*	-0.08	-0.18	-0.02
Decisive	-0.16	-0.11	-0.16	-0.16	-0.24*	-0.13	-0.12	-0.05
Persuasive	-0.17	-0.15	-0.08	-0.15	-0.06	-0.22*	-0.22*	-0.14
Controlling	-0.06	-0.10	0.02	-0.07	-0.04	-0.08	-0.07	-0.04
Outspoken	-0.15	-0.07	-0.15	-0.14	-0.09	-0.11	-0.24*	-0.11
Independent Minded	-0.02	-0.10	-0.01	-0.10	0.07	-0.04	-0.03	0.07
Outgoing	-0.02	-0.10	0.07	0.00	0.07	-0.10	0.01	-0.08
Affiliative	0.00	0.03	0.11	-0.03	0.07	-0.02	-0.08	-0.12
Socially Confident	-0.04	-0.07	0.01	-0.01	-0.01	-0.07	-0.01	-0.06

Table 11 continued.

Personality Trait	Teamwork	Identify chances to support others	Offer help	Discuss options with colleagues	Positive contribution to team	Respect all people	Create professional environment	Considerate of others
Modest	0.17	0.09	0.11	0.20	0.02	0.18	0.24*	0.16
Democratic	0.21*	0.17	0.17	0.18	0.30**	0.17	0.12	0.17
Caring	-0.14	-0.12	-0.02	-0.18	-0.16	-0.07	-0.18	-0.16
Data Rational	0.20	0.25*	0.21	0.18	0.16	0.16	0.14	0.08
Evaluative	0.13	0.18	0.08	0.16	-0.01	0.13	0.14	0.14
Behavioural	0.11	0.14	0.08	0.03	0.09	0.10	0.09	0.12
Conventional	0.17	0.23*	0.17	0.19	0.11	0.14	0.17	0.00
Conceptual	-0.03	-0.02	-0.07	0.01	-0.01	-0.08	0.02	0.00
Innovative	-0.18	-0.18	-0.18	-0.15	-0.17	-0.19	-0.16	-0.07
Variety Seeking	-0.10	0.00	-0.04	-0.14	-0.08	-0.11	-0.17	-0.10
Adaptable	0.16	0.26*	0.21*	0.18	0.15	0.15	0.02	0.01
Forward Thinking	0.05	0.00	0.12	0.09	-0.05	0.07	0.09	-0.01
Detail Conscious	-0.01	-0.11	-0.02	0.07	-0.07	-0.04	0.08	0.04
Conscientiousness	0.11	0.13	0.10	0.15	0.08	0.04	0.10	0.08
Rule Following	0.14	0.18	0.11	0.10	0.12	0.11	0.11	0.12

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

Table 12. Results of validation analysis for the Responsible and Reliable Competency measure

Personality Trait	Responsible and Reliable	Punctual for shifts	Adhere to rules and regulations	Identify what needs to be done	Willing to do extra tasks	Complete assigned work	Embrace job and provide support
Relaxed	0.03	0.04	-0.01	-0.01	0.08	-0.01	0.03
Worrying	0.00	-0.18	0.02	0.03	0.09	-0.03	0.07
Tough Minded	-0.05	0.00	-0.09	-0.04	-0.03	-0.01	-0.10
Optimistic	-0.09	-0.10	-0.09	-0.09	-0.03	-0.02	-0.13
Trusting	0.04	0.01	0.13	0.02	0.03	-0.01	0.02
Emotionally Controlled	0.06	0.13	0.04	0.16	-0.05	0.03	0.01
Vigorous	-0.03	-0.05	-0.10	-0.09	0.02	0.07	-0.03
Competitive	0.00	-0.09	0.01	0.00	0.01	0.04	0.05
Achieving	-0.03	0.03	-0.13	-0.11	-0.06	0.10	-0.02
Decisive	-0.05	0.12	0.08	-0.05	-0.15	-0.09	-0.11
Persuasive	-0.09	-0.12	-0.20	-0.08	-0.05	0.08	-0.10
Controlling	-0.02	-0.08	-0.17	-0.08	0.08	0.07	0.04
Outspoken	-0.15	-0.17	-0.10	-0.13	-0.14	-0.09	-0.09
Independent Minded	0.04	0.06	0.01	0.05	0.03	0.08	-0.02
Outgoing	-0.01	-0.11	-0.04	-0.04	0.10	0.05	-0.02
Affiliative	-0.09	-0.20	-0.21	-0.10	0.05	-0.02	0.00
Socially Confident	-0.14	-0.24*	-0.28**	-0.17	0.02	0.01	-0.07
Modest	0.17	0.26	0.16	0.09	0.10	0.06	0.18
Democratic	0.15	0.13	0.02	0.11	0.17	0.17	0.12

Table 12 continued.

<b>Personality Trait</b>	<b>Responsible and Reliable</b>	<b>Punctual for shifts</b>	<b>Adhere to rules and regulations</b>	<b>Identify what needs to be done</b>	<b>Willing to do extra tasks</b>	<b>Complete assigned work</b>	<b>Embrace job and provide support</b>
Caring	-0.16	-0.17	-0.19	-0.17	-0.10	-0.05	-0.14
Data Rational	0.13	0.02	0.11	0.17	0.14	0.10	0.12
Evaluative	0.15	0.10	0.14	0.09	0.11	0.14	0.15
Behavioural	0.06	0.08	0.01	-0.09	0.00	0.08	0.18
Conventional	0.03	-0.03	0.13	0.11	-0.02	-0.10	0.07
Conceptual	0.07	0.08	0.13	0.10	0.02	0.11	-0.05
Innovative	-0.08	0.01	-0.15	-0.19	-0.10	0.07	-0.09
Variety Seeking	-0.09	-0.15	-0.16	-0.09	-0.04	0.08	-0.11
Adaptable	0.06	-0.09	-0.05	-0.04	0.09	0.18	0.16
Forward Thinking	-0.03	-0.13	-0.19	-0.08	0.02	0.13	0.05
Detail Conscious	0.03	0.03	-0.06	-0.04	0.07	0.05	0.06
Conscientiousness	0.11	0.04	0.04	0.13	0.14	0.14	0.07
Rule Following	0.08	0.03	0.12	0.12	0.12	-0.03	0.03

\*\* Correlation is significant at the 0.01 level  
N = 90

\* Correlation is significant at the 0.05 level

It was concluded that, if a behavioural indicator was not useful in predicting any personality trait, then it would be removed from further analysis and the remaining indicators would be used to form the finalised performance competency scales. At this point, 13 behavioural indicators were removed from analysis (shown in Table 13). By completing this process, it is likely that the redundancy in scale items has been reduced and therefore only behavioural indicators that are significantly related to personality remain.

*Table 13. Process of removal of behavioural indicators through checking scale accuracy*

<b>Performance Competency</b>	<b>Behavioural Indicators Removed</b>
<b>Planning and Time Management</b>	Nil
<b>Problem Identification and Analysis</b>	PA_1: Proactively anticipate and avoid potential overloads by using gaps in traffic to plan PA_6: Recognise mistakes or anomalies quickly
<b>Customer Service</b>	Nil
<b>Communication</b>	Nil
<b>Contextual Decisions</b>	CD_3: Absorb and acknowledge information CD_5: Resolve complex problems smoothly
<b>Positive Attitude towards Learning and Change</b>	PLC_1: Enjoy learning and want to know more  PLC_4: Keep up to date with system developments, and develop a broad knowledge of its capabilities PLC_6: Learn from mistakes
<b>Teamwork</b>	TW_3: Discuss options with others and make suggestions TW_7: Be considerate of others, handing over in an orderly manner, be prompt to relieve colleagues, and, aware of their impact on other work
<b>Responsible and Reliable</b>	RR_3: Identify what needs to be done RR_4: Be willing to do extra tasks to improve things RR_5: Complete what is asked of them RR_6: Embrace the job and remain available to support others if needed

## Performance Data Assessment

The descriptive statistics for the final performance competency scales are outlined in Table 14. There is minimal difference shown between the descriptive statistics for the original competency scales and the final competency scales.

*Table 14. Descriptive statistics for final performance competency scales and overall performance*

Competency	N	Mean	SD	Min	Max	Skewness	Kurtosis
<b>Planning and Time Management</b>	90	5.00	0.74	2.40	6.00	-0.53	0.52
<b>Problem Identification and Analysis</b>	90	5.00	0.71	2.70	6.00	-0.66	-0.44
<b>Customer Service</b>	90	5.06	0.83	1.40	6.00	-1.63	4.19
<b>Communication</b>	90	5.00	0.70	3.00	6.00	-0.66	0.14
<b>Contextual Decisions</b>	90	4.98	0.75	2.60	6.00	-0.67	0.52
<b>Positive attitude towards learning and change</b>	90	5.06	0.76	2.25	6.00	-1.07	1.72
<b>Teamwork</b>	90	5.02	0.86	1.00	6.00	-1.67	4.77
<b>Responsible and Reliable</b>	90	5.02	0.73	3.00	6.00	-0.45	-0.21

Inspection of Table 14 shows that there is a negative (left) skew on all 8 competencies on the 6-point scale. This indicates that majority of the scores are at the higher end of the spectrum across all the different competencies. Much of the research surrounding range restriction has been focused on correcting for the range restriction within the predictor variable (Sackett & Yang, 2000; Sjöberg et al., 2012). There is extremely limited literature looking at the criterion variable and correcting for range restriction within this variable. If we were to apply the Thorndike 2 case formula, we would need a normative standard deviation that is only often supplied for predictor measures. This is not available for the criterion variable of ATC performance. Due to this, the performance data will continue as a restricted sample and will be taken into account when interpreting results.

It is important to analyse the reliability of the new scales to ensure they are internally consistent measures of performance (see Table 15). As can be seen, the reliabilities still sit above the cut-off of 0.8 indicating the scales are adequately reliable.

*Table 15. Reliability analysis for the final performance competency scales*

Performance Competency	Number of indicators	Cronbach Alpha
Planning and Time Management (PT)	5	0.95
Problem Identification and Analysis (PA)	10	0.92
Customer Service (CS)	5	0.93
Communication (C)	5	0.85
Contextual Decisions (CD)	5	0.92
Positive Attitude towards learning and change (PLC)	4	0.85
Teamwork (TW)	5	0.92
Responsible and Reliable (RR)	2	0.82

## **Regression**

To test hypotheses 2-11, regressions, more specifically a curve estimation, will be conducted.

To establish the existence of a curvilinear relationship, a linear relationship must first exist. Within a curvilinear relationship, there is a portion of that curve which is linear therefore only if the linear relationship is significant can we find a curvilinear relationship. The final competency scales were, therefore, used to compute the linear bivariate correlations between personality and the 8 air traffic controller performance competencies as rated by their supervisors (see Table 16). Based on the rationale outlined above, these correlations will be used to determine which relationships will be taken into the regression analysis.

As stated earlier, only significant linear bivariate correlations need to be tested for a curvilinear correlation. As well as this, this process acts in giving the remainder of the analysis direction to ensure there are not excessive calculations. There will be 18 relationships tested within the regression comparing the linear and curvilinear functions. Only one of these relationships link back to the original hypotheses. This is the relationship between the vigorous trait and customer service which was hypothesis 11.

Table 16. Correlations between the 32 OPQ Personality traits and final competency scores

	<b>Planning and Time Management</b>	<b>Problem Identification and Analysis</b>	<b>Customer Service</b>	<b>Communication</b>	<b>Contextual Decisions</b>	<b>Positive Attitude to learning &amp; Change</b>	<b>Teamwork</b>	<b>Responsible and Reliable</b>
<b>Relaxed</b>	-0.01	-0.03	-0.00	0.06	0.00	0.12	0.05	0.02
<b>Worrying</b>	0.02	0.00	0.07	0.10	0.00	0.02	0.19	-0.09
<b>Tough Minded</b>	-0.19	-0.08	-0.02	-0.08	-0.14	-0.09	-0.08	-0.05
<b>Optimistic</b>	-0.20	-0.22*	-0.07	-0.13	-0.17	-0.03	-0.08	-0.11
<b>Trusting</b>	0.08	0.03	0.23*	0.10	0.09	0.07	0.16	0.07
<b>Emotionally Controlled</b>	-0.03	0.07	0.00	0.06	0.01	-0.01	0.03	0.10
<b>Vigorous</b>	-0.04	-0.13	-0.21*	-0.06	-0.03	0.04	-0.14	-0.08
<b>Competitive</b>	0.16	0.04	-0.04	0.03	0.03	0.07	-0.03	-0.05
<b>Achieving</b>	-0.10	-0.14	-0.19	-0.11	-0.10	-0.05	-0.20	-0.05
<b>Decisive</b>	-0.11	-0.08	-0.15	-0.09	-0.20	-0.20	-0.17	0.11
<b>Persuasive</b>	-0.25*	-0.23*	-0.16	-0.15	-0.24*	-0.15	-0.18	-0.17
<b>Controlling</b>	-0.11	-0.13	-0.07	-0.08	-0.11	0.01	-0.05	-0.14
<b>Outspoken</b>	-0.09	-0.16	-0.20	-0.14	-0.18	-0.17	-0.14	-0.15
<b>Independent Minded</b>	-0.10	-0.01	-0.05	0.06	-0.07	-0.07	-0.05	0.04
<b>Outgoing</b>	0.00	-0.01	0.00	0.04	0.00	0.00	-0.01	-0.08
<b>Affiliative</b>	-0.10	-0.14	0.06	-0.13	-0.12	-0.02	0.05	-0.22*
<b>Socially Confident</b>	0.01	-0.03	0.04	-0.17	-0.06	0.01	-0.01	-0.28**
<b>Modest</b>	0.22*	0.20	0.24*	0.14	0.31*	0.27*	0.17	0.23*

Table 16 continued.

	<b>Planning and Time Management</b>	<b>Problem Identification and Analysis</b>	<b>Customer Service</b>	<b>Communicat ion</b>	<b>Contextual Decisions</b>	<b>Positive Attitude to learning &amp; Change</b>	<b>Teamwork</b>	<b>Responsible and Reliable</b>
<b>Democratic</b>	0.12	0.10	0.16	0.17	0.13	0.06	0.19	0.08
<b>Caring</b>	-0.20	-0.27*	-0.10	-0.30*	-0.26*	-0.09	-0.11	-0.20
<b>Data Rational</b>	0.15	0.14	0.04	0.17	0.13	0.16	0.21	0.07
<b>Evaluative</b>	0.19	0.16	0.04	0.08	0.08	0.15	0.11	0.13
<b>Behavioural</b>	-0.10	-0.05	0.14	0.01	-0.04	0.08	0.10	0.05
<b>Conventional</b>	0.13	0.09	0.20	0.09	0.15	0.11	0.20	0.05
<b>Conceptual</b>	0.11	0.07	-0.17	-0.02	-0.01	-0.04	-0.06	0.11
<b>Innovative</b>	-0.10	-0.16	-0.18	-0.20	-0.15	-0.13	-0.20	-0.07
<b>Variety Seeking</b>	-0.05	-0.11	-0.15	-0.25*	-0.21*	-0.11	-0.10	-0.17
<b>Adaptable</b>	0.05	0.04	0.10	-0.04	0.06	0.02	0.15	-0.07
<b>Forward Thinking</b>	0.05	0.01	0.10	-0.02	0.03	0.13	0.06	-0.17
<b>Detail Conscious</b>	-0.08	-0.05	-0.03	-0.06	-0.02	0.02	-0.05	-0.01
<b>Conscientiousness</b>	0.15	0.14	0.09	0.13	0.13	0.20	0.09	0.04
<b>Rule Following</b>	0.01	0.01	0.13	0.01	0.07	0.06	0.13	0.08

\*\* Correlation is significant at the 0.01 level

\* Correlation is significant at the 0.05 level

N=90

## Curve Estimation Analysis

Within this study, curvilinear refers to a quadratic function as research has displayed that this is the most common nonlinear function to find amongst personality and performance relationships. A range of past research studies have found only a quadratic function to exist between personality and performance (Cucina & Vasilopoulous, 2005; LaHuis et al., 2005; Le et al., 2011). Adding to this, Whetzel et al., (2010) found significantly more quadratic relationships than cubic when conducting his comparison of functions for the personality-performance relationship. For this reason, the current study will analyse the linear function in comparison to the quadratic function only as this appears to be the most relevant. There will be 18 relationships analysed in the regression. The results of this regression can be seen in Table 17.

*Table 17. Regression analysis comparing the linear and curvilinear model for the personality and air traffic controller performance (by competency)*

Relationship	Linear (R squared)	Curvilinear (R squared)	$\Delta R$	Function
Optimistic - PA	0.049	0.059	0.01*	Curvilinear
Trusting – CS	0.055	0.065	0.01*	Curvilinear
Vigorous – CS	0.045	0.057	0.012*	Curvilinear
Persuasive – PT	0.062	0.083	0.021*	Curvilinear
Persuasive - PA	0.054	0.061	0.007	Linear
Persuasive – CD	0.059	0.076	0.017*	Curvilinear
Affiliative –RR	0.049	0.049	0	
Socially Confident –RR	0.077	0.084	0.007	Linear
Modest - PT	0.046	0.047	0.001	Linear
Modest – CS	0.056	0.062	0.006	Linear
Modest – CD	0.094	0.098	0.004	Linear
Modest – PLC	0.075	0.075	0	Linear
Modest – RR	0.051	0.058	0.007	Linear
Caring – PA	0.074	0.088	0.014*	Curvilinear
Caring – C	0.093	0.105	0.012*	Curvilinear
Caring – CD	0.068	0.080	0.012*	Curvilinear
Variety Seeking – Cn	0.062	0.081	0.019*	Curvilinear

Variety Seeking – CD	0.046	0.070	0.024*	Curvilinear
N=90				

Inspection of Table 17 shows that some differences do exist between the linear and curvilinear functions for the significant relationships between personality and ATC performance. The  $\Delta R$  column in Table 17 shows the difference in R squared in comparing the fit of the linear with the curvilinear model. The relationships with a red asterisk indicate that some evidence has been found for a curvilinear relationship according to the Whetzel et al., (2010) criteria.

Whetzel et al., (2010) stated that due to multiple different traits being analysed, reliance on statistical significance could mean that type I errors are increased. In order to avoid this issue, it was recommended to define a meaningful curvilinear (nonlinear) relationship using three levels of a specific criteria. (Whetzel et al., 2010). Therefore, this research will apply the criteria set by Whetzel et al., (2010) to determine meaningful curvilinear relationships in the data. Whetzel et al., (2010) defined three different criteria for determining the strength of the difference in fit between the curvilinear and linear models. The goal is to determine the difference in the ‘goodness of fit’ for each relationship and the two functions therefore the change in the R value will be analysed. The first criteria outline that the curvilinear model would need to generate an R value that was 0.05 larger than the linear model ( $\Delta R \geq 0.05$ ) (Whetzel et al., 2010). This would indicate a significant difference in fit between the curvilinear and linear models for the relationships and concludes that the curvilinear function is a better fit for the relationships than the linear function. For a moderate difference in fit, Whetzel et al., (2010) proposed a second criteria of  $\Delta R \geq 0.025$  and then a modest difference being represented by a change in R between the curvilinear and linear of equal or greater than 0.01. The  $\Delta R$  values were calculated by using the formula  $\Delta R = R(\text{curvilinear}) - R(\text{linear})$ .

When applying both the first two criteria for identifying evidence and subsequently accepting a curvilinear relationship, ( $\Delta R \geq 0.05$  and  $\Delta R \geq 0.025$ ), there was no evidence displayed for the curvilinear function being a better fit than the linear function. When applying the third criterion for accepting the presence of a curvilinear function, ( $\Delta R \geq 0.01$ ), there were 10 relationships that showed evidence that a curvilinear function was a better fit for specific relationships. As stated earlier, these relationships are displayed with a red asterisk in Table 17. This displays that under the third criteria (Whetzel et al., 2010), there are 10 relationships that appear to have a better curvilinear fit than linear. Two showed a larger difference than the others with the differences being greater than 0.02 however this still failed to reach the second criterion of  $\Delta R \geq 0.025$ . These relationships were persuasive and planning and time management and variety seeking and contextual decision making. Table 17 also indicates which function each relationship has been deemed to have based on the analyses outlined above.

### **Hypothesis Testing**

Based on the results of the personality data assessment, hypothesis one regarding the presence of response distortion was supported with 17 of the 15 traits showing a significant difference in scores between the high and low stakes conditions.

Majority of the results found through the regression (Table 17) do not support the hypotheses outlined in this study based on the fact that many different significant relationships were found during the initial correlation analysis. Of the traits hypothesised, only the vigorous trait was shown to have a significant relationship with any of the 8 performance competencies. In this case vigorous was found to have a curvilinear relationship with the customer service competencies which does not support the function outlined in hypothesis 11 (which was linear).

While not predicted (and not directly linking back to any hypotheses), many traits did produce significant relationships with the 8 performance competencies. There were 18 significant relationships between personality traits and performance competencies found with the results displayed in Table 20. 10 of these were found to have evidence of a curvilinear relationship with 8 being confirmed linear.

### **Expectancy Tables**

In order to help increase the ability to interpret the personality profiles collected within the air traffic control selection process, expectancy tables have been created for all the significant relationships found between personality traits and performance at the competency levels. This has been said to allow selection decisions to be made with more clarity and also allows justification for selection decisions to be more evident (Cascio, 1977).

Table 18 displays each of the 18 significant relationships at competency performance level along with the percentage of participants that fall above and below satisfactory performance. The New Zealand Air Traffic Control provider have defined 'satisfactory performance' as a score that is 4 or above on the scale shown in Figure 4. To create these expectancy tables, the percentage of participants we would expect to meet this performance expectation given a specific sten score for a trait on the OPQ has been calculated. For example; the relationship between Optimism and Problem Identification and Analysis. The numbers in Table 18 can be used to predict that with a score of 5 for Optimism, we would expect 76.9% of people to achieve above the desired score of 4 for the problem analysis and identification competency whereas a score of 2 or 9 will produce 100% over the performance level. This can allow predictions to be made and help the selection of employees who are going to perform and achieve the required performance level or help to increase certain competencies that may be lacking in the current workforce.

Table 18. Expectancy tables for significant relationships between personality and performance at competency level

Personality Sten Score		1	2	3	4	5	6	7	8	9	10
<b>Optimistic-PA</b>	Below	0%	0%	9.1%	9.1%	23.1%	4.5%	0%	18.2%	0%	0%
	Above	100%	100%	90.9%	90.9%	76.9%	95.5%	100%	81.8%	100%	100%
<b>Persuasive- PA</b>	Below	0%	10%	12.5%	0%	11.1%	14.3%	13.6%	0%	100%	0%
	Above	100%	90%	87.5%	100%	88.9%	85.7%	86.4%	100%	0%	0%
<b>Caring – PA</b>	Below	0%	0%	13.3%	5.9%	5.9%	8.3%	0%	25%	50%	100%
	Above	100%	100%	86.7%	94.1%	94.1%	91.7%	100%	75%	50%	0%
<b>Trusting – CS</b>	Below	25%	0%	15.4%	0%	0%	13.3%	0%	0%	0%	0%
	Above	75%	100%	84.6%	100%	100%	86.7%	100%	100%	100%	100%
<b>Vigorous – CS</b>	Below	0%	0%	0%	0%	11.1%	10%	20%	22.2%	14.3%	0%
	Above	100%	100%	100%	100%	88.9%	90%	80%	77.8%	85.7%	100%
<b>Modest – CS</b>	Below	0%	0%	0%	14.3%	17.6%	8.3%	6.3%	0%	0%	0%
	Above	0%	100%	100%	85.7%	82.4%	91.7%	93.8%	100%	1000%	100%
<b>Persuasive – PT</b>	Below	0%	0%	12.5%	0%	11.1%	14.3%	4.5%	0%	100%	0%
	Above	100%	100%	87.5%	100%	88.9%	85.7%	95.5%	100%	0%	0%
<b>Modest – PT</b>	Below	0%	0%	33.3%	0%	5.9%	8.3%	6.3%	6.7%	0%	0%
	Above	0%	100%	66.7%	100%	94.1%	91.7%	93.8%	93.3%	100%	100%
<b>Persuasive – CD</b>	Below	0%	10%	0%	0%	11.1%	0%	9.1%	0%	100%	0%
	Above	100%	90%	100%	100%	88.9%	100%	90.9%	100%	0%	0%
<b>Modest – CD</b>	Below	0%	0%	33.3%	0%	5.9%	0%	12.5%	6.7%	0%	0%
	Above	0%	100%	66.7%	100%	94.1%	100%	87.5%	93.3%	100%	100%

Table 18 continued.

Personality Sten Score		1	2	3	4	5	6	7	8	9	10
<b>Caring - CD</b>	Below	0%	0%	6.7%	5.9%	0%	8.3%	0%	25%	0%	100%
	Above	100%	100%	93.3%	94.1%	100%	91.7%	100%	75%	100%	0%
<b>Variety Seeking - CD</b>	Below	0%	0%	13.3%	0%	15.4%	0%	11.1%	0%	0%	0%
	Above	100%	100%	86.7%	100%	84.6%	100%	88.9%	100%	100%	100%
<b>Affiliative - RR</b>	Below	0%	0%	8.3%	0%	0%	0%	14.3%	0%	0%	0%
	Above	100%	100%	91.7%	100%	100%	100%	85.7%	100%	100%	100%
<b>Socially Confident – RR</b>	Below	0%	0%	10%	0%	6.3%	7.1%	0%	0%	0%	0%
	Above	100%	100%	90%	100%	93.8%	92.9%	100%	100%	100%	0%
<b>Modest – RR</b>	Below	0%	0%	0%	0%	11.8%	0%	0%	6.7%	0%	0%
	Above	0%	100%	100%	100%	88.2%	100%	100%	93.3%	100%	100%
<b>Modest – PLC</b>	Below	0%	0%	33.3%	0%	5.9%	8.3%	6.3%	6.7%	0%	0%
	Above	0%	100%	66.7%	100%	94.1%	91.7%	93.8%	93.3%	100%	100%
<b>Caring - C</b>	Below	0%	0%	13.3%	5.9%	5.9%	8.3%	9.1%	25%	0%	100%
	Above	100%	100%	86.7%	94.1%	94.1%	91.7%	90.9%	75%	100%	0%
<b>Variety Seeking – C</b>	Below	0%	0%	13.3%	6.7%	23.1%	0%	11.1%	20%	0%	0%
	Above	100%	100%	86.7%	93.3%	76.9%	100%	88.9%	80%	100%	100%

## **Discussion**

The aim of this research was to investigate the validity of personality in predicting air traffic controller performance. Further to this, the shape of the relationship between personality and performance was to be identified, and expectancy tables created to increase the usefulness of the air traffic controller selection process. In order to ensure that the personality data utilised is providing for a valid analysis, the presence of response distortion in the personality data was examined. The discussion first examines the results of the study, specifically looking at the issue of response distortion followed by the personality variables that are important within ATC. After this, research limitations are discussed, as well as range restriction issues, future research, and finally concludes with the theoretical and practical implications of the study.

## **Summary of Results**

### *Response Distortion*

Based on previous research, it was expected that there would be a difference in scores between the low and high stake measures of personality, indicating the presence of response bias (Boyce, 2005; Dilchert et al., 2006; Ellingson & Connelly, 2007; Gordon & Stapleton, 1956). Consistent with hypothesis 1, significant differences were identified at the 0.05 level between the personality scores of the low and high stakes conditions for the majority (17 out of 32) of the personality traits. This indicates that practioners and recruiters need to be very aware of the presence of such bias and the effects that it can have on the outcome of selection processes.

The main effect that response distortion, especially when involved in selection processes, can have is that some applicants distort more than others (Ones & Viswesvaran,

1998). It has been stated that all high stakes condition contain distortion (Dilchert et al., 2006) however if some applicants distort more than others, the distortion will cause unfair advantage and will change the selection outcome (Rosse et al., 1998). By identifying that this distortion may exist, it has allowed the remaining analyses to contain minimal distortion and therefore produce accurate results. For future use of the organisation's selection process, the idea that response distortion could be present in high stakes condition needs to be taken into account.

The first measure of personality was completed at recruitment whilst the second was in the year 2014. The amount of time between these time points is different for all participants. Personality can be altered over time due to experiences and circumstances and Soto et al., (2011) found that different traits increased and decreased with age. Therefore, it cannot be determined whether the finding of differences between this data and the data collected in 2014 was a result of this evolution of personality over time for some participants or whether it was in fact a sign of response distortion. This is important to note, however the personality data from the low stakes point (2014) was used in an attempt to eliminate any response bias that may have existed in the data therefore the results of the regression analysis should not have been effected.

### *Personality variables important to ATC*

Within the beginning phases of this research, both the past validation studies and the ATC job description were used to narrow down what traits were to be the focus of the analyses. A large amount of research was then utilised to determine what function (linear or curvilinear) would be expected from the given relationship. When looking at the results in comparison to the hypotheses outlined earlier in the study, only one personality trait hypothesised to be related to performance was found. This personality trait was the vigorous

trait and only correlated with one performance competency, customer service. The hypothesis related to this trait was only partially supported with a relationship found with customer service but no other competencies. As well as this, the better function was found to be curvilinear, not the hypothesised linear which contrasted research by Little et al., (2011). The remaining hypotheses (2-10) were not supported at all with no significant relationships found between the traits and any performance competency. Surprisingly, in contrast to the results of previous studies (Barrick et al., 2001; Salgado, 1997), conscientiousness was found to have no significant correlations with any of the ATC eight performance competencies.

Although many of the results were not expected or hypothesised, they still provide valuable information for the organisation. There were 18 significant relationships found between the personality traits and performance competencies. Interestingly, many of the relationships were found to be negative between the personality traits and various performance competencies. Some of these relationships are understandable whereas others appear to be unusual and beg the question of whether extraneous variables are involved. Of these, 10 displayed some evidence of the curvilinear function being the better fit using the cutoffs by Whetzel et al., (2010). The remaining 8 significant relationships showed no evidence of a better curvilinear fit therefore were concluded to be linear. Overall, it appears that a curvilinear function is uncommon and when it is found, it is modest. These results do, however, provide a basis for continuing research on the curvilinear function of the personality-performance relationship within air traffic control. Overall, only 9 different traits showed an ability to predict some aspect of air traffic control performance. These traits were optimistic, trusting, vigorous, persuasive, caring, modest, socially confident, affiliative and variety seeking.

It was interesting to find that some performance behavioural indicators were not predicted by personality at all. Also interesting was that a number of the correlations found

when assessing the performance data accuracy did not make sense. For example; there was a negative correlation found between decisiveness and decisions under pressure. As stated above this could indicate the presence of some extraneous factors that may need to be further explored. More interestingly, the entire teamwork competency was not found to be significantly predicted by any of the personality traits. This indicates that there is a small issue with the point-to-point correspondence of the personality measure. Despite this, it is an accepted issue as the OPQ is purely a sub-element of the overall selection process and it is known that teamwork is measured within stage three (the assessment center) therefore it can be cautiously concluded that the process captures all aspects of performance within selection of trainees. In this sense, the OPQ measure alone does not display full criterion related validity as it does not completely match all 8 competencies however it can be concluded that the OPQ shows some evidence of an ability to predict performance within the air traffic control industry.

Many of the traits utilised in the hypotheses revolved around the thinking style and feeling and emotions categories which are very much internal with no traits looking at the relationships with people category. The hypotheses were written based on the organisation's validation studies and the ATC job description, therefore it can be assumed that there is less focus from the organisation on the people relations aspect of air traffic control. On review, six out of the nine traits that did display relationships with some aspect of performance, were from the relationships with people category. This begs the question of whether the air traffic control selection process has not placed enough emphasis on this category when, in fact, it may be hugely influential into the performance of individual ATC's. It is understood that the OPQ is used again within the Assessment Center therefore there is potentially more emphasis placed on the relationships aspects within this section. Despite this, the question remains of

whether the industry not putting enough of its focus on the customer service aspect of performance? A question that is worth exploring.

### **Research Limitations**

As stated throughout the current research study, response bias is common in self-report data, including personality (Paulhus, 1991). This was unavoidable as the only way to measure the independent variable (personality) is to use a personality measure. This was, however, controlled for by completing the personality data assessment (see Table 2) and choosing to use the low stakes personality data set to attempt to avoid these biases. It is almost impossible to remove all response distortion bias within high stakes personality data as it has been said to always be present (Dilchert et al., 2006).

### **Range Restriction Issues**

When inferring information from the results of this study, it is important to consider the large negative skew that existed in the performance data. This skew was unavoidable due to the data being collected from participants that are already employed with the organisation therefore would be expected to have a higher level of performance. There is extensive research regarding correcting for range restriction within the predictor variable (Huy le et al., 2016), however the range restriction exists in the criterion variable for the current study. Even when range restriction in the criterion variable is given attention, Pfaffel et al., (2016) state that indirect range restriction has been considered for a continuous criterion variable but not for a dichotomous or discrete criterion variable (the current study contains a discrete criterion variable). Furthermore, the methods that have been identified are not applicable due to the disregard given to the base rate of success (Pfaffel et al., 2016). Pfaffel et al., (2016) propose to use a missing data mechanism to deal with range restriction in the dichotomous or discrete criterion variable. The two methods are full information maximum likelihood and

multiple imputation (Pfallet et al., 2016). Both these data sets involve an estimation of data in order to generate a complete data set. As the current study is in reasonably new territory (air traffic control), it was decided not to use the estimation technique as outlined in the study by Pfallet et al., (2016). In an attempt to correct for the range restriction, a log transformation was completed however on analysis of the resulting descriptive statistics, the statistics became uninformative and for the purpose of gathering meaningful and useful results, the range restriction was accepted with caution. The range restriction in the performance data is not seen as detrimental to the outcome of the study as looking at just the candidates that were selected is valuable for learning what traits produce high performance despite the evident restricted sample.

### **Future Research**

The current research provides a platform for further research to occur into the relationship between personality and air traffic controller performance. Further research is needed into the nature of such relationships and a more open mind into the possibility of curvilinear relationships is needed in line with the current research direction. The first suggestion for further research looks to correct an aspect of the current study. This suggestion is to obtain performance data that is free of range restriction to avoid any obscure effects that this may be having on the current research such as under or overestimating the strength of the relationships found (Sackett & Young, 2000) or reducing the external validity of the study (Hu Le et al., 2016). In this sense, it would be beneficial to collect performance data from the entire applicant pool and not just those selected. This could be done through an air traffic control simulation test that all applicants are to complete.

Due to the results that not all performance competencies are predicted by the personality measure, future research is required into the specific selection process as a whole

to ensure that performance is being measured in its entirety. This would then allow the overall criterion related validity and point-to-point correspondence to be assessed of the process as a whole.

It would also be beneficial to replicate the study using a more complex measure of performance. Due to current performance measure being solely manager ratings, there can be bias within the data depending on the relationship the manager has with the specific employee including how close they are to observe their performance. In future, it may be useful to use 360-degree feedback to ensure that full coverage of performance is captured which could minimise the effect of proximity of person rating performance. This involves gaining ratings from three different sources of self, manager and peers and when implemented correctly has been said to maximise performance and encourage and aid learning and development (Tee & Ahmed, 2013).

The next suggestion is looking in detail into the combination of traits and how these combinations can predict the performance achieved by a given individual and then also predicting future managerial success. This may be achieved using a combination of two traits and seeing how these interact or by creating complete personality profiles and assessing which are most likely to produce the highest level of performance. Although not specifically involving personality, Wasti (2005) looked at the three types of commitment and generated profiles relating to job outcomes using a cluster analysis. A cluster analysis could be used in this research to identify the personality profiles and how they relate to ATC performance. Specifically looking at leadership effectiveness, Parr, Lanza and Bernthal (2016) looked at how different specified personality profiles predicted leadership performance. A latent class analysis was used to classify the leader sample into groups and then the nature of the

relationship between each of these classified groups were associated with leadership success (Parr et al., 2016). The results found that there is not a 'one size fits all' for leadership profile and personality should be analysed holistically as opposed to by each individual trait (Parr et al., 2016).

Extending upon the managerial personality profiles as mentioned above, the expectancy tables can be utilised to further predict this as they are to be used to predict general ATC performance. For example, research by Judge et al., (2002) showed that conscientiousness and extroversion have a moderate, positive relationships with leadership effectiveness. Developing a measure of leadership effectiveness and replicating the current study (i.e. how personality traits relate to leadership effectiveness and then developing expectancy tables) will allow the selection process to also be able to flag potential future leaders within candidates. This, alongside generating personality profiles as indicated above, would be a beneficial process as the organisation currently have concerns regarding a lack of effective managers/team leaders within the industry (personal communication, 2016).

### **Theoretical and Practical Implications**

From a theoretical stand point, the current research provides important implications. There is a significant amount of research looking at the relationship between personality and a variety of different performance types. Despite this, Whetzel et al., (2010) identified a lack of literature looking specifically for a curvilinear relationship between personality and performance. This research therefore looks to contribute to filling this identified gap and also add to the limited literature on the relationship between personality and performance in the ATC industry. As well as adding to the personality-performance literature generally, the current research has also added to the literature looking at how personality can predict ATC performance (Luuk et al., 2009; Suresh et al., 2012) as well extending into the analysis of the

function of these relationships. The current study acts as an extension of research by Whetzel et al., (2010) in terms of comparing the curvilinear and linear functions and digresses from the research through the use of the air traffic control industry. As a smaller focus of the study, however still a valuable contribution, the evidence of response distortion in the personality data adds to and supports past research done (Boyce, 2005; Ellingson et al., 2007; Gordon & Stapleton, 1956; Hurtz & Alliger, 2002; Ones et al., 2006).

This research also provides a vast number of practical implications. The first acts as a means to widen the scope of the ATC selection process. The 8 personality traits outlined by the New Zealand air traffic control provider as being used within their selection process are controlling, detail conscious, rule following, relaxed, emotional control, decisive, independent minded. These are very much focused on the task performance of ATC which is the effectiveness of the individual at performing tasks that contribute to the overall success of the organisation, normally set in objectives (Borman & Motowidlo, 1993). In doing this, the focus on contextual performance and the large customer service aspect of ATC may have been neglected. Contextual performance involves volunteering to complete tasks that are not outlined in the role or how an individual corporates and helps others (Borman & Motowidlo, 1993). In another attempt to widen the scope, the current research has also introduced the potential for curvilinear relationships to exist. Due to the organisation's validation studies only considering the linear relationship between these traits, some information may be lost or the performance level may decrease as trait score gets higher. Not only this, but it is critical to conduct analysis using the correct function as the performance of the individual or selection decisions can be greatly affected (Converse & Oswald, 2014). The recommendation is for the New Zealand Air Traffic Control provider to also utilise findings from the current

study and begin to accept the existence of curvilinear functions within the personality and ATC performance relationships.

Looking at the current selection process, this research looks to add both validity and reliability to the process and ensure that the correct and high performing ATCs are being selected. Not only this, but due to the fact that this research looked at the relationships of personality with each individual competency, the expectancy tables can be used to compare and contrast applicants based on very specific competencies that may be lacking or required in a team or as a future team leader. The expectancy tables created allow clarity in the prediction of the success of candidates on particular performance competencies but also create an ability to justify any selection decisions made (Casio, 1977). The value of these tables for the organisation is the opportunity for clear emphasis to be put on particular performance competencies that have been identified as lacking in the current workforce. It is important to note that these expectancy tables are based on current employees of the organisation therefore have missed the low performance scoring individuals. There are then clear statistics available indicating what score on specific traits would predict a successful performance in these identified competencies. As a whole, the expectancy tables can be utilised as a selection tool to indicate how likely an applicant is to be successful at the performance competency given a given personality trait which will be useful in comparing candidates within the applicant pool.

The current study has not only supplied a useful selection tool in the expectancy tables, but has supplied a platform for further research into the personality section of the air traffic control selection process and the shape of relationships between these traits and ATC performance.

## **Conclusions**

The results of the current study provide valuable information for future selection of air traffic controllers within New Zealand. The New Zealand air traffic control selection process incorporates the OPQ Personality measure from which a portion of traits were found to have significant correlations with performance aspects and then a portion of these relationships displayed evidence of a curvilinear function. This extends upon past research and indicates that personality does have a place within selection processes and, more importantly, in ATC selection. Not only this, but it opens the eyes of the industry to the feasibility of a curvilinear function of personality and performance which will largely influence selection decisions and increase successful selections.

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## Appendix A. Performance Measure

Table 19. Competencies and related behavioural indicators for Air Traffic Control performance

Competency (2 <sup>nd</sup> Order factor)	Behavioural Indicator (1 <sup>st</sup> Order factor)
Planning and Time Management	<p>Proactively anticipate and avoid potential overloads by using gaps in traffic to plan</p> <p>Solve problems before they become issues</p> <p>Think ahead and prioritise their tasks</p> <p>Plan and achieve an efficient and logical flow of air traffic</p> <p>Maintain a continuous awareness of developing situations, revise their actions and juggle their tasks to account for the changed circumstances</p>
Problem Identification and Analysis	<p>Follow procedures systematically and accurately</p> <p>Complete procedures fully</p> <p>Have high standards of accuracy</p> <p>Deal with errors and take action to ensure that they are not repeated</p> <p>Continually maintain vigilance over accuracy of own work and other relevant parties by checking all information on computer output received for accuracy</p> <p>Recognise mistakes or anomalies quickly</p> <p>Identify air traffic problems and analyse situations in order to produce a safe and efficient solution that best meets the relevant party's needs</p> <p>Investigate the history of a situation as well as assessing the likely outcomes of any actions that are taken</p> <p>Keep the bigger picture in mind</p> <p>Identify alternative solutions</p> <p>Refine and adapt their solutions as situations unfold</p>
Customer Service	<p>Use best judgement within the confines of the rules</p> <p>Give the best possible service to pilots</p> <p>Put effort into generating options in order to find the best solution for a customers needs</p> <p>Go to all lengths to be helpful</p> <p>Develop good public relations with external contacts</p> <p>Be commercially astute and sensitive in dealings with pilots and controllers from other ATS Units</p>
Communication	<p>Communicate information and instructions accurately, clearly and concisely</p> <p>Use standard phraseology</p> <p>Be diplomatic, unemotional and sensitive to cultural and linguistic differences when communicating</p> <p>Be prepared to say "no" and justify their decisions as per operating procedures</p> <p>Complete required documentation in a timely manner</p>

Contextual Decisions

Make quick decisions under pressure  
Be relaxed, calm and collected in all situations  
Absorb and acknowledge information  
Have the cognitive capacity to analyse the whole situation  
Resolve complex problems smoothly  
Make decision that facilitate the overall team's performance  
Weigh up alternatives with regard to safety, customer needs, and relevant laws and regulations

Positive attitude to learning and change

Enjoy learning and want to know more  
Respond positively to new requirements  
Be happy to tackle challenging new tasks  
Keep up to date with system developments, and develop a broad knowledge of it's capabilities  
Respond positively to feedback  
Learn from mistakes  
Ask questions and make suggestions for improving the functioning of systems

Teamwork

Proactively identify opportunities to support others  
Put their hand up to offer help  
Discuss options with colleagues and make suggestions  
Make a positive, vocal and active contribution to the team  
Respect people from all backgrounds  
Create a professional work environment  
Be considerate of others, handing over in an orderly manner, be prompt to relieve colleagues, and aware of their impact on others work

Responsible and Reliable

Be punctual, read briefings and getting an 4 handover before taking over  
Adhere to procedures and regulations  
Identify what needs to be done  
Be willing to do extra tasks to improve things  
Complete what is asked of them  
Embrace the job and remain available to support others if needed