The Impact of Neuroticism on an Individual's Intelligence Scores: A Cross Cultural Study

Khalid Mohamed Elmadani

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Dedication

This Dissertation Is Dedicated To My
Late Father Mohamed, To My Mother
Omsaad and To All My Family

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Abstract

Intelligence scales have become a commonly used method for the prediction of human performance across a variety of occupations and settings. Nevertheless, there is still debate among researchers about whether the results of these scales can be considered an accurate indicator of an individual's true capability or whether they also reflect the impact of personality traits on intelligence scores. Researchers have begun to investigate connections between neuroticism and intelligence scores, but the results of studies are somewhat conflicting and inconclusive. Moreover, it is noteworthy that few studies have considered cross-cultural differences in this relationship, and have systematically examined age and sex differences when explaining the relationship between intelligence scores and neuroticism. To replicate and extend previous work, four independent but related studies were conducted to explore the empirical relationship between neuroticism and intelligence scores, and the mediation effect of sex, age and cultural differences in this association.

Study 1 investigated the psychometric properties of an English version of the Neurotic Behaviour Scale (NBS) among a student population of undergraduate students (N = 177). The NBS is a specifically-designed test by the author to measure the neuroticism trait among the Libyan population. The results confirmed the validity and reliability of using the English version of the NBS for the remaining studies in the thesis. Study 2 examined the relationship between intelligence and neuroticism scores using the Arabic version of the NBS and the Wechsler -Bellevue Intelligence Scale (WBIS) among a sample of Libyan students (N = 75*)*. The findings revealed that while differences between the intelligence scores of the levels of neuroticism scores were not statistically significant, the scaled scores of the high-neuroticism group on the WBIS subtests were more scattered than other groups, and the differences were clinically significant on the Arithmetic, Information and Digit Symbol subtests. In Study 3, the English version of the NBS and the Wechsler Adult Intelligence Scale (WAIS-III) were administered to 77 British students, ages between 16 to 26 years. The main finding of this study was that the effect of the high level of neuroticism on an individual’s performance on the Performance scale of the WAIS-III was higher than its effect on the Verbal scale. Finally, Study 4 provided an aggregated analysis of the data from Studies 2 and 3 to systematically compare the effect of cultural differences in explaining the

relationship between neuroticism and intelligence scores (alongside age and sex differences). The results revealed that while sex and age differences in students' neuroticism scores were similar across Libyan and British samples, there were differences in the relationship between neuroticism and intelligence scores across the two cultures. Findings are evaluated in light of recent empirical and theoretical developments relating to neuroticism and intelligence.

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CHAPTER 1 Introduction

1.1 Study Background

The purpose of this chapter is to outline the contribution in the current thesis and to illustrate the importance of examining the links between neuroticism and intelligence scores across different cultures. It also aims to illustrate the need to examine the possible mediation of sex and age in this association. It will argue that personality and intelligence are two core individual difference domains (Bonaccio & Reeve, 2006) and that the use of personality and IQ tests has become well established and a commonly used method for recruitment and the prediction of human performance across a variety of occupations and settings (Chamorro-Premuzic, 2003; Maltby, Day, & Macaskill, 2007; Manktelow & Lewis 2005; Neisser et al., 1996). Nevertheless, there is still debate among cognitive researchers about the extent to which intelligence tests can be considered a pure measure of intelligence, and whether the results of these tests can be considered an accurate indicator of an individual's true capability or whether they also reflect the impact of non-cognitive factors on intelligence scores.

Cognitive researchers have not reached an agreed statement about the importance of non-cognitive factors, such as personality traits, in explaining an individual's performance on intelligence tests. Moreover, researchers (e.g., Costa et al., 2000; Lynn & Irwing, 2008; McCrae et al., 1999; McCrae, 2001a) have argued that other variables, such as sex, age, and one's cultural background, may provide better explanations for individual differences in intelligence and neuroticism scores. However, there is a general lack of agreement regarding those factors that might play an important role in influencing an individual's level of neuroticism and intelligence. Therefore, the role of personality traits in intelligence scores, and the role of sex, age, and culture in explaining the relationship between intelligence and personality scores require further detailed examination. The following sections of this chapter are presented in three sections: to explore the link between personality and intelligence scores (1.1.1), the role of sex and age differences in explaining differences in personality and intelligence (1.1.2), and, finally, the importance of cross-cultural differences in describing changes in personality and intelligence scores (1.1.3).

1.1.1 Personality and Intelligence Scores

Theories of personality presented by Cattell, Eysenck, and Costa and McCrae are considered to be some of the most important and influential studies in the field of personality traits. However, while there is some distinction among these theories with regard to the number of personality traits and meaning of different personality factors, all theories are in agreement that neuroticism forms an important basic dimension of personality (Bargeman et al., 1993). Neuroticism has been defined as "a broad dimension of individual differences in the tendency to experience negative, distressing emotions and to possess associated behavioural and cognitive traits" (Costa & McCrae, 1987, p. 301). The dimension of neuroticism encompasses all individuals; differences between people are of degree, not type (Ellenbogen & Hodgins, 2004).

The importance of personality traits in explaining individual differences in intelligence scores has received much support. For instance, Wechsler (1950, 1975) argued that intelligent behaviour requires specific mental factors (e.g., abstract reasoning, visual and auditory perception, speech flow, general memory and place memory), but also requires other necessary factors, which he called non-intellective factors, such as disinterest, impulsion, and personality traits. More recently, many researchers have argued that non-cognitive factors, such as personality traits, play an important role in the development of adult intellectual competences (Ackerman & Beier, 2003; Ackerman & Heggestad, 1997; Chamorro-Premuzic, 2003; Chamorro-Premuzic, Furnham, & Ackerman, 2006; Chamorro-Premuzic, Furnham, & Petrides, 2006), and that the performance of individuals on IQ tests may be influenced not only by their abilities but also by their personality traits (Ackerman & Heggestad, 1997; Moutafi, Furnham, & Paltiel, 2005; Moutafi, Furnham, & Tsaousis, 2006).

Therefore, many researchers have attempted to demonstrate how intelligence and personality traits are empirically related. Those researchers have, however, found conflicting results. For instance, while several researchers (e,g., Ackerman & Heggestad, 1997; Austin et al. 2002; Chamorro-Premuzic, Furnham, & Ackerman, 2006; Escorial, Garcia, Cuevas, & Juan-Espinosa, 2006; Lounsbury, Welsh, Gibson, & Sundstrom, 2005) have found evidence of a negative relationship between neuroticism and intelligence scores as measured by various mental ability scales (e. g., vocabulary, spatial, abstract reasoning, fluid intelligence and crystallised intelligence), other

researchers (e.g., Baker & Bichsel, 2006; Di Fabio & Palazzeschi, 2009; Furnham & Monsen, 2009; Holland, Dollinger, Holland, & MacDonald, 1995) have failed to support this relationship. Another perspective argues that the relationship between neuroticism and intelligence is not a direct relationship but it is mediated by test anxiety, which has negatively impacted upon the performance of participants on intelligence measures (Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006). The conflicting results from previous studies suggest that the relationship between neuroticism and intelligence is not clear, and therefore requires further investigation.

1.1.2 Role of Sex and Age Differences in Personality and Intelligence

There is now growing evidence to support the claim that sex and age differences play an important role in explaining individual differences in both neuroticism and intelligence scores (e.g., H. Eysenck & Eysenck, 1991a; S. Eysenck, Barrett, & Barnes, 1993; Furnham, Rawles, & Iqbal, 2006; Rubinstein & Strul, 2007). However, the findings from previous studies have continued to show conflicting results. For example, while several researchers (e.g., H. Eysenck & Eysenck, 1991a; S. Eysenck et al., 1993; Furnham et al., 2006; Lewis & Maltby, 1995) have concluded that neuroticism scores among females remain significantly higher than neuroticism scores among males, other researchers (e.g., Abdullatief, 1990; Rubinstein, 2005) have failed to support this conclusion. Moreover, there are contradictory findings with regard to the role of age in neuroticism scores. It is believed that levels of neuroticism among individuals do not remain stable with age, but vary over time. For example, the highest level of neuroticism scores appears during adolescence (H. Eysenck & Eysenck, 1991a; Schultz & Schultz, 2005), and that this decline in neuroticism scores begins at almost the age of 18 (McCrae, 2001a; 2001b) for both males and females (McCrae et al., 1999). However, age differences in individuals' neuroticism scores have not been found by other researchers (e.g., Aboalniel & Doosoki, 1986; Elmadani, 2001).

The role of sex and age differences in explaining intelligence scores was also found to be unclear. Researchers studying intellectual abilities have not agreed about the importance of age and sex differences in intelligence scores. Some of them have reported that the performance of individuals on tests that measure fluid abilities, such as

the Performance Scale of the Wechsler Adult Intelligence Scales (WAIS), tends to decline with age (Tucker-Drob & Salthouse, 2008), and that performance on tests measuring crystallised abilities, such as the Verbal Scale of WAIS, tends to increase with age (Kaufman & Horn, 1996). However, the findings are unclear, as several researchers have also failed to identify any age-related differences in individuals' fluid abilities (Moutafi, Furnham, & Crump, 2003) or crystallised abilities (Shuttleworth-Edwards et al., 2004). Similarly, whereas researchers (e.g., Furnham & Monsen, 2009; Lynn & Dai, 1993; Rushton, Cvorovic, & Bons, 2007) supported the advantage of males in general intelligence, the findings of other researchers (e.g., Holland et al., 1995; Maleka, 1996) have not found sex differences in general intelligence. Moreover, sex and age differences were found to have an interaction in influencing intelligence scores (Lynn & Irwing, 2008). These conflicting results offer good evidence about the importance of further investigation into the effect of sex and age differences and the interaction between both sex and age variables in intelligence scores. The effects of sex and age differences in personality traits and intelligence lead to predictable differences in leisure behaviour, occupational performance, and health-related outcomes of men and women of all ages (Schmitt, Realo, Voracek, & Allik, 2008).

It is argued that a clearer understanding of how age and sex differences may influence both neuroticism and intelligence scores is required. A further contribution of the current thesis is to see how these variables may influence the relationship between intelligence scores and neuroticism within the same population (and across cultures). Indeed, there is considerable research evidence to identify a strong relationship between sex and age differences in an individual's neuroticism and intelligence test scores, (e.g., Ackerman & Heggestad, 1997; Di Fabio & Palazzeschi, 2009; Furnham & Monsen, 2009). However, despite studies that have investigated the relationship between neuroticism and intelligence test scores, very few have considered sex and age differences in explaining the relationship between neuroticism and intelligence. There is some evidence suggesting that the relationship between neuroticism and intelligence scores is stronger among males than among females (Jorm et al., 1993; Lynn, Hampson, & Magee, 1984), and age differences have been found to influence or mediate the relationship between neuroticism and intelligence scores (Moutafi et al., 2003). Therefore, given the conflicting results, the precise role age and sex differences in

explaining the relationship between neuroticism and intelligence scores requires further consideration.

1.1.3 Cross-cultural Differences in Personality and Intelligence Scores

It is argued that cultural diversity may play an integral role in explaining the possible differences in neuroticism and intelligence scores. Cross-cultural research on cognitive abilities highlights some interesting cultural differences in many cognitive processes including perception, attention, numerical abilities, and problem-solving. Researchers attributed these differences to the variations between cultures in terms of education (Matsumoto & Juang, 2008), technology (Greenfield, 1998), and economy (Rushton & Čvorović, 2009). Alongside, the role of culture on neuroticism scores has been supported by researchers who have investigated the role of cultural differences on neuroticism scores and the cultural variations in sex and age differences in neuroticism scores (c.f., Costa et al., 2001; Eysenck et al., 1993; Lynn & Martin, 1997; McCrae & Terracciano, 2005). Therefore, a central argument put forward in this thesis concerns the need to examine cross-cultural differences in the relationship between neuroticism and intelligence scores, and in the magnitude of sex and age differences in neuroticism and intelligence scores.

Most previous studies (e.g., Lynn, 1981; Lynn & Martin, 1997; J. T. Nijenhuis & VanderFlier, 1997; Rushton, Skuy, & Fridjhon, 2002) have found differences in neuroticism and intelligence scores across different cultures. Costa et al. (2000) argued that age differences in personality scores appeared to reflect maturational changes rather than cohort differences; men and women became more emotionally stable, more socially independent, more conventional, and goal-directed. Most of these changes are socially desirable; therefore, "different environments might be expected to give rise to different patterns of adult [males and females] development" (Costa et al., 2000, p. 237). Aligned with this, patterns of age differences in neuroticism scores were not found to be similar in British and German samples (Donnellan & Lucas, 2008).

The effectiveness of cultural differences in neuroticism scores was assumed not only in the pattern of age differences, but also in the magnitude of the level of neuroticism and sex differences in neuroticism scores. Lynn (1981) reported that the level of

neuroticism in developing countries is higher than the level of neuroticism in advanced Western countries; and this was because stress, which is an important factor in neuroticism, may arise from different sources including political, social and economic instability. Lynn argued that life in the advanced Western countries is relatively unstressful compared with other countries. Moreover, Costa, Terracciano, and McCrae, (2001) argued that cultures differ in the degree to which sex roles are emphasized, which should lead to differences in personality traits. As a result, sex differences in personality traits might be greater in developing countries (Matthews, Deary, & Whiteman, 2003), where differences in norms for sex roles are generally larger and there is less equality between the sexes (Lynn & Martin, 1997). However, the claim that cultural differences in neuroticism scores simply reflect the differences between developing and advanced countries in the term of level of stress may not be an accurate explanation for cultural difference in neuroticism. Stress may also arise from sources other than those mentioned by Lynn (1981). For instance, stress may arise when individuals are unable to create the necessary conditions for obtaining their goals (Hobfoll, 1998). Therefore, cultures may differ in term of stress sources rather than the degree of stress (Aldwin, 2007).

While many researchers have argued that sex differences (Furnham & Monsen, 2009; e.g., Rushton et al., 2007) and age differences (e.g., Moutafi et al., 2003; Tucker-Drob & Salthouse, 2008) are important predictors of individual differences in intelligence scores, very few studies have explicitly examined the magnitude of sex and age differences in intelligence scores across different cultures (c.f., Lynn & Irwing, 2008; Tsushima & Bratton, 1987). Therefore, the role of cultural differences in the magnitude of age and sex differences in an individual's intelligence scores remains unclear and requires further investigation.

As will be identified in chapter 2, there is growing support for the identification of cross-cultural differences in explaining the relationship between neuroticism and intelligence scores. Previous researchers (e.g., Chamorro-Premuzic, Furnham, & Petrides, 2006; Demetriou, Kyriakides, & Avraamidou, 2003; Di Fabio & Palazzeschi, 2009; Holland et al., 1995; Moutafi et al., 2006; Stough et al., 1996) have found differences in the relationship between neuroticism and intelligence scores in different cultures, and such findings have contributed to our understanding with regard to the

possible moderation of the cultural background of participants in the relationship between neuroticism and intelligence scores. Thus, how we understand the relationship between neuroticism and intelligence scores would be different across cultures. Previous researchers have not investigated this assumption, and the current work, therefore, will examine whether the cultural background of individuals can be considered as a moderator variable in the relationship between neuroticism and intelligence scores.

In summary, there are two important limitations within previous work that needs to be addressed within the current thesis. Firstly, most of the previous studies were aimed at investigating the magnitude of the relationship between cognitive abilities and the neuroticism trait using a wide range of cognitive ability tests and personality measures. As a result, it was difficult to obtain consistent and replicable results on correlations. Stough et al. (1996) suggested that because many tests of cognitive abilities may share only a 30–40 per cent common variance when correlated, if personality traits do not correlate with a specific test of intelligence, they may still correlate significantly with another test. Therefore, the best approach is to use a range of intelligence tests that cover a wider range of abilities (Escorial et al., 2006; Stough et al., 1996). Wechsler intelligence tests were designed to measure a wider range of cognitive and non-cognitive abilities in addition to the general factor of intelligence 'g' (Wechsler, 1975). The numerous subtests of the WAIS provide an extensive understanding of the overall intelligence of the individual, as well as their particular strengths and weakness (Maltby et al., 2007). Therefore, the WAIS is widely used by psychologists in evaluating cognitive performance (Greve, Bianchini, Mathias, Houston, & Crouch, 2003; Huffman, 2004). Nonetheless, studies that have utilized the entire WAIS to investigate the relationship between intelligence and personality traits were limited. The author therefore will use two versions of the WAIS in this thesis.

Secondly, the majority of previous work used scales that measure a wide variety of personality traits, such as the Fifteen Factor Questionnaire (comprises 200 items measuring 15 personality traits), and therefore often overlooked more detailed explanations of individual personality traits. For example, if a questionnaire fails to include many items that clearly tap into measures of neuroticism, then the description of neuroticism that is studied by researchers will be narrower (c.f., Maltby et al., 2007).

Other studies (e.g., Chamorro-Premuzic, Furnham, & Petrides, 2006) used scales consisting of a large number of items to measure one particular personality trait (e.g., the Eysenck Personality Profiler [EPP], which comprises 420 items measuring the three specific personality dimensions), then a clearer and more robust definition of these specific personality traits will be captured, and might be very difficult to answer in one session. Elmadani (2001) suggested that to avoid these two difficulties, personality traits can be separated from each other during testing, and to create new detailed measures of each personality trait. This will provide measures for each trait consisting of a brief number of items that covers all the trait components and can be answered in one session. Thus, a new scale, the Neurotic Behaviour Scale (NBS), was prepared (Elmadani, 2001), consisting of 39 items which measure the neuroticism trait separately from other personality traits. The NBS will be used in this thesis.

1.2 Aims of the Thesis

The thesis investigates the relationship between neuroticism and intelligence scores among two different cultures: British and, for the first time, Libyan. It also aims at extending the findings from previous studies by examining the possible mediation of age and sex differences in this relationship. The unique contribution in the current thesis is to examine the role of cultural differences between Libya and Britain on the relationship between neuroticism and intelligence scores and on the magnitude of sex and age differences in neuroticism and intelligence scores. Moutafi et al. (2005) believed that this kind of study is important because:

> It has important implications in the applied field of psychology. Both personality and intelligence are individually used as predictors of different types of performance, such as academic and job performance … Therefore, the understanding of the underlying relationship between these two constructs can be used to improve their predictive validity, and shows that it would be most useful to use both measures in conjunction instead of either individually. (p. 1031)

1.3 Research Questions

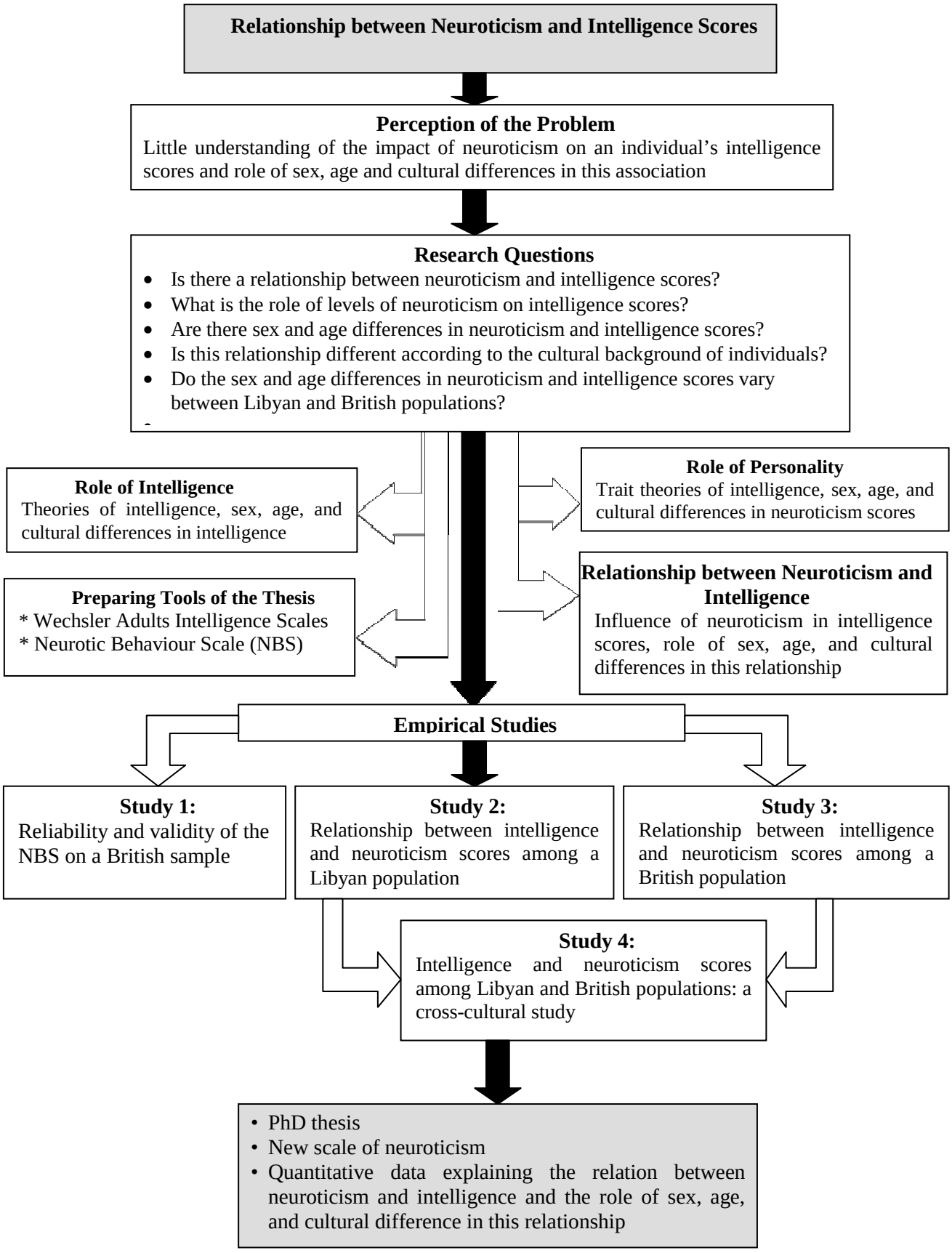
The thesis addresses five research questions designed to provide a more comprehensive understanding of the links between personality, neuroticism, and intelligence scores among British and Libyan populations. The following five research questions are addressed:

1. Is there a relationship between neuroticism scores and intelligence scores after the contributions of age and sex have been taken into account?
2. Does students' performance on the Wechsler adult intelligence scales and subtests differ according to their sex, age, and levels of neuroticism?
3. Are there sex and age differences in the Libyan and British students' neuroticism and intelligence scores?
4. To what extent does the relationship between neuroticism and intelligence scores and the effect of sex and age on this relationship differ between the Libyan and British samples?
5. To what extent do the differences in neuroticism and intelligence scores among the Libyan sample differ from the differences in neuroticism and intelligence scores among the British sample, according to the variables of sex, age, and level of neuroticism?

1.4 Pictorial Representation of Outline and Steps of Thesis

Figure 1 provides a pictorial representation of the outline in the current thesis. The thesis will examine the relationship between neuroticism and intelligence, and investigate the role of sex, age, and cultural differences in explaining this relationship between neuroticism and intelligence scores. The thesis includes a literature review, followed by four main studies, each of which is designed to examine the relationship between neuroticism and intelligence scores across two different cultures.

Figure 1 Outline and steps of thesis



1.5 Chapter Summary

It is argued that whilst intelligence tests have become well established and a commonly used method for understanding and predicting the behaviour and performance of individuals across a variety of purposes, there are inconsistencies with regard to the relationship between intelligence and personality traits. It has also been suggested that the relationship between personality traits and intellectual abilities might be a factor affecting performance on personality and IQ tests (Ackerman & Heggestad, 1997; Moutafi et al., 2005; Moutafi et al., 2006; Wechsler, 1975; Zeidner & Matthews, 2000). Using the psychometric approach, many researchers have examined the relationship between personality traits, in particular neuroticism and intelligence scores. Consequently, a number of points have been observed. Firstly, the results among many studies were conflicting. Secondly, the roles of sex, age, and cultural differences in this relationship have not received much attention, despite their relevance. Thirdly, most previous studies were largely based on samples that derived from Western and Asian populations; the Arabic culture has not received much attention, although it differs greatly from the Western and Asian cultures in terms of language, religion, economy, gender roles, interests, and customs, all of which may vary significantly (Hofstede, 2001; Keddie, 2007). Finally, relatively few researchers have utilized the entire WAIS-III test to investigate the relationship between intelligence and personality traits, although it was designed to measure a wider range of cognitive abilities in addition to general intelligence, and is considered to be the most widely used intelligence test. The current work, therefore, further examines the relationship between neuroticism and intelligence scores and the role of sex, age, and cultural background in explaining this relationship across two different cultures, using the third edition of the Wechsler Adult Intelligence Scale (WAIS-III) and, for the first time, a new scale of personality measuring only the neuroticism trait.

It was also argued that while personality and intelligence remain as two core individual domains, there may be some degree of overlap across the two variables, but at present there is no agreed understanding with regard to those shared factors that might influence scores on neuroticism and intelligence scales. While many researchers (e.g., Costa et al., 2000; Lynn & Irwing, 2008; McCrae et al., 1999; McCrae, 2001a)

have presented sex, age, and cultural differences as possible explanations for accounting for individual differences in both intelligence and neuroticism scores, other researchers have failed to find any role for age or sex differences in explaining individual differences in either intelligence scores (e.g., Crawford, Gray, & Allan, 1995; Holland et al., 1995; Shuttleworth-Edwards et al., 2004) or personality scores (e.g., Elmadani, 2001; Rubinstein, 2005; Schmitt et al., 2007). Thus, the extent to which age and sex differences may explain individual differences in both neuroticism and intelligence scores remain relatively unclear and require further investigation. This thesis will therefore investigate the specific nature of both sex differences and age differences in explaining individual differences in neuroticism and intelligence scores, and also investigates the role of cultural differences between Libya and Britain on the magnitude of both sex differences and age differences in neuroticism and intelligence scores.

Chapter 2 will provide a more detailed summary of previous theory and research concerning intelligence and neuroticism, before considering the importance of examining the role of age and sex differences when explaining individual differences in neuroticism and intelligence scores across cultures.

CHAPTER 2: Literature Review

2.1 Introduction

This chapter will critically outline alternative theories of intelligence and personality and illustrate how further research is needed to examine the role of sex and age differences in explaining individual differences in both personality and intelligence scores across different cultures. It will demonstrate how researchers in the field of human intellectual abilities and personality traits have yet to reach total agreement on the role of age, sex and cultural differences in personality traits and intelligence scores. This chapter will argue that previous research has failed to provide an agreed statement about the role of personality traits, particularly neuroticism, and how this particular trait may influence an individual's performance on intelligence tests. The chapter will begin by summarising key theories and approaches to explaining intelligence before summarising the key literature of personality (and neuroticism). Finally, the chapter will review previous literature to establish the importance of age, sex and cultural differences in explaining the relationship between both intelligence scores and personality traits (specifically neuroticism).

2.2 Role of Intelligence

Researchers who have studied the development of cognitive abilities have not reached agreement about the importance of age, sex and cultural differences in the performance on intelligence tests. Some researchers argue that the performance of individuals tends to increase with age on tests that measure crystallised abilities (e.g., Kaufman & Horn, 1996), and that performance on tests measuring fluid abilities tends to decline with age (e.g., Tucker-Drob & Salthouse, 2008), and that the general intelligence scores of males tend to be higher than females (e.g., Deary, Irwing, Der, & Bates, 2007; Dykiert, Gale, & Deary, 2009; Furnham & Monsen, 2009; Lynn & Dai, 1993; Rushton et al., 2007), However, findings of other studies did not confirm these results either for age differences in individuals' fluid abilities (e.g., Moutafi, et al., 2003) or crystallised abilities (e.g., Shuttleworth-Edwards et al., 2004) or for sex differences (e.g., Holland et al., 1995; Maleka, 1996). Therefore additional research is needed to examine the role of age and sex differences in an individual's intelligence

scores. These conflicting results highlight the importance of further investigation into the effect of sex and age and the interaction between sex and age in individuals' scores on intelligence tests. The effects of sex and age differences in intelligence lead to predictable differences in school performance and occupational performance of men and women at all ages (Schmitt, Realo, Voracek, & Allik, 2008).

There is further evidence to suggest that different cultures have found fundamental differences in general intelligence scores (Lynn & Vanhanen, 2006; Rushton & Čvorović, 2009). However, other researchers (Tsushima & Bratton, 1987) found that cultural differences may just relate to differences on specific sub-scales such as Verbal subtests of the Wechsler Adult Intelligence Scales (WAIS). Furthermore, the interaction between sex, age and cultural differences in influencing intelligence scores has not received much attention from researchers in the field of intellectual behaviour. Therefore, the current thesis was designed to build on such findings to examine the importance of age and sex differences in intelligence scores across cultures, and to examine the extent to which sex and age differences in intelligence scores affected by cultural differences between Libya and Britain.

2.3 Definition and Theories of Intelligence

The term 'intelligence' is commonly used in everyday life, despite a lack of agreement between either laypeople or psychologists on its actual definition. Thus, there have been many definitions of intelligence, which reflect the variety of the theoretical backgrounds of authors. Sternberg (1985) summarized the findings of a symposium titled "Intelligence and its Measurement", published in the Journal of Educational Psychology in 1921, where fourteen experts offered definitions of intelligence. Sternberg (1997) classified the most common elements in the proposed definitions into three groups (a) higher level abilities including abstract thinking, mental representation, problem solving, and decision making; for instance, 'intelligence is the ability to carry on abstract thinking' (L. Terman) (b) the ability to learn, such as 'intelligence is the ability to acquire abilities' (H. Woodrow), and (c) adaptation to meet the demands of the environment effectively; an example for this context is that 'intelligence is a general capacity of an individual consciously to adjust his thinking to new requirements' (W. Stern).

It is argued that an important theme in many definitions of intelligence over the years has been that of adaptation (Sternberg, 1997). For example, Huffman (2004) defined intelligence as "a general capacity to profit from experience, acquire knowledge, and adapt to changes in the environment" (p. 299). Intelligence, according to Demetriou et al. (2003), refers to the "abilities underlying knowledge acquisition, understanding, and learning that enable the person to cope with the changing demands of the world" (p. 548). Similarly, Sternberg et al. (2000) defined intelligence as "the ability to adapt flexibly and effectively to the environment" (p. 11). Adaptation is also the main theme in David Wechsler's definition, where "Intelligence is the capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (Wechsler, 1997, p. 1).

Differences between these definitions of intelligence are more related to detail than substance; each one includes a description of parts of intelligence (Nettelbeck & Wilson, 2005). The definition that is regarded as one of the most influential definitions is Wechsler's definition (Colman, 2006), and this because Wechsler in his definition of intelligence combines between cognitive and non-cognitive factors in intelligence. Wechsler (1950) argues that intellectual factors such as abstract reasoning, numerical, and working memory are required for intelligence behaviour as well as non-intellective factors such as personality traits. In addition, Wechsler did not only provide a theory about intelligence, but also provided an objective measure of intelligence, which was designed in light of his definition. Wechsler's tests of intelligence enable us to obtain separate verbal and performance IQs in addition to the general IQ score. As the current study uses the Wechsler Adult Intelligence Scales (WAIS), the researcher adopts Wechsler's definition of intelligence in this thesis. While this chapter does not aim to provide a comprehensive account with regard to the concept of intelligence, it will provide some background information concerning theories of intelligence in order to examine the relationship between personality and intelligence scores.

2.3.1 Charles Spearman: Theory of General Intelligence (g)

Spearman (1923) proposed that intelligence comprises two kinds of factors: a general factor and specific factors. The general ability or 'g', which is perceived to be the most important, is required for performance on intelligence tests of all kinds, while

each specific ability or ‘s’ is required for performance on one type of mental test. Spearman based his theory on his observation when he examined data on many cognitive abilities, using a diversity of tests, and found that there were positive correlations between these tests. On the basis of Spearman’s theory, performance of an individual on tests that measure a specific ability depends on both factors: ‘g’ and ‘s’ (Sternberg et al., 2000). Spearman did not specify the number of specific abilities ‘s’ that make up general intelligence (Sundin, 2010). Nonetheless, the general ability factor ‘g’ has become the most important statistical variable in the psychology of individual differences; it represents the most powerful predictor of formal education, marital choice, professional success and political conceptions (Chamorro-Premuzic, 2003).

2.3.2 Multifactor Theory: L. Thurstone

Thurstone (1938) agreed with Spearman’s hypothesis of a general factor of intelligence. However, he argued that the general factor is a second order factor; therefore the importance of this factor is not so large. The important factors, according to Thurstone, are what he termed primary mental abilities. Thurstone (1938) proposed that intelligence comprises approximately seven primary mental abilities: verbal comprehension, word fluency, number skill, spatial visualisations, perceptual speed, associative memory, and reasoning. Thurstone’s theory of intelligence postulates that general intelligence is the result of these seven different aspects of intelligence (Sternberg, 1985). Thurstone was the first who suggested that there were a number of factors to intelligence, rather than just one or two factors. However, conclusion of this theory has been reached by the result of factor analytic studies of tests scores; as such, it is limited by the nature of the instruments used to assess various abilities (Gardner, 2006a).

2.3.3 Raymond Cattell’s Theory

Raymond Cattell (1971) agreed with Spearman’s view with respect to general intelligence ‘g’, but suggested that there are two types of ‘g’, namely: fluid intelligence and crystallised intelligence. Fluid intelligence (gf) refers to the ability to solve abstract relational, acquisition of new information, and to reasoning abilities and memory. According to Cattell’s theory, fluid intelligence is not influenced by the environment and education, it is dependent on the efficient functioning of the central nervous system

(Chamorro-Premuzic, 2003), and therefore tends to decline with age (Kaufman & Horn, 1996; Tucker-Drob & Salthouse, 2008). In contrast, crystallised intelligence is a product of environmental variation and depends on information and skills that are acquired through experience and education within a culture, and therefore tends to increase with age as knowledge and experience increase (Cattell, 1963; 1971).

Eysenck (1995) argued that tests of fluid ability (gf) are usually timed and that tests of crystallised ability (gc) are usually untimed. He also suggested that the Wechsler verbal subtests could be used as measures of (gc) and performance subtests as measures of (gf). Maltby et al. (2007) reported that Wechsler tests measure crystallised intelligence because they contain scales such as vocabulary, information and comprehension. Fluid and crystallised factors are wide enough to represent the concept of intelligence and involve abilities that are important in determining intelligence. However, each factor differs from the others when viewed developmentally and psychometrically and in represents a definite concept of intelligence. Thus, Cattell's theory characterises several distinct forms of intelligence, rather than a unitary theory of intelligence (Horn, 1991).

2.3.4 Robert Sternberg's Theory of Successful Intelligence

Sternberg introduced the term *successful intelligence* to describe the ability to realise one of three functions: (a) adaptation to environment, which refers to one's ability to change oneself to suit the environment in which one lives; (b) shaping of environment, which refers to one's ability to change the environment to suit oneself; and (c) selection of environment, which refers to the ability to find a new environment when the individual failed to achieve the two previous functions. The successfully intelligent person is able to carry out all the three functions when necessary (Sternberg, 1985; Sternberg et al., 2000).

Sternberg et al. (2000) argued there are three broad aspects of intelligence that are important to successful intelligence: analytic intelligence, creative intelligence, and practical intelligence. Analytic intelligence refers to the ability to analyse and evaluate information, and comparison skills. Creative intelligence refers to the ability to discover, invent, and generate novel and interesting ideas, and imagination skills. Practical (or everyday) intelligence refers to the ability to implement and utilise ideas; it

is involved when intelligence is applied in everyday life. These aspects of intelligence are learned; therefore, each can be improved (Sternberg et al., 2000). Furthermore, an individual tends to have a stronger aptitude for one or more of these aspects of intelligence. The value of this theory is that it emphasises the importance of applying mental abilities to real world situations rather than testing mental abilities in laboratories (Huffman, 2004). Sternberg, however, does not describe the particular contents with which intelligence operates. That is, it is irrelevant to his theory whether a person is processing words or pictures or bodily information or material from the personal or natural world. Rather, he supposes that the same components will operate irrespective of the kind of material that is being processed (Gardner 2006a).

2.3.5 Howard Gardner: Theory of Multiple Intelligences

Gardner and Sternberg reject the focus on the general intelligence 'g' that is measured by a short answer test. Both researchers agree that intelligence involves multiple independent abilities. Gardner (2006a) for example suggested that there were nine distinct intelligences: (1) linguistic: language skills as intelligence of orator, and journalist, (2) logical-mathematical: numerical skills as intelligence of mathematician, scientist, (3) musical: ability to generate, perform and value music, (4) spatial: ability to form mental images, and to operate those mental images such as intelligence of engineer, surgeon and chess player, (5) bodily- kinaesthetic: ability to use the whole body such as intelligence of athletes, surgeons and actors, (6) interpersonal: ability to understand other people, which important for people in business, teachers clinicians, and almost all careers, (7) intrapersonal: ability to understand oneself such as intelligence of salesperson, therapist and teacher, (8) naturalistic: ability to interact with nature, such as intelligence of biologist and naturalist, (9) existentialist: Gardner calls this kind of intelligence the 'intelligence of big questions'; it refers to the sensitivity and ability to understand deep questions about human existence, such as the meaning of life, and why do we die.

Although Gardner (2006b, 2006c) critiqued the idea of the general factor "g", he reported that "g" is possibly a mixture of linguistic and logical intelligence with some component of spatial intelligence. However, he argued that 'g' is, in fact, a measure of certain attributes that are valued in Western countries, such as speed of response,

flexibility of response, and motivation to succeed in tests. Therefore, most tests of intelligence focus on logical and linguistic intelligence. He refused to measure intelligence through some paper and pencil task; instead, he suggested that all kinds of intelligence can be measured through directly looking at activities, asserting that: "spatial intelligence is most properly examined by seeing how individuals navigate an unfamiliar terrain, while interpersonal intelligence is most properly examined by seeing how individuals negotiate with other persons" (Gardner, 2006c, p. 504).

Gardner (2006b) affirmed that these forms of intelligence are independent and that the value of them may change according to one's culture. He also reported that although all individuals have these forms of intelligence, no two individuals have exactly the same profile of intelligence, not even identical twins (Gardner, 2006a). Gardner's theory has captured the interest of educators; he challenges education systems to present material in variety of learning modes rather than the traditional linguistic and logical-mathematical (Huffman, 2004). However, Gardner's theory does not provide a scientific method that can be trusted and validated to measure these abilities. Indeed, Gardner (2006a) refused to measure these abilities through paper and pencil tasks that come up with a single IQ score; instead, he suggested that all kinds of intelligence can be measured through directly looking at activities. Thus, there is no scale or fixed standards from which to assess these abilities by more than one assessor. Therefore, the outcome of this kind of assessment would be dependent on the abilities of the assessor.

2.3.6 Wechsler and Non-intellective Factors in General Intelligence

Previous research by Spearman, Thurston and Cattell focused on intellectual abilities; they considered that intelligence was the result of an individual's performance on these abilities. Wechsler (1975) however rejected this orientation and argued that intelligence cannot be equated with intellectual ability nor a kind of cognitive ability; furthermore, he postulated that tests of intelligence were not the same as tests of mental abilities. Wechsler (1950) discussed intellective factors of intelligence, such as abstract reasoning, numerical, and working memory, arguing that these were specific requirements for intelligent behaviour, but they do not determine it alone. Intelligent behaviour also required other necessary factors which he called *non-intellective* factors in general intelligence. These factors included all affective and conative abilities which

are part of global behaviour, such as disinterest, impulsivity, emotional stability, and "relate to an individual's potential to perceive and respond to social, moral, and aesthetic values" (Wechsler, 1975, p. 136). He argues that intellectual factors are required for intelligence behaviour as well as non-intellective factors such as emotional stability.

Wechsler's (1975) theories were supported by two main considerations. Firstly, most factor analysis studies of intelligence have a large residual correlational variance without interpretation, which may comprise of 40 % to 60 % of the total variance. Wechsler suggested that this variance was due to the non-intellective factors entering into, but not being measured by, the intelligence scales. Secondly, the clinical cumulative experiences indicate that individuals, who score the same marks in the test, are not necessarily equal in their capabilities of appropriate dealing with their environment (Wechsler, 1975). He found in one of his studies that neurotics scored about 13 points less than psychopaths on the performance subtests of the Wechsler-Bellevue adult scale and about 13 points higher on the verbal subtests, while both had approximately equal general IQ scores (Wechsler, 1943).

Wechsler (1950) argued that the majority of intelligence scales, which are based upon the concept general intelligence or factor "g", simply measure a variety of mental abilities. He emphasised that any attempt to measure human intelligence must concentrate on both cognitive and non-cognitive factors; otherwise, it should not be called a measure of intelligence (Wechsler, 1975). Therefore, Wechsler published[1] his own tests of intelligence, which enable us to obtain separate verbal and performance IQs in addition to the general IQ score. He believed that his intelligence tests are able to assess the influence of non- intellectual factors on intelligence scores. The influence of non-intellective factors appears as differences in individuals' scores on the subtests and in the difference between verbal and performance subtests scores (Maleka, 1996; Wechsler, 1943, 1950).

Wechsler (1975) refuted the view that intelligence is a quality of the mind.

[1] Wechsler published the Bellevue-Wechsler Scale in 1939; the Bellevue-Wechsler II in 1942; the Wechsler Intelligence Scale for Children (WISC) in 1949; the Wechsler Adult Intelligence Scale (WAIS) in 1955; the Wechsler Preschool and Primary Scale of Intelligence in 1967; the Wechsler Intelligence Scale for Children-revised (WISC-R) in 1974; and the Wechsler Intelligence Scale for Adults-revised (WISC-R) in 1981.

Intelligence, according to Wechsler, was “An aspect of behaviour; it has to do primarily with the appropriateness, effectiveness, and worthwhileness of what human beings do or want to do” (Wechsler, 1975, p. 135). Wechsler (1975) presented the conditions of intelligent behaviour as being:

1. Awareness: An individual must be aware of why and what he is doing. Thus, instinctual and reflex responses are not a kind of intelligent behaviour since they are shown by non-human animals;
2. Meaningfulness: Intelligent behaviour is not random; it must have meaning and a goal;
3. Rationality: It is not enough for the intelligent behaviour to be meaningful but it must be based on reason and relevant to the goal;
4. Worthwhile: In order to be considered as intelligent behaviour, it must be judged on its usefulness and value through a consensual group of criterions, which might change over time.

2.4 Influences on Intelligence Scores

It has been argued that individual characteristics, such as age and sex as well as wider social characteristics, such as culture, play a crucial role in explaining an individual’s intelligence scores (Furnham & Monsen, 2009; J. Nijenhuis, Tolboom, Resing, & Bleichrodt, 2004; Tucker-Drob & Salthouse, 2008). The following section of this chapter will critically examine some of the previous research that has examined the influence of sex, age and culture in explaining individual differences in intelligence scores.

2.4.1 Sex Differences in Intelligence Scores

It has been widely argued that males do not differ from females on tests of general intelligence, but that males tend to obtain higher scores on tests measuring spatial and mathematical abilities, while females tend to obtain higher on tests measuring verbal abilities (Lynn & Dai, 1993; Moutafi et al., 2003). However, several researchers have reached different conclusions. For example, Rushton, Cvorovic, and Bons (2007) administered the Raven's Standard Progressive Matrices (SPM), which measures the

general factor of intelligence *g*, to 323 adults (111 males and 212 females, age ranged from 16 to 66 years) and found that the mean scores of males were significantly higher than the mean scores of females, F (1,321) = 22.29; $P < 0.01$. The advantage of males' scores on intelligence tests has been further supported by a recent study conducted by Furnham and Monsen (2009). They examined sex differences in the performance of 334 English secondary school students (196 males, 138 females) on the Wonderlic Personnel Test (WPT), which measures general intelligence 'g', and the Baddeley Reasoning Test (BRT), which measures fluid intelligence 'Gf', and found that the mean scores of boys was significantly higher than girls' scores on both intelligence tests, t (1,271) = 24.64, $p < .001$, and t (1,269) = 8.47, $p < .001$, respectively. However, it remains clear that these sex differences may not relate just to an individual's overall intelligence score, but may become more apparent when we consider differences on specific sub-scales. For example, Lynn and Dai (1993) found sex differences on the Chinese standardisation sample of the WAIS-R (N = 1,979, males = 1,138, females = 841, ages ranged from 16 to 65 years). The mean scores of males were significant higher than female scores on verbal, performance and full scale IQs (d = .35, .25 and .33, respectively, $p < .001$); and on the Information, Comprehension, Arithmetic, Similarities, Vocabulary, Picture Completion and Object Assembly subtests (d = .55, .24, .31, .15, .18, .32, .17, respectively, $p < .001$). The mean scores of females were significantly higher than males scores on the Digit Symbol subtest (d = .12, $p < .01$).

Sex differences in the performance of individuals on the subtests of the Wechsler Adult Intelligence Scales have been reported by Snow and Weinstock (1990) as they reviewed 25 studies that used the Wechsler scales (between 1953 and 1989); they reported that a number of studies found males to have higher scores than females on Information, Arithmetic, Picture Completion, Block Design and Comprehension (d = .28, .42, .10, .19 and .14, respectively). No studies found females to have higher scores on these subtests except one study indicating superior female performance on Block Design and Comprehension. On the other hand, the performance of females on the Digit Symbol subtest was better than males (d = .32); none of the studies reviewed have found males to have higher scores on this subtest. With respect to sex differences in verbal and performance IQs, a number of studies have found sex differences on these scales. However, only four of the studies reviewed have found significant differences on

the Verbal IQ scores in favour of males, and only two studies found significant differences on the Performance IQ in favour of females.

However, the higher scores of males on most of WAIS subtests were not replicated in the study of Holland et al. (1995), where they investigated the relationship between intelligence and personality traits among 85 participants (56 males and 29 females, mean age = 34.15 years). They found that there were no significant sex differences on any of the WAIS- R IQ scores and subtests except for the Vocabulary and Digit Span. In each of these subtests, the mean scores of females were significant higher than that of males ($p < .05$). Similarly, Maleka (1996) investigated the sex differences on the Wechsler-Bellevue Intelligence Scale-Arabic version (WBIS; 32 males and 34 females, ages ranged from 20 to 25 years), and found that sex differences on all the WBIS scales and subtest were not statistically significant.

It is argued that apparent sex differences in intelligence are at least partly created by biological factors. Lynn (1994) believed that sex differences in IQ refer to the actual brain size differences between males and females, with different magnitudes and directions expected in childhood, adolescence and later adulthood. He argued that among children the intelligence difference is smaller because girls mature earlier than boys; their brains become similar in size relative to the brains of boys of the same age. At adolescence, the differences in brain sizes increase, with boys having on average larger brains. As result, men have a higher mean IQ than women by approximately four points. Lynn (1994) suggested that the findings of previous researches were not comparable because they used participants of different ages.

The role of age on sex differences in an individual's intelligence scores has been investigated by more recent study. Lynn and Irwing (2008) analysed the data of males and females on the Wechsler Arithmetic and Digit Span subtest. Data were derived from normative standardisation samples of 28 studies. The overall Cohen's *d* showed a small male advantage of .11 in Arithmetic for children and adolescents, and a large male advantage of .467 for adults. Six differences in Digit Span in children and adolescents were in favour of females, $d = .134$, while six differences in Digit Span in adults were in favour of males, $d = .116$. They concluded that the Arithmetic subtest was a measure of working memory capacity and, as there was a high correlation between working

memory capacity and g, “males have an advantage in *g* and that the higher average means obtained by men in IQ tests like the WAIS and the Progressive Matrices is attributable to their advantage in g” (Lynn & Irwing, 2008, p. 226).

Dykiert et al. (2009) suggested different reason for the lack of consensus between researchers. They argued that these inconsistencies could partly be due to the degree of sample restriction, that is, sample which is not fully representative of the population. Thus, while children are likely to obey parents and teachers, adults are more autonomous in their decisions, and there is more opportunity for withdrawal which, in turn, can lead to bias. Furthermore, because almost all children from 5 years attend school, they are relatively easy to sample, and potentially all of them can be traced and approached quite easily, almost without bias. The same is not true for adult samples, few of which can be recruited in an unbiased method from population-wide registers. This inequality may, and almost obviously do, bias the findings of studies on sex differences in intelligence scores.

2.4.2 Age Differences in Intelligence Scores

Aside from sex differences in intelligence scores, there is empirical research evidence to suggest that age differences may play an important role in explaining individual differences in intelligence scores over time. For instance, it is argued that the performance of individuals on tests measuring fluid abilities, such as the Performance scale of Wechsler’s tests, tends to decline with age, whilst the performance on tests measuring crystallised abilities, such as the Verbal scale of Wechsler’s tests, tends to increase with age (Moutafi et al., 2003; Ryan, Sattler, & Lopez, 2000; Sattler, 1982). This argument has been supported by a recent study by Tucker-Drob and Salthouse (2008) in which the authors analysed the data of 2,227 adult participants (24 to 91 years) from seven studies conducted between 2003 and 2007 at the Cognitive Aging Lab at the University of Virginia. All of the studies had administered a number of cognitive tests to the participants measuring fluid reasoning (Gf), spatial reasoning (Gv), verbal knowledge (Gc), processing speed (Gs), and episodic memory (Gm). Their analysis indicated that mean scores on all cognitive tests (except for the Gc tests) tend to decrease with age, particularly Gs.

There is also evidence to suggest that only specific aspects of intelligence may decline with age. Kaufman and Horn (1996) analysed data from the standardization sample of the Kaufman Adolescent and Adult intelligence Test (*N* = 1,500, ages ranged from 17 to 94 years, divided into 13 age groups). This test was designed to measure fluid intelligence (Gf), and crystallised intelligence (Gc). The results from these analyses indicate that the best performance on the Gf IQ subtest occur in young adulthood and declines thereafter; this decline accelerating during the period beginning at approximately age 55. On the other hand, for Gc IQ and subtests, the averages increase into young adulthood and only start to decline after the age of 70. The negative affect of age on fluid abilities has been also supported by a study by Moutafi et al. (2003) in which the authors found a negative correlation between the ages of 900 British participants (age ranged from 23 to 64, mean age = 42) and their scores on a test of abstract reasoning ability, which considered to be a measure of fluid intelligence. The results showed significant correlation of .18 between participants' date of birth and their intelligence scores.

Age differences in intelligence scores on Raven's Successive Arrangement Test, which measures a general factor, have been investigated among an Egyptian female sample. For example, Dessokey (2003) administrated the Raven's scale to 150 students, with a mean age of 14 years, and to another 150 students with a mean age of 17years showing strong age-related differences in performance. More importantly, it is also noted that an individuals' performance on the Wechsler intelligence tests, particularly on the performance subtests, tends to decrease with age (Maleka, 1996; Wechsler, 1997). The optimal performance in intelligence scores, according to Wechsler (1997) tended to occur at the 20-34 age group. In order to investigate the effect of age on WAIS-III subtests, Ryan et al. (2000) therefore analysed data from the standardisation sample of the WAIS-III; the lower limit of the range of raw scores for each subtest that equalled the scaled score of 10 in the reference group of examinees (aged 20-34 years) was used to obtain the scaled scores for the 13 age groups of WAIS-III. The researchers computed the number of point above or below the average of the reference group by subtracting 10 from each of the scaled scores. The findings showed that there were slight decreases in the verbal subtests of the younger (16 - 54 years) and older (55 - 89 years) age groups. The information subtest shows the most stability across age groups.

On the other hand, there were considerable decreases in the performance subtests, particularly among the older age group. The Digit Symbol showed the most instability across the age groups. However, using the WAIS-III as their measure of intelligence, Shuttleworth-Edwards and colleagues (2004) found that the correlation between the ages of 68 South African participants (age ranged from 19 to 30 years) and the raw scores of all subtests were negative indicating that older age is associated with poorer scores on intelligence tests.

2.4.3 Summary

It is clear from this section that a consistent conclusion regarding sex and age differences in intelligences scores has not yet been reached. Moreover, the interaction between sex and age in intelligence scores has not received much attention. Therefore, the role of both factors in general intelligences scores and in specific intellectual abilities scores still require further investigation. The previous studies that are discussed in this section have contributed to our understanding of the importance of age and sex differences in intelligence scores. Moreover, research has shown that cultural differences are another feature that may have important implication for understanding individual differences in intelligence scores (c.f., Lynn & Dai, 1993; Maleka, 1996). The following section of this chapter provides an argument for studying the contribution of cultural differences on an individual's intelligences scores.

2.5 Cross-Cultural Differences in Intelligence Scores

While it is acknowledged that age and sex may play a role in explaining an individual's intelligence scores, there is further evidence that cultural diversity may play an integral role in explaining differences in intelligence scores. Thus, there has been an increasing interest in research questions about the influence of cultural background on individuals' intelligence, either through cross-cultural comparisons between populations from different countries or through cultural differences within one country, if there is more than one culture within the same country (Nijenhuis et al., 2004).

Although there is considerable evidence that IQ is a heritable trait (Bouchard, 1997; Neisser et al., 1996), the influence of the environment cannot be ignored. Crystallised intelligence, according to Cattell (1963, 1971) is a product of environmental variation

and depends on information and skills that acquired through experience and education within a culture. Moreover, Neisser et al., (1996) argued that the cultural environment that people live in is an important factor not simply for intelligence scores but also in the type of intelligence that might develop. Similarly, Westen (1999) reported that "if the function of intelligence is to help people manage the tasks they confront in their lives, then intelligent behaviour is likely to vary cross-culturally, since the circumstances that confront members of one society differ markedly from those that face another" (p. 356).

Some researchers (e.g., Gardner, 1993; Sternberg, 2000; Wechsler, 1997) have proposed definitions of intelligence as comprising abilities that are valued by culture and are necessary for adaptation to meet the demands of the environment effectively. According to such definitions, intelligence is reactive to the environment and behaviour that is labelled as intelligent may differ from one cultural context to another (Nettelbeck & Wilson, 2005; Sternberg, 1997). Thus, it has been argued that in Western cultures there is an emphasis on the speed of mental processing and the ability to gather, understand and sort information quickly and efficiently while in Eastern cultures the emphasis is on social aspects of everyday interactions, knowledge and problem solving. For example, in Eastern cultures the ability to show skills in problem solving, verbal ability and social competence would not just extend to the individual's own ability to solve the problem but also to their ability to solve a problem within the context of their family and friends (Maltby et al., 2007).

Scores on IQ tests have not been found to be similar across cultures. Lynn and Vanhanen (2006) hypothesised that differences in IQ were partly responsible for differences in national wealth around the world. They argued that national IQ correlates positively with gross domestic product (GDP), the rate of economic growth, and with the quality of life. They analysed the IQs of participants (N = 813,778) in numerous studies used different instruments from 113 different countries and found that the world average IQ found to be 90. Mean IQs as high as 100 are seldom found outside of European and East Asian population groups. The highest mean IQ was for East Asians (Chinese, Japanese and Koreans) at 105; followed by Europeans with an IQ of 100. A mean IQ of 85 was for South Asians and North Africans, followed by sub-Saharan Africans (IQ 70) (Rushton & Čvorović, 2009). Nevertheless, actual GDP did not always

correspond with that predicted by IQ. For example, although Qatar had a high per capita GDP of roughly USD $17,000, its IQ was estimated by Lynn and Vanhanen to be about 78. By contrast, although China had a lower per capita GDP of USD $4,500, its IQ was estimated to be 100. In addition, it was noted that most studies reviewed by Lynn and Vanhanen (2006) were conducted in European and East Asian populations and few of them were in Africa. For instance, while the mean IQ scores of Japan was estimated from data of 10 studies, Mean IQ scores of Egypt, Ethiopia Uganda, and Zambia was only estimated from data of one study, and all the participants from these African countries were children. That is, samples of the African countries were not fully representative of the population, and this could be the reason for the low mean IQ of the African countries.

The influence of cultural background on an individual's intelligence has also been investigated among one country. For instance, Rushton, Skuy and Fridjhon (2002) examined differences between White, Indian, and African ethnic groups in South Africa on the Raven's Standard Progressive Matrices (SPM). They administered the SPM to 342 participants, with ages ranging from 17 to 23 years. Of those, 198 were African (155 men, 43 women), 58 Indian (41 men, 17 women), and 86 Whites (75 men, 11 women). All of them were engineering students at the University of the Witwatersrand in South Africa. Rushton et al. (2002) found significant differences between the three ethnic groups, and the highest mean scores was for the White ethnic group followed by the Indian and then African group. They concluded that one possible explanation for the advantage of the White ethnic groups on the SPM would be that the nonverbal tests, such as the SPM, require "The same Western cultural style of analytical rule following that more traditional IQs do …. [Therefore] score differences cannot be attributed to anything other than cultural impact" (Rushton et al., 2002, p. 420). Similarly, using the Raven's SPM, Rushton and Čvorović (2009) examined general mental ability in 608 adults from four communities in Serbia with ages ranging from 17 to 65 years. The findings revealed differences between the four Serbian communities; with an IQ range of 83 to 97.

These cultural differences may not just relate to an individual's overall intelligence score, but may also relate to differences on specific sub-scales. It is important to consider different constructs of intelligence rather than simply look at the overall

intelligence score for each individual. For example, Shuttleworth-Edwards et al. (2004) reviewed a number of studies that investigated differences on the cross-cultural application of Wechsler intelligence tests and concluded that "both Vocabulary and Block design [subtests] are particularly sensitive to cultural diversity usually in a negative direction in association with a relatively deprived educational background" (Shuttleworth-Edwards et al., 2004, p. 905). Similarly, Crawford, Gray, and Allan (1995) inspected the psychometric properties of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) in a sample of UK participants (N = 200, age range 16 - 83 years) and found that the Full Scale IQ, Verbal IQ and Performance IQ scores were similar to those for the US standardisation sample. However, these findings also demonstrated differences for the Arithmetic and Digit Spain subtests. Scores of the UK sample were higher than scores of the US standardization sample on both subtests.

The interaction between age, culture and intelligence scores has been also examined. Tsushima and Bratton (1977) investigated geographic differences in Wechsler Adult Intelligence Scale-Revised (WAIS-R) results by comparing 60 Hawaiian and 60 mainland United States participants divided into two age groups: young (aged 16-20 years) and old (aged 30-66 years). The results revealed that there were highly significant differences on the WAIS verbal subtests between Hawaiian and mainland US participants while there were no significant age differences on the performance subtests. In addition, there was no significant interaction between age and geographical factors. Tsushima and Bratton (1977) concluded that because the performance on the verbal subtests of the WAIS-R required more verbal usage, these findings were expected "on the basis of the continued influence in Hawaii of pidgin English, the local dialect that has evolved through the linguistic interaction of the various ethnic groups in Hawaii" (p. 501).

The cultural factors that are important on the development of intelligence are still not entirely clear; however researchers have attempted to introduce a number of factors. For example, Greenfield (1998) argued that education, urbanisation, and technology are three important determinants of between-group IQ differences. Rushton and Čvorović (2009) reported that, as the trend toward a more global economy continues, national differences in IQ scores are likely to become greater.

Researchers have attempted to explain differences among cultural populations in performance on cognitive tasks. For example, Sonke, Van Boxtel, Griesel, and Poortinga (2008) pointed to differences in broad cognitive dispositions which are postulate to have developed in a cultural population historically or in response to prevailing eco-cultural and socio-cultural factors. Nell (2000) argued that the alternative explanation for why non-Western populations score lower than Westerners are that non-Western groups are less test-wise, less interested, more anxious, work less efficiently, or quickly give up on items they find difficult. This explanation refers to the role of personality traits in the performance of individuals on intelligence tests. The next section is concerned with understanding personality theories, and in particular, theories of personality traits, and the role of age, sex and cultural differences in personality traits.

2.6 Personality

This part of the chapter considers previous literature on personality trait theories with a particular focus on the role of neuroticism in explaining an individual's intelligence test scores. It has been recognised that personality theories offer a wide range of descriptions of behaviour and what constitutes an individual. Early traditional approaches to personality, including psychoanalytic theories, learning theorists and humanistic theories, focussed on the detail of the ill person's behaviour and provided detailed information about the origins of and treatments for such behaviour (Maltby et al., 2007). Meanwhile, theories of personality traits focussed on describing, interpreting, and predicting the behaviour of the 'normal person' (Abdullah, 1996). This section will outline a number of the traditional approaches to personality and will concentrate on the theories of personality traits; particularly Cattell's 16 factors (e.g., Cattell, 1977; Cattell & Kline, 1977), the big five model (e.g., McCrae & Costa, 1990, 1997) and Eysenck's three dimensions (1967). Sex, age and cultural differences are three factors that it has been proposed have an influence on individual personality traits. This section will consider the possible influence of these variables on explaining neuroticism scores among individuals.

2.6.1 Early Traditional Approaches to Personality

There has been a long-standing tradition of explaining personality by many of the

schools of thought within psychology. Psychoanalytic theories attempt to explain individual differences by examining how unconscious forces interact with human behaviour. Sigmund Freud (1856-1939) created the psychoanalytic approach to personality. Freud, (1915, 1923) argued that mind is composed of three levels: conscious, preconscious and unconscious; the unconscious has the strongest impact on human behaviour. Personality, according to Freud (Freud, 1923), has three structures: id, ego and super ego.

Alfred Adler (1870-1937), Carl Jung (1875-1961) and Karen Horney (1885-1952) were neo-Freudians who were influential in developing our understanding of personality traits. Adler (1921/1999) emphasised the inferiority complex and how we compensate for feelings of inferiority. He argued that all people struggle for superiority and the neurotic personality is associated with the development of inferiority or superiority complexes, and with a lack of capability in adjusting to reality. Jung (1969) developed a model of the personality he called the "psyche" and he described it as complex and inclusive of the ego, personal unconscious, collective unconscious and a range of archetypes (e.g. gods, persona and shadow). Jung argued that mental illness is caused by an imbalance within the psyche. Horney (1950) emphasised the importance of basic anxiety and the role of cultural and social factors in developing an individual's potentialities. She argued that the origin of neurosis was a disturbance in human relationships, particularly with one's parents, which generated basic anxiety and feelings of insecurity in the child.

Learning theorists believe that individual differences in behaviour are the result of the different learning experiences rather than internal motives. Abnormal development, according to the learning theorists, happens when maladaptive responses are learned (Feshbach & Weiner, 1991). Skinner (1953/1965) claimed that individuals respond to stimuli in their environment, and the consequences of their responding determine their learning. Dollard and Miller (1950) furthermore argued that human behaviour is learned. They introduced a stimulus-response (S-R) theory of learning; they described the learning of habits as being composed of four fundamental factors: the initial drive, the cue to act, the response and reinforcement of the response. They confirmed that observational learning played an important role in learning.

Humanistic theories confirm internal experiences, thoughts and feelings that generate the individual's self-concept. Abraham Maslow and Carl Rogers' theories are humanistic theories. Both emphasise personal growth and aim to help the clients to understand their problems by themselves and concentrate on the present and not on the past (Huffman, 2004). Rogers (1980) emphasised the concept of self-esteem and the importance of unconditional positive regard on this concept. Maslow (1987) furthermore stressed the concept of self-actualisation which is the highest need on Maslow's hierarchy of needs.

Theories of personality traits believe that personality consists of relatively stable characteristics or factors. Using the factor analytic approach, these theories hypothesize that the basic units of the personality are those factors that are revealed by analysis of the matrix coefficients, which are the results of the application of personality tests and questionnaires.

In recent years, there seems to have been an agreement among psychologists on that personality consists of five broad dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (Matthews et al., 2003; McCrae, 2001b). Researchers (e.g., Chamorro-Premuzic, 2003; Furnham et al., 2006; Maltby et al., 2007) have agreed on the advantages of the Big Five factors proposed by McCrae and Costa (1987). However, other researchers have not supported the big five model, showing a preference for either Eysenck's three dimensions model (H. Eysenck, 1968) or Cattell's 16 factors (Cattell, 1977; Cattell & Kline, 1977) explanation of personality traits.

Given the importance of neuroticism as one of the key personality dimensions, this chapter will concentrate on the development of trait theories, in particularly those focussing on the neuroticism trait. It will first introduce some important definitions of different trait theories and their underlying arguments before providing a further definition of neuroticism. It will be followed by discussing a number of variables that are related to neuroticism, such as age, sex and culture. Then the relationship between neuroticism and intelligence will be addressed.

2.7 Trait Theories of Personality

The purpose of this section is to outline and critically discuss theoretical approaches in understanding personality. Trait theories occupy a prominent place in the literature of personality psychology. This thesis considers three broad theoretical perspectives that have received considerable competitive support in literature and are considered of the most common personality theories. These are Cattell's theory of 16 factors, Big Five factor model and Eysenck's theories. According to these theories, personality is composed of a number of traits or factors derived by the factor analytic approach. Many researchers in the area of personality structure have agreed on the psychometrical advantages of the Big Five factors model although it has sometimes been criticised for its lack of theoretical explanation on the development of some of its personality factors. However, many researches are reluctant to support the Big Five factors; they usually prefer the theory of either Eysenck or Cattell instead. It should be noticed here that although there are differences among the three theories in regard to the number and meaning of personality factors, the three theories agree that neuroticism is a basic dimension of personality dimensions (Bargeman et al., 1993; Cattell & Kline, 1977). The three views will outline in this section and demonstrate the importance of studying neuroticism as a key feature for personality.

2.7.1 Theory of Raymond Cattell

Cattell (1977) and Cattell and Kline (1977) criticised theories which are based only on clinical assumptions and conclusions. They pointed out that if it is not possible to measure the personality experimentally and the expression of that quantitatively, then we cannot have confidence in a theory. Cattell (1977) believed that traits are the essential structural units of the personality. Using a factor analytic approach, his studies showed that it is a possible to classify traits in several ways, namely:

Common Traits and Unique Traits

Common traits are possessed by all the people in the same culture and the differences among them are of degree not type such as extraversion. Unique traits are possessed by one or a small number of persons, which distinguish people as individuals; for instance, an interest in fishing or liking for politics (Maltby et al., 2007).

Ability, Temperament, and Dynamic Traits

Ability traits refer to the possibility to work in the direction of an individual's goals; such as the various aspects of intelligence. Temperament traits determine behaviour of individuals as a response to environmental stimuli; easygoing, irritable and assertive are examples of this type of trait. Finally, dynamic traits describe the motivations and interests of individuals and the forces that drive their behaviour (Schultz & Schultz, 2005).

Surface Traits and Source

Cattell distinguishes between surface traits and source traits; surface traits are the behavioural phenomena or events which correlate with one another and can be observed (Cattell & Kline, 1977). These traits are the result of source traits. For example, integrity, honesty, self-discipline, and thoughtfulness are surface traits. When people are measured on each of these surface traits, correlation will be found between their scores on all these surface traits, because these are the result of the same source trait, which is ego strength (Maltby et al., 2007).

Cattell and Kline (1977) argued that source traits are the real factors that assist in describing and explaining human behaviour. They stressed the shared role of genetics and environment in personality traits with some of the source traits (e.g., intelligence) being seen as largely genetic, while others (e.g., radicalism) are considered to be largely environmental in origin. Cattell and Kline (1977) further identified sixteen source traits using factor analysis techniques. These traits were bipolar and were viewed as representing the basic factors of personality. However, the factor that related with a subject of the current thesis (neuroticism) is Factor (C), Stable-Emotional (high ego strength versus low ego strength). The high ego strength factor indicates the ability of individuals to control their impulses and solve problems effectively. Individuals with high ego strength are emotionally stable, realistic in their approach to life and are able to control emotions and express them in different life positions. On the other hand, low ego strength describes individuals that are easily upset, susceptible to disorders and less emotionally stable (Feshbach & Weiner, 1991).

2.7.2 Five-Factor Model

McCrae and Costa (1990, 1997, 1999) postulated that the personality traits cannot be explained solely by three factors (as Eysenck does), but are also not expansible to 16 factors as in Cattell's theory. Using the factor analysis approach and combining the findings of several previous researchers and a long list of possible personality traits, they derived five major dimensions, which they called the five factor model (FFM) or, as McCrae (2001b) preferred to call it, the Big Five factors theory. These factors are (a) Openness; people who score high on openness are independent thinkers, imaginative, and interested in cultural pursuits. People with low scores tend to be conventional, narrower in their interests and prefer the familiar to the new; (b) Conscientiousness; this factor combines between individuals who are organised, responsible and self-disciplined at the high end, and individuals with low scores who tend to be irresponsible, careless and undependable; (c) Extraversion; people with high scores in this factor are labelled extraverts and they are very sociable, friendly, optimistic and affectionate. On the other hand, people with low scores are labelled introverts and tend to be withdrawn, reserved, and passive; (d) Agreeableness; individual with high scores on this factor are trusting, warm, helpful and soft-hearted, whereas low scores are suspicious, argumentative, irritable, unhelpful and uncooperative, and (e) Neuroticism; this factor is a measure of an individual's emotional stability and personal adjustment. People with high scores on neuroticism are emotionally unstable and prone to insecurity, worry, angry and vulnerability. They respond emotionally to events that would not affect most people, and their reactions to adverse situations tend to be stronger than normal. They are more likely to understand normal situations as threatening, and minor frustrations as difficult. Individuals with low scores are calm, have a high self-esteem, emotionally stable, well adjusted, and even-tempered (McCrae & Costa, 1990, 1997, 1999).

2.7.3 Theory of Hans Eysenck

Eysenck (1991) agreed with Cattell that personality is constructed of dimensions or factors but he did not agree with him about the large number of factors and reviewed four previous studies that had factor analysed Cattell's 16 PF questionnaire concluded that Cattell's 16-factors of personality are not replicable. Using the factor analytic approach, Eysenck derived three broad personality dimensions, which he termed:

neuroticism, extraversion, and psychoticism. The following contains descriptions of these higher-order dimensions according to H. Eysenck and Eysenck (1991a).

1. *Extraversion versus introversion*

Extraversion was represented as a bipolar dimension with extraversion at one end, and introversion at the other. The typical extravert, who scored a high score on introversion- extraversion scales, is sociable, less reliable, optimistic, and impulsive, while the typical introvert is a person who is deliberate, reliable, unsociable, controlled feelings, and has high ethical standards (H. Eysenck & Eysenck, 1991a).

2**.** *Neuroticism versus emotional stability*

Neuroticism is a bipolar factor that combines between aspects of maturity and good adjustment, emotional stability, and between defects this adjustment. Eysenck (1968) reported that neuroticism is "a trait which forms a continuum from the normal to the neurotic end" (p.52). A person with high neuroticism tends to be anxious, depressed, worried, has bad sleep, and body disorders. In addition, their emotional responses are exaggerated, and they may have difficulty in returning to normality after passing through emotional experiences. In contrast, individuals with low neuroticism scores are generally quiet, comfortable and quickly recover their stability after emotionally disturbing experiences (H. Eysenck & Eysenck, 1991a).

3. *Psychoticism versus impulse control*

Psychoticism is an independent dimension and is not an advanced level of neuroticism. A person with a high degree of psychoticism is reckless, antisocial, aggressive, and do not care about ethical standards (H. Eysenck & Eysenck, 1991a).

Table 1

Traits of Eysenck Personality Dimensions

Extraversion/ introversion	Neuroticism/ emotional stability	Psychoticism/ impulse control
Sociable	Anxious	Aggressive
Lively	Depressed	Cold
Active	Guilt feeling	Egocentric
Assertive	Low self-esteem	Impersonal
Sensation seeking	Tense	Impulsive
Carefree	Irrational	Antisocial
Dominant	Shy	Creative
Venturesome	Moody	Tough-minded

Source: Schultz and Schultz (2005)

Although Eysenck (1967) and Eysenck and Eysenck (1991a) believed that neuroticism and psychoticism might predispose indirectly to neurotic and psychotic disorders (respectively), they did not mean that people who score highly on neuroticism or psychoticism scales are necessarily neurotics or psychotics, only that they have a high aptitude for neurotic or psychotic disorders. Such disorders will not happen unless there are environmental pressures upon an individual (Abdullah, 1996). Differences among people on these dimensions are of degree and not type (Ellenbogen & Hodgins, 2004).

Eysenck (1967) linked personality to two sets of loops, which are connected with each other: a cortico-reticular loop and viscero-reticular loop. While the first is concerned with cortical arousal and inhibition, the second links the cerebral cortex with the 'visceral brain' and concerned with emotion. Control subjective and autonomic emotional reaction is the function of the viscero-reticular loop. Cortical arousal is excited by received sensory stimulation or by problem-solving activity of the brain. This means that there is no autonomic arousal; however, cortical arousal can also be produced by emotion. In this case, there are cortical arousal and autonomic arousal. Eysenck (1967) reported that "activation always leads to arousal, but arousal very

frequently arises from types of stimulation which don't involve activation" (p. 233). According to Eysenck, introverts are more readily activated than extraverts; as result of that introverts are more easily aroused and show high levels of cortical arousal as well as individuals with high scores of neuroticism. He hypothesized that while intermediate levels of arousal are satisfied, the low and high arousal is unacceptable. As there is a low level of arousal among extraverts, they seek to raise their arousal to intermediate levels through looking for sources of excitement. Therefore, they tend to be adventurous and participate in social events. In contrast, high-neuroticism and introverts individuals tend to be over-aroused, and so they keep themselves away from sources of stimulation. The second system, viscero- reticular loop, among people with high neuroticism scores is more sensitive, therefore, these people "Are more likely than low neuroticism scorers to become autonomically aroused, and to experience distress and agitation when subjected to stress" (Matthews et al., 2003, p.170).

Although, there has been wide acceptance of the five factor model among researchers in the field of personality (Bargeman et al., 1993; Goldberg, 1993; Matthews et al., 2003), it has incurred a number of criticisms. One such criticism is that the approach that was used in the FFM is not a common approach in psychology where researchers develop hypotheses based on theory about characteristics of behaviour and then collect their data. The findings of these researchers either support their hypotheses or disprove them. On the other hand, with the FFM research, the hypothesis that five factors represent the basic structure of personality was derived from the data that was collected; that is, "The Big Five Model is a data-derived hypothesis as opposed to a theoretically based one" (Maltby et al., 2007, p.176). Therefore, Digman (1997) reported that the FFM "is not a complete theory of personality, nor have its proponents" (p. 1246). Moreover, Eysenck (1991a) described this model as 'arbitrary' because it lacks a nomological or theoretical network. Eysenck (1992) suggested that agreeableness and conscientiousness are most likely to be "Primary factors, rather than being at the highest level of the factor hierarchy" (H. Eysenck, 1992, p.887). Thus, agreeableness and conscientiousness are facets of his psychoticism factor, and openness is a part of extraversion and low conscientiousness is part of the dimension of neuroticism (Matthews et al., 2003).

It is also argued that there are consistent intercorrelations between the big five traits. Digman (1997) analysed factor correlations of 14 studies supporting the Five-Factor Model and reported that only two factors were typically identified. The first factor combines neuroticism, agreeableness, and conscientiousness and labelled alpha; while the second factor combines the extraversion and openness and labelled beta. These findings were supported by the study of DeYoung, Peterson and Higgins (2002) who suggested that the alpha factor might be better labelled stability and the beta factor plasticity; and "the Big Two" as a name for the two factors.

2.7.4 Summary

Trait theory is a major approach to the study of human personality. Trait theorists are primarily interested in the measurement of traits, which are relatively stable over time, and influence behaviour. There are almost an unlimited number of potential traits that could be used to describe personality. However, the statistical technique of factor analysis has confirmed that particular groups of traits consistently correlate together. Cattell and Kline (1977) have identified sixteen traits, while Eysenck (1991) has suggested that personality is reducible to three major traits. Other researchers argue that more factors are needed to adequately describe human personality. McCrae and Costa (1990) derived five major dimensions. Although the three major trait models are descriptive, only the Eysenck model offers a detailed causal explanation. Eysenck (1967) suggested that different personality traits are caused by the properties of the brain factors (see Section 2.7.3).

It should be noticed that although there are differences among the three models of personality traits that are discussed in this chapter in regard to the number and meaning of personality factors, they are in agreement that neuroticism is a fundamental personality dimension (Bargeman et al., 1993; Cattell & Kline, 1977). Neuroticism, or emotional instability, is the only personality trait that can be found across all theoretical models. In addition, there is agreement regarding the importance of neuroticism as a personality construct with several researchers confirming the universality of neuroticism traits (c.f., McCrae, 2001a; Narayanana, Menon, & Levine, 1995; Schultz & Schultz, 2005). Compared with other personality traits, neuroticism has therefore been identified as a crucial risk factor for a number of diseases (Matthews, Yousfi, Schmidt-Rathjens,

& Amelang, 2003), in particular depressive and anxiety disorders (Jylhä, Melartin, & Isometsä, 2009) and with personality disorders (Saulsman & Page, 2004). Neuroticism was found to be negatively associated with the performance of individuals on intellectual abilities tests (Ackerman & Heggestad, 1997; Lounsbury, Welsh, Gibson, & Sundstrom, 2005). However, the relationship between neuroticism and intellectual abilities has not been confirmed and current research examining the relationship between neuroticism and intelligence scores has found conflicting results (see Section 2.11). Therefore, the current thesis examines the relationship between neuroticism and intelligence and the role of sex, age and culture differences in this relationship. The next section will concentrate on the meaning of neuroticism and the role of sex, age and cultural differences in neuroticism scores.

2.8 Neuroticism

Neuroticism has been variously viewed as a bipolar or continua dimension rather than being indicative of one of two distinct types of person. For example, neuroticism, according to Colman (2006), is "one of the Big Five personality factors, ranging from one extreme of neuroticism, including such traits as nervousness, tenseness, moodiness, and temperamentality, to the opposite extreme of emotional stability" (, p.503). Similarly, Costa and McCrae (1987) defined neuroticism as "a broad dimension of individual differences in the tendency to experience negative, distressing emotions and to possess associated behavioural and cognitive traits" (p. 301).

People vary in their level of neuroticism. The distribution of neuroticism scores in the population approximates to the normal distribution; most people cluster around the average, with a small group of individuals scoring extremely high or extremely low on the dimension (Matthews et al., 2003). Neuroticism is one of the high order factors in the Eysenck's three factor model and in the big five model. Both models broadly accept that neuroticism is associated with emotional instability and negative effect. In addition, the description of individuals who score high / low on neuroticism is similar in both models. H. Eysenck and Eysenck (1991b) reported that "our description [of neuroticism] would be very similar to those given by countless other writers" (p. 4). However, Eysenck's model contains nine lower order factors (facets), while the five factor model has six.

Individuals who score low in neuroticism are more emotionally stable, calm, have a high self-esteem, well adjusted, even-tempered, quickly recover their stability after emotionally disturbing experiences, resistant and are relaxed individuals even under very stressful conditions. Although they are low in negative feelings, they are not necessarily high on positive feelings. On the opposite end of this dimension, a person with high neuroticism scores may be described as being anxious, worried, moody and frequently depressed. They are likely to sleep badly, and to suffer from guilty feelings and from various psychosomatic disorders. They are emotionally unstable and prone to insecurity, angry and vulnerability. They are responds emotionally to events that would not affect most people, and their reactions tend to be more strong than normal, and they may have difficulty in returning to normality after passing through emotional experiences (H. Eysenck & Eysenck, 1991a; 1991b; McCrae & Costa, 1990, 1997, 1999).

2.9 Influences on Neuroticism Scores

The purpose of this section is to consider the possible influence of individual and social variables on explaining individual differences in neuroticism. Specifically, age, sex and culture are the variables that will be addressed in this section. The effects of sex and age differences in personality traits lead to predictable differences in leisure behaviours, occupational performance and health-related outcomes of young and older men and women (Schmitt et al., 2008). The influence of sex and age variables on neuroticism scores has received much attention. However, many of the claims regarding the influence of age and sex differences in explaining an individual's neuroticism scores has largely been based on findings derived from western samples and cannot be generalised across different cultures. Moreover, any interaction between these variables has not received much attention either on neuroticism scores, or on the relationship between neuroticism and intelligence. Therefore, this thesis examines the effect of age, sex and cultural differences in neuroticism scores. This section will examine the role of age, sex and culture on neuroticism.

2.9.1 Neuroticism and Age

There are contradictory findings with regard to the importance of age in explaining individual differences in neuroticism levels. It is argued that the degree of neuroticism

among individuals is not equal at all ages (H. Eysenck & Eysenck, 1991a). It changes with age, with the highest level appearing in adolescence (Schultz & Schultz, 2005). McCrae (2001a; 2001b) reported that there is evidence suggesting that an individual's neuroticism score reduces with age, and that this decline begins almost at the age of 18. McCrae et al. (1999) found that this decrease in the degree of neuroticism with age occurs similarly for males and females, and across different cultures. Costa et al. (2000) argued that age differences in personality appeared to reflect maturational changes rather than cohort differences; men and women between 18 and 30 years become more emotionally stable, more socially independent, more conventional, and goal-directed; the rate of change in personality apparently does not change after age 30 (Costa & McCrae, 1994). Similarly, McCrae (2001b) referred the age differences in personality to maturational factors. He reported that changes in adult personality "reflect intrinsic maturational processes common to the human species" (McCrae, 2001b, p. 110). Based on a longitudinal study, Haan, Millsap and Hartka (1986) argued that personality traits change between adolescence and young adulthood "When most people make the profound role shifts entailed by entry into full-time work and marriage" (Haan et al. 1986, p. 225), and that females changed more noticeably than males. In line with the notion of decrease in the degree of neuroticism scores with age, Ready and Robinson (2008) recently found that the neuroticism scores of older individuals (N = 60, M age = 74.9 years) were significantly lower than the neuroticism scores of younger adults (N = 44, M age = 19.5 years) when using the neuroticism scale of the Big Five Inventory (BFI).

The age difference trends in neuroticism scores have been further supported by more cross-cultural studies. For example, McCrae et al. (2004) administrated the Revised NEO Personality Inventory to 705 Czech participants (294 males, 411females) with ages ranging from 15 to 81 (M = 36.1, SD = 14.1), and to 800 Russian participants (387 males, 413 females) with ages ranging from 15 to 80 (M = 31.2, SD = 12.0). Participants in both samples were allocated to one of eight age groups. Findings showed that the pattern of age differences in neuroticism scores was similar in both samples. The mean neuroticism scores of the participants decreased significantly among the older groups for both samples. Similarly, patterns of age differences in neuroticism scores were similar among Canadian and Hong Kong Chinese participants in a cross cultural study

by Fung and Ng (2006). The Canadian sample of this study involved 166 participants. Of those, 61 shaped the young sample (ages ranged from 18 to 29 years, *M* = 23, *SD* = 2.91), and 105 comprised the older sample (ages ranged from 50 to 87 years, *M* = 72.67, *SD* = 7.56). The Hong Kong Chinese sample included 116 participants. Of those, 50 participants comprised the young sample (ages ranged from 20 to 22 years, *M* = 20.74, *SD* = 0.56), and 66 participants shaped the older sample (ages ranged from 50 to 88 years, *M* = 64.23, *SD* = 8.11). All the participants completed the Big Five Inventory. Findings showed that the correlation between age and neuroticism in the Canadian and Hong Kong Chinese samples was negative and significant (-.43, -.53. $p < .01$, respectively), and that the interaction between age and culture was not significant.

Age differences in neuroticism scores were also supported by the cross cultural study of Donnellan and Lucas (2008). However, the patterns of age differences in neuroticism scores in their study were not similar across cultures. Thus, Donnellan and Lucas (2008) investigated age differences in neuroticism scores among two national samples, namely Britain and Germany. 14,039 British participants (*M* age = 45.29 years, *SD* = 18.04), and 20,852 German participants (*M* age = 46.03 years, *SD* = 17.23) completed the 15-item version of the Big Five Inventory. Ages of both samples ranged from 16 to 85, and were divided into eight groups. Findings of this study showed that neuroticism was slightly negatively associated with age in the British sample, and was slightly positively associated with age in the German sample.

On the other hand, findings from other researchers have not revealed any strong age differences on individuals' neuroticism scores. For example, Kim, Shin and Swanger (2009) more recently examined the effect of age on neuroticism scores; they administered the International Personality Item Pool (IPIP) to 187 American participants (125 were females and 62 were males); their ages ranged from 16 to 57 years (*M* = 22 years). Kim et al. (2009) found that the effect of age on neuroticism scores was small and not significant. Similarly, the hypothesis of universal age differences has not been supported by the cross-cultural study of Costa et al. (2000); the NEO personality Inventory-Revised (NEO-PI-R) was administered to 3292 participants (1195 males and 2097 females) from four cultures: American, Russian, Japanese and Estonian. This study examined age differences in four age groups: 18 to 21, 22 to 29, 30 to 49, and 50+ years. The Russian sample consisted of 297 students and community

adults classed to the first three groups. The Japanese sample consisted of 247 university students with their age ranging from 18 to 21 years, and from 232 community residents, their ages ranged from 67 to 87 years. The full range from 18 to 83 years was represented in the Estonian sample (598 participants) and American sample (1918 participants). The findings revealed that age differences in neuroticism scores were significant in the American and Japanese samples; mean scores of 18 to 21 years group was significantly higher than mean scores of the other groups in both samples. However, there were no significant age differences in the Russian and Estonian samples. These findings illustrate the interaction between age and culture variables in neuroticism, and demonstrate evidence of possible cultural influences on neuroticism scores

There is some support from other cultures that age differences are not consistent among Arabic cultures. In creating the Neurotic Behaviour Scale (NBS), the author of the current thesis examined the effect of age on scores of the standardisation sample of the NBS (N = 619, age ranged from 15 to 25) and found no significant differences between ages (Elmadani, 2001). Similarly, Aboalniel and Doosoki (1986) found from their study of neuroticism among children and adolescents that although the average scores of children on the neuroticism scale was higher than adolescents; the difference among them was not significant. Nevertheless, Dessokey (2003) found significant age differences on the neuroticism scale of the Eysenck Personality Questionnaire (EPQ). In this study, the EPQ was administrated to 300 Egyptian female students, divided into two groups; mean ages of the group one was 14.2 years, while mean age of the group two was 17.1 (.71) years. Findings showed that age difference between the two groups was significant.

2.9.2 Neuroticism and Sex

A further variable that has a direct influence on neuroticism scores is an individual's sex. Indeed, there is a tendency among researchers in the field of personality traits to assume that females are more neurotic than males (Cattell & Kline, 1977; Huffman, 2004; Maltby et al., 2007; Matthews et al., 2003); however, empirical studies have continued to show inconsistent results. For example, S. Eysenck, Barrett and Barnes (1993) found from their application of the (EPQ) upon 650 males and 642 females in

Canada that Canadian females scored significantly higher on neuroticism scales than males. Similar findings, but among a different population, were reported by Lewis and Maltby (1995). They administrated the Revised Eysenck Personality Questionnaire to 164 U.S. participants (58 males and 106 females). Of those, 94 were students (32 males and 62 females), and 70 were non-students (26 males and 44 females). They found that the mean neuroticism scores of females were significantly higher than the mean scores of males. Rubinstein and Strul (2007) also found similar results but among a different culture and using a different neuroticism scale; they administrated the NEO-FFI to 236 Israeli participants (118 males and 118 females, mean age = 31.2, standard deviation = 9.3), from four different professions (i.e., doctors, lawyers, clinical psychologists and artists). They found that mean scores of females, as a whole, on the neuroticism scale were significantly higher than males. However, this conclusion was inconstant with a previous study conducted by Rubinstein (2005), where 320 Israeli university students (160 female and 160 male, mean age = 24.03, standard deviation = 3.96), from four university colleges (i.e., law, social sciences, natural sciences and arts) completed the short form of the NEO-personality Inventory. The findings revealed that there were no significant sex differences between the four faculties. Rubinstein (2005) assumed that sex difference reflects the impact of work experience and reality concerns on the neuroticism traits. Thus, work experience, for instance, might increase the level of neuroticism among females more than males.

In Arabic society, Elmadani (2001) examined sex differences in neuroticism scores among the normative sample of the Neurotic Behaviour Scale (NBS, N = 619, 343 female, mean age =18.91 and 276 male, mean age = 19.23). The findings showed that mean overall scores were significantly higher in females than the mean scores of males, $P < .001$. Similarly, Owad (1986) administrated the Eysenck Personality Questionnaire (EPQ) to 368 Lebanese students (243 males, mean age was 22.5, and 125 females, mean age was 21.7), and to 361 Egyptian students (201 males, mean age was 22.8, and 160 females, mean age was 21.6) and reported that there were significant differences at the level .01 between males and females in favour of females in both samples. However, Abdullatief (1990) administered the Eysenck Personality Inventory (EPI) to 140 Egyptian students (70 males and 70 females, age ranged from 19 to 23 years) and he did not find sex differences in neuroticism scores.

It was argued that higher neuroticism scores are associated with greater activation of the sympathetic division of the autonomic nervous system (Eysenck, 1967). Robinson (1998) suggested that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; he hypothesised that female groups are higher on cerebral arousal than male groups. Robinson (1998) tested this hypothesis among a sample of 76 participants, (36 males and 36 females, mean age = 52.50 years, *SD* = 19.06) by measuring sex differences in behavioural arousal and in the neuroticism scores of the Eysenck Personality Questionnaire, and by using EEG averaged evoked potential (AEP) measures to evaluate differences in cerebral arousability. The findings supported the Robinson's hypothesis; the mean scores of female were significantly higher than mean scores of males in neuroticism and arousal variables, $p < .05$ and $p < .01$, respectively.

It is also argued that these apparent sex differences in neuroticism scores could perhaps in part be explained by the nature of neuroticism measures that have been used (Francis, 1993). As Francis believed, Eysenck's scales of neuroticism have a strong sex-base component; he found from his studies (Francis, 1993) that Eysenck's scales contain two components: sex-related and sex-free. Therefore, and from an analysis of Eysenck's scales of neuroticism, he derived two measures of this dimension, one of them was sex-related and the other not. He found, after application of these measures, that there were no significant sex differences in neuroticism. However, Heaven and Shochet (1995) administered the same measures used in Francis' study to 144 undergraduate Australian students and he found that the mean scores of males were lower than females on the sex-related and sex-free scales, and that the difference between them was significant at the levels .001 and 0.05, respectively. They concluded that observed sex differences might reflect socio-cultural influences. The influence of culture on neuroticism scores is considered in the following section.

2.10 Cross Cultural Studies of Neuroticism

There is a dispute among researchers in the field of personality about the influence of the environment and biological factors on personality traits. A number of researchers (e.g., Bargeman et al., 1993; H. Eysenck, 1990; McCrae et al., 2000) believe that heredity has a notable effect on dimensions of personality. It is argued that more than

50% of the differences between people in scores of personality traits are due to genetic differences among them (McCrae & Costa, 1999), and that personality traits are more expressions of human biology than the product of life experience (McCrae et al., 2000). Eysenck (1967) reported that heredity has a key role in personality traits; particularly for neuroticism. He suggests that personality traits appear to be related to physiological differences in the brain (see Section 2.7.3). However, Eysenck does not ignore environmental effects on personality, but he believes that these are somewhat limited (Eysenck, 1990). Other researchers, however, argue that the influence of genetic and environment on personality traits is either in roughly equal proportions (Jang, Livesley, & Vernon, 1996; Plomin, DeFries, McClearn, & McGuffin, 2001) or in favour of environmental influences (McAdams & Pals, 2006; Plomin & Nesselroade, 1990).

The role of the environment on neuroticism scores has been supported by researchers who have investigated the role of cultural differences on neuroticism scores and the moderation of age and sex differences in neuroticism scores. It will argue in this section that there is a strong interaction between age differences and cultural differences in explaining individual differences in neuroticism scores among the general population (Donnellan & Lucas, 2008). Furthermore, it will be argued that sex differences also appear to play a key role in explaining individual differences in personality scores as a function of cultural expectations (e.g., Elmadani, 2001; S. Eysenck et al., 1993; Rubinstein, 2005). Researches (e.g., Costa et al., 2001; Hanin, Eysenck, Eysenck, & Barrett, 1991; McCrae et al., 1999; Schmitt et al., 2007), who have examined the role of cultural differences in explaining individual differences in neuroticism scores have found conflicting results. This section, will address a number of empirical studies that have investigated cross cultural differences in neuroticism scores and the moderating effect of sex and age in neuroticism scores.

2.10.1 Cultural Influence on Neuroticism

It is argued that neuroticism scores may vary significantly across different cultures (Costa et al., 2001; Eysenck et al., 1993; Hanin et al., 1991; Lynn, 1981). Lynn (1981) proposed one reason to expect such variation; he argued that there are differences in stress in different countries and these differences are a causal factor, and that among individuals, stress is an important factor of neuroticism and anxiety. According to Lynn

(1981) susceptibility to stress appears to be an important determinant of the level of neuroticism among people from different cultures. He suggested that relevant stress may arise from different sources; it may be from political, social and economic instability, or from war and occupation, or even climates, where some climates might be more stressful than others. Lynn (1981) compared the mean neuroticism scores of nine developed countries with six developing countries of the Middle East on the neuroticism scale of the EPQ; he found that the means of the Middle East countries were higher than advanced countries, and that the difference between the two groups was significant. He explained this difference as that "Life in the advanced Western democracies is relatively unstressful. They are politically stable … and there are no violent revolutions or military coups. The economies are long established and free from the worst ravages of hyperinflation" (Lynn, 1981, p. 273). However, although these variables, which were first identified by Lynn (1981), may contribute to increasing stress, but they may not provide an accurate explanation for the cultural differences in neuroticism because many developing countries, such as Libya, are currently politically stable, their economies are growing strongly, and the economies of many developing countries (compared with Western developed countries) have been less affected by global financial and economic crises, including the current crisis (2007-2010) (Velde, 2008). Moreover, stress may arise from sources other than those mentioned by Lynn (1981). For instance, stress may arise when individuals are unable to create the necessary conditions to achieve their goals (Hobfoll, 1998). Therefore, cultures may differ in term of sources of stress rather than the degree of stress (Aldwin, 2007).

Differences in neuroticism scores were also found between advanced countries. For example, Hanin et al. (1991) compared the performance of 1067 Russian participants on the Eysenck Personality Questionnaire (EPQ) with the original English norms of the EPQ. They found that Russian males were scored significantly higher than English males. Similarly, Eysenck et al. (1993) analysed data of 1257 Canadian participants and 1434 English participants, all the participants having completed the EPQ. The analysis showed that Canadian participants scored lower on neuroticism than the English participants, and that the difference among them was significant at the level .001.

However, there are counter-arguments to the claim that cultural differences in neuroticism scores simply reflect the differences between developing and advanced

countries. Schmitt et al. (2007) administered The Big Five Inventory (BFI) to 17,408 participants from 56 nations; the majority of participants were students, and some were members of the general public. The 56 nations were grouped into 10 geographic world regions: North America, South America, Western Europe, Eastern Europe, Southern Europe, Middle East, Africa, Oceania, South and Southeast Asia, and East Asia. The results of this study did not support the notion of the differences between developing and advanced countries. The finding showed that the main effect of world regions on neuroticism was significant but small. The lowest neuroticism scores were for Africa, while East Asia scored higher than all other world regions. Neuroticism scores of South America and Southern Europe were higher than for all other regions except East Asia. Schmitt et al. (2007) concluded that it is possible that the cross-cultural trait differences, measured by personality instruments, "do not reflect people's enduring dispositions to think, feel, and behave in certain ways but are instead culturally endorsed styles of responding to personality questionnaires" (p. 205).

2.10.2 Importance of Sex and Age Differences in Cultural Studies

Whilst there does appear to be differences in neuroticism scores across different cultures (S. Eysenck et al., 1993; Hanin et al., 1991; Lynn, 1981; Schmitt et al., 2007) these cross-cultural differences appear to be moderated by other factors, including sex and age. For instance, the effect of sex and age on neuroticism scores across cultures has been examined. Many researchers (e.g., Cattell & Kline, 1977; Costa et al., 2001; Huffman, 2004; Rubinstein & Strul, 2007), have found that neuroticism scores among females are higher than neuroticism scores among males. However, the magnitude of sex differences in neuroticism scores was not found to be similar in different cultures. One reason to expect variation in neuroticism scores across different cultures is that cultures differ in the degree to which sex roles are emphasized, which might lead to differences in personality traits (Costa et al., 2001). In line with the social role model, sex differences in personality traits might be greater in developing countries (Matthews et al., 2003), where differences in norms for sex roles are generally larger and there is less equality between the sexes (Keddie, 2007). Nevertheless, Costa et al. (2001) reviewed several studies that investigated the five factor model across 26 cultures and found that the mean scores for females on all neuroticism measures were significantly

greater than that of males across 26 cultures, and that "sex differences are most marked among European and American cultures [*d*s = 46 to .75] and most attenuated among African and Asian cultures [*d*s = .02 to .34]" (p. 327).

Lynn and Martin (1997) analysed the data of studies that examined sex differences on the Eysenck Personality Questionnaire in 37 countries (N = 40315), and found that while females were consistently higher than males in neuroticism across all the 37 countries, there were no significant differences between developing and advanced countries in the magnitude of sex differences in neuroticism scores. Lynn and Martin (1977) conclude that this finding supports the idea that sex differences in neuroticism scores may have a genetic basis.

It is argued, therefore, that neuroticism scores tend to decrease with age across many different cultures. McCrae et al. (1999) investigated role of age differences on the Big Five factor among people from five different cultures: German, Italian, Portuguese, Croatian, and Korean samples. They administrated the NEO-PI–R test to 7361 participants (n = 3051 males, and n = 4310 females) between the ages of 18 and 84 (distributed into five age groups). They found that the youngest group scored higher in neuroticism than the older across all five cultures. They conclude that these are universal maturational changes in adult personality. Similarly, but among many populations, McCrae (2001a) reviewed several studies which used the Revised NEO Personality Inventory (NEO-PI-R) across 26 cultures. Participants in all these studies (N = 23,031) were from community samples representative of five continents. Samples were divided, according to age, into college age (age 18- 21) and adult (age 22+) and the results confirmed that the overall mean scores in neuroticism were lower in adults' populations than college students across all 26 cultures. Moreover, there was no interaction between sex and age differences in neuroticism scores across these different cultures. However, McCrae and Terracciano (2005) reached different conclusions. They and their colleagues in 50 countries asked participants to complete the NEO-PI-R. The participants were divided into two age groups, the college group ranged in age from 18–21 years (M = 19.8); the adult group was aged 40–98 years (M = 49.9). McCrae and Terracciano reported that "only six cultures show the hypothesized decline of N with age, and in two cultures—Estonia and Slovakia—adults scored significantly higher than college-aged group" (p. 557).

It is noteworthy that researchers in the field of personality have yet to reach an agreed consensus on the factors that might influence the neuroticism scores of individuals. Age, sex and culture may all have varying degrees of influence on an individual's neuroticism scores in many studies and across different cultures (c.f., Costa et al., 2001; S. Eysenck et al., 1993; Lynn, 1981; McCrae et al., 1999; McCrae, 2001b). Similarly, the influence of the three variables on intelligence, as discussed in Section 2.4 and 2.5, remains unclear and requires further consideration. This conclusion allows researchers to hypothesise that because sex, age and culture have an influence upon neuroticism and intelligence scores, the relationship between neuroticism and intelligence may also be influenced by the culture, sex and age of participants. The relationship between neuroticism and intelligence scores, which is the main focus of the current thesis, will be considered in the next section.

2.11 Relationship between Neuroticism and Intelligence

Intelligence has become one of psychology's most popularised concepts and the use of IQ tests has become an established and commonly used method for the prediction of school performance and the performance of individuals across a variety of occupations and settings (Chamorro-Premuzic, 2003; Maltby et al., 2007; Neisser et al., 1996; Zeidner & Matthews, 2000). The importance of non-cognitive variables in intelligence has been suggested by a number of researchers. Wechsler (1975) argued that non-cognitive variables are required as well as the cognitive factors in general intelligence. More research conducted by Chamorro-Premuzic and his colleagues (e.g., Chamorro-Premuzic, 2003; Chamorro-Premuzic, Furnham, & Ackerman, 2006; Chamorro-Premuzic, Furnham, & Petrides, 2006) and by Ackerman and others (Ackerman & Heggestad, 1997; Ackerman & Beier, 2003) have suggested that non-cognitive factors such as personality traits play an important role in the development of adult intellectual competence. Performance of individuals on IQ tests may be influenced not only by their abilities but also by their personality traits (Ackerman & Heggestad, 1997; Moutafi et al., 2005; Moutafi et al., 2006).

It is argued that personality and intelligence are two core domains that may not be mutually exclusive but related (c.f., Bonaccio & Reeve, 2006). Given the possibility of overlap, additional research is required to explain the relationship between neuroticism

and intelligence scores further. There is some inconsistency in the research findings from earlier studies regarding the relationship between personality and intelligence which requires more detailed examination. For example, whilst McCrae and Costa (1997) and Brebner and Stough (1995) argued that personality and intelligence are independent of each other, Ackerman and Heggestad (1997) believed that personality and intelligence are independent but correlated. Demetriou, Kyriakides and Avraamidou (2003) described this correlation when they claimed that "personality frames how individuals make use of and control their intellectual abilities and intellectual abilities provide the cognitive background for the formation of interests, preferences, attitudes, and orientations to different types of activities that differentiate between personalities" (p. 548). Therefore a closer examination of this relationship between neuroticism and intelligence is deemed worthwhile.

The following sections will outline results of a number of studies that investigated the relationship between neuroticism and intelligence scores and emphasise the relative importance of taking into account role of age, sex and cultural differences in explaining the relationship between both personality and intelligence scores.

2.11.1 Influence of Neuroticism on Types of Intellectual Abilities

A number of researchers (e.g., Baker & Bichsel, 2006; Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001; Furnham & Chamorro-Premuzic, 2004) have reported that neuroticism is not significantly correlated with intelligence. For instance, Furnham and Chamorro-Premuzic (2004) examined the relationship between neuroticism and general intelligence scores measured by the NEO Personality Inventory—Revised (NEO-PI-R) and the Wonderlic Personnel Test (WPT) respectively, among 187 undergraduate English students (89 females and 98 male, mean age = 20.02 years) and found that neuroticism scores was not significantly related to general intelligence scores.

There is similar evidence to suggest that neuroticism scores are not related to measures of fluid intelligence. For example, Ettinger and Corr (2001) examined the correlation between fluid intelligence as measured by the Raven's Advanced Progressive Matrices (APM) and neuroticism as measured by the Eysenck Personality Questionnaire-Revised (EPQ-R) in a British undergraduate sample (N = 57, males were 26, M age = 25.92, , and females were 31, M age = 23.10,). The correlation between

neuroticism and intelligence was found to be minimal. Di Fabio and Palazzeschi (2009) also reached the same result but among a different sample with respect to age and nationality. Using the same instruments as in the study of Ettinger and Corr (2001), Di Fabio and Palazzeschi (2009) investigated the relationship between neuroticism and fluid intelligence amongst a sample of Italian high school students (N = 124, 34 males and 90 females), with ages ranging from 16 to 20 (M = 17.49) finding very low correlations.

There are similar arguments that measures of crystallised intelligence are not found related to neuroticism scores. Baker and Bichsel (2006) investigated the relationship between personality and intelligence among a large sample of older and younger adults (239 females, 142 males, aged 19–89). They administered to their sample the Big Five Personality Inventory-version 44 and the Woodcock–Johnson III tests of cognitive abilities (WJ-III), which measures crystallised intelligence (Gc), and fluid intelligence (Gf), in addition to five other abilities namely: visual-spatial thinking (Gv), auditory processing (Ga), processing speed (Gs), short-term memory (Gsm) long-term retrieval (Glr). They found that neuroticism was not related to any of the seven cognitive abilities.

Five other cognitive abilities were not found to be related to neuroticism scores. Demetriou et al. (2003) examined the relationship between the big-five factors and five cognitive abilities: (1) *categorical* which deals with similarity-difference relations; (2) *quantitative*, which deals with quantitative variations and relations in the environment; (3) *causal*, which deals with cause–effect relations; (4) *spatial*, which deals with orientation in space and the imaginal representation of the environment; and (5) *propositional*, which deals with the truth/falsity and the validity/invalidity of the flow of information in the environment. The sample comprised 629 Cypriot secondary students (348 females and 281 males, age ranged from 12 to 17 years with mean age = 15.7). They found that correlations between neuroticism and the five cognitive abilities were positive but small and not significant.

By contrast, it is important to address those studies that have found a correlation between neuroticism and intelligence scores. For example, Ackerman and Heggestad (1997) conducted a large meta-analysis of 135 studies with a total of 64,592 participants

and reported that neuroticism was negatively correlated with general intelligence (g), with a modest correlation of the magnitude of r = -0.15, and with some intellectual abilities (e.g., crystallised intelligence, fluid intelligence, knowledge and achievement and math-numerical). Austin et al. (2002) more recently analysed three large datasets conducted in Manchester, Newcastle and Edinburgh and used a number of intelligence tests (e.g., Raven's Standard Progressive Matrices, Culture Fair Intelligence Test and the Digit Symbol Subtest of the Wechsler Adult Intelligence Scale) and personality scales (e.g., Eysenck Personality Questionnaire and NEO Five Factor Inventory). The results of this study revealed negative and significant correlations between neuroticism and intelligence scores among the Manchester, Newcastle and Edinburgh samples. Austin et al. (2002) referred this relationship to differential item comprehension; people with high intelligence are better able to "discriminate the constructs underlying [neuroticism] and it is this effect which is reflected in their responses. The less intelligent are either less able to discriminate the constructs or, perhaps, understand the items less well and this induces a correlation between [neuroticism and intelligence])" (Austin et al., 2002, p. 1408).

Taking into account the effect of age differences in neuroticism scores, Lounsbury et al. (2005) found that neuroticism scores were negatively related to cognitive abilities among their samples of 457 American middle school students (*M* age =11.63), and 375 high school students (*M* age =15.81). Both samples completed the Adolescent Personal Style Inventory (APSI) and a cognitive abilities test, which measure the big five personality traits, and verbal and numerical reasoning abilities, respectively. The results indicated that there were negative and significant correlations between scores of participants on both scales among both samples.

A significant correlation has also been found between neuroticism and fluid intelligence scores. Furnham, Rawles, and Iqbal (2006) have administered a brief measure of the big five factors and the Baddeley Reasoning Test (BRT), which measures the big five personality trait and fluid intelligence (Gf) respectively, to 240 secondary school students (187 females and 53 males, mean age = 18.66 years, *SD* = 4.06). They found that neuroticism was negatively and significantly correlated with fluid intelligence scores.

However, it is argued that the type of measures that are used in such studies is important in determining the relationship between personality and intelligence. This argument is supported by the finding of a study conducted by Furnham and Monsen (2009). In this study, the full NEO Five-Factor Inventory-Revised, instead of a brief version that was used in the study of Furnham et al. (2006), was administered to 334 English secondary school students. The relationship between neuroticism and fluid intelligence as measured by BRT was zero.

Moreover, the relationship between neuroticism and intelligence was found to be mediated by test anxiety. Chamorro-Premuzic, Furnham, and Petrides, (2006) reported that neuroticism has negative effects on the performance of individuals on tests because of its “Likelihood to elicit test anxiety and lack of confidence” (p. 149). Moutafi, Furnham and Palttel (2005) argued that during the period of the test, individuals experienced high level of test anxiety (state anxiety) which negatively impacted their performance on intelligence measures.

The mediation of test anxiety in the relationship between neuroticism and intelligence was supported in the study by Moutafi, Furnham and Tsaousis (2006). In this study, Moutafi et al., (2006) examined the neuroticism scale of the Traits Personality Questionnaire (TPQue5) and the Raven’s progressive matrices were administrated to 113 Greek university students. Before the participants completed the TPQue5, they were asked to specify the level of anxiety that they felt at that moment on a scale from 1 to 10 (in order to estimate test anxiety). The findings showed that the correlation between neuroticism and intelligence was significant. However, after the effect of test anxiety was partialled out the relationship between neuroticism and intelligence was not significant. Moutafi et al. (2006) suggested that the negative correlation between neuroticism and intelligence was because "neurotics become more anxious under testing conditions, and this anxiety affects their performance on the IQ tests. It is therefore proposed that neuroticism is not related to intelligence per se but to intelligence test performance." (p. 595).

2.11.2 Intelligence and Individual Differences in Neuroticism Scores

While previous studies have each examined the relationship between intelligence and neuroticism scores, it is important to note that they have not examined individual differences in neuroticism scores. It is argued that rather than considering neuroticism as a whole, it may be that the level of neuroticism plays a more subtle role in explaining individual differences in intelligence scores. The correlation coefficient between intelligence and neuroticism scores refers to the degree and direction of the relationship between these two variables. Nevertheless, it does not tell us about the point at which the effect of the relationship began. Previous researchers (e,g., Ackerman & Heggestad, 1997; Austin et al., 2002; Escorial et al., 2006; Lounsbury et al., 2005) reported negative correlations between neuroticism and intelligence scores. However, their results did not explain whether the performance on intelligence scales will be negatively affected even by the low levels of neuroticism, or wither it will only be affected by the high levels of neuroticism. Few researchers have considered the impact of the level of neuroticism on the performance of participants on measures of intelligence and reached conflicting results.

A high level of neuroticism was found to be a positive factor in explaining variations in an individual's intelligence scores. This statement was reported by Austin, Deary, and Gibson (1997) who investigated the relationship between neuroticism and intelligence scores using a sample of 210 Scottish farmers (208 were males), their mean age was 48.4 (11.3) years. All participants completed the NEO Five Factor Inventory (NEO-FFI), the National Adult Reading Test (NART) and Raven's Standard Progressive Matrices (SPM). Based on mean neuroticism scores, participants were divided into two groups with standardised neuroticism scores above and below zero. Results showed that while the correlation between neuroticism and intelligence scores, as measured by SPM and NART, were small and non-significant among the low neuroticism group, both correlations among the high neuroticism group were significant. In contrast, the high levels of neuroticism were found to correlate negatively with individuals' intelligence scores in the study of Escorial, Garcia, Cuevas, and Juan-Espinosa (2006). In this study, the researchers administrated the Spanish version of the NEO five-factor inventory and three cognitive tests of the primary mental abilities

battery (PMA): vocabulary, spatial rotation and inductive reasoning, to a sample of Spanish college students ($N = 569$), and divided the sample into three groups (low, medium, and high), according to the norms of the NEO Five-Factor Inventory to investigate the effect of levels of neuroticism on intelligence scores. Escorial et al. (2006) found that the mean scores of the low neuroticism group were higher than that of the medium and high neuroticism groups on the three cognitive tests, the largest difference (2.47) is observed in the vocabulary test between low and medium neuroticism groups with a small effect size of 0.25.

The different types of intelligence measures that have been used in the previous studies could in part provide some possible explanation for the conflicting results of the relationship between neuroticism and intelligence. Stough et al. (1996) suggested that because many tests may only share 30-40 per cent common variance when correlated, if personality traits do not correlate with a specific test of intelligence they may still correlate significantly with another test. Therefore, the best approach is to use a range of intelligence tests that cover a wider range of cognitive and non-cognitive factors (Escorial et al., 2006; Stough et al., 1996).

2.11.3 Influence of Neuroticism on an individual's performance on Wechsler Intelligence Tests

As reported in Section 2.11.2, previous research (e.g., Escorial et al., 2006; Stough et al., 1996) has shown that there is a tendency to examine the relationship between neuroticism and intelligence using a wide range of intelligence tests that cover a wider range of cognitive factors. There is a lack of consistency over measures used within previous studies therefore it is difficult to make any specific comparisons or indicative conclusions. Wechsler's intelligence tests were designed to measure a broader range of cognitive and non-cognitive abilities in addition to the general factor of intelligence 'g' (Wechsler, 1975) and therefore, considered to be the most widely-used tests by psychologists, who are evaluating cognitive performance (Greve et al., 2003; Maleka, 1996). More specifically, although there are several researchers that have investigated the relationship between intelligence and personality traits (e.g., Austin et al., 1997; Chamorro-Premuzic, Furnham, & Petrides, 2006; Escorial et al., 2006; Furnham & Chamorro-Premuzic, 2004; Moutafi et al., 2006), studies that have utilised the entire Wechsler Adult Intelligence Scale (WAIS) are limited. Holland, Dollinger, Holland, and

MacDonald (1995) examined the relationship between psychometric intelligence and the five-factor of personality. They administrated the Wechsler Adult Intelligence Scale- Revised (WAIS- R) and the NEO-PI to 85 rehabilitation clients, 56 males and 29 females, mean age 34.15 (9.99). They found that the only significant correlation, but with small effect size, was on the Picture Arrangement subtest. The other correlation coefficients were almost zero except on the Picture Completion. Correlation coefficients between the neuroticism scores and the WAIS-R scores are presented in the Table 2.

Table 2

Correlation Coefficients between Neuroticism and WAIS-R Scales (Based on Holland et al., 1995)

	WAIS-R scales	Correlation Coefficients
WAIS-R IQs	Full Scores FSIQ	.02
	Verbal Intelligence VIQ	-.02
	Performance Intelligence PIQ	.06
Verbal subtests	Information	.01
	Digit span	-.01
	Vocabulary	.04
	Arithmetic	.04
	Comprehension	-.03
	Similarities	.06
Performance subtests	Picture completion	.17
	Picture Arrangement	.25*
	Block Design	-.05
	Object Assembly	.02
	Digit symbol	-.07

Source : Holland et al. (1995) $^{*}p < .05$.

In similar studies, neuroticism has been found to be negatively correlated with both verbal and performance-related intelligence scores. Stough et al. (1996) for example examined the relationship between neuroticism and intelligence scores among 68 undergraduate students, their mean age was 18.1(2.0). The WAIS-R and the EPQ were used to measure the intelligence and neuroticism, respectively. They found that neuroticism was negatively related to the Verbal IQ and Performance IQ scores, while the relationship between neuroticism and the full scores of intelligence was almost zero. However, all the correlation coefficients were non-significant. The relationship between neuroticism and WAIS-R subtests scores was not investigated in this study.

It is argued that the performance of individuals with high neuroticism scores on the Performance IQ scale of WAIS is lower than their performance on the Full Scale IQ and the Verbal IQ scales. This argument has received some support from a study conducted by Saggino and Balsamo (2003). In this study, 100 Italian participants (*M* age = 78.6), completed the WAIS-R and the NEO-PI-R to measure intelligence and personality traits, respectively. Partialling out sex, age, and years of education, the correlations between neuroticism and the Performance IQ scale and subtests scores were higher than correlations between the Verbal IQ scale and subtests scores. All the correlations were negative and were significant on the Performance IQ scale, and on the Picture Arrangement and Object Assembly subtests. Correlation coefficients between the neuroticism scores and the WAIS-R scores are presented in Table 3.

Table 3

Correlation Coefficients between Neuroticism and WAIS-R Scales (Based on Saggino and Balsamo, 2003)

	WAIS-R scales	Correlation Coefficients
WAIS-R IQs	Full Scores	-.24
	Verbal Intelligence	-.14
	Performance Intelligence	-.29*
Verbal subtests	Information	-.07
	Digit span	-.02
	Vocabulary	-.14
	Arithmetic	-.12
	Comprehension	-.15
	Similarities	-.07
Performance subtests	Picture completion	-.13
	Picture Arrangement	-.37*
	Block Design	-.24
	Object Assembly	-.33*
	Digit symbol	-17

Source: Saggino and Balsamo (2003) $^{*}p < .05$.

2.12 Role of Sex and Age in the Relationship between Neuroticism and Intelligence Scores

As shown in the preceding sections of this chapter, the relationship between neuroticism and intelligence scores has been comprehensively investigated but often the findings from previous studies appear contradictory. However, it is important to acknowledge that relatively few studies have considered the role of age and sex differences in the relationship between the two variables although many researchers have presented sex and age as possible explanations for individual differences in intelligence and neuroticism. There is some evidence to suggest that both sex and age differences in students may be important in explaining the possible relationship between

intelligence and neuroticism scores. For instance, in an early study, Lynn, Hampson, and Magee (1984) examined 701 adolescents (aged 15/16 years) from N. Ireland. Participants were tested for intelligence and for Eysenck's personality traits using the Abstract Reasoning scale of the Differential Aptitude Test, and EPQ, respectively. The correlation between neuroticism and intelligence for females was negative and non-significant while for males, this was positive and significant. This indicates that the impact of sex is not just on the magnitude of the correlation between both variables but also on the direction of this correlation.

By contrast, neuroticism was negatively correlated with fluid intelligence scores just among males. Jorm et al. (1993) administered the neuroticism scale of the short form of the Eysenck Personality Questioner Revised (EPQ-R) and a number of cognitive functioning measures (e.g., the Mini-Mental State Examination [MMSE]; the National Adult Reading Test [NART]; the Symbol Letter Modalities Test [SLMT] and scale of episodic and semantic memory) to an elderly community sample (344 women and 367 men, age 70+ years). The findings indicated that the correlation coefficients between neuroticism and cognitive functioning were not the same for males and females. Correlations between the neuroticism scale and the MMSA, SLMT and episodic memory test were negative and significant among the males sample (r = -.26, -.19, and -.25, respectively, all $p < .001$), while among females, correlation coefficients were very small (r_s = -.05, -.08 and -.07, respectively, all $p > .05$). Although Jorm et al. (1993) and Lynn et al. (1984) did not explain the factors behind the sex differences in the pattern of correlations between neuroticism and cognitive function, their findings have contributed to our understanding of the role of sex in explaining the relationship between intelligence and neuroticism scores. Moreover, the inverse pattern of the correlations among males in both studies reflects the role of age in explaining this association between neuroticism and intelligence test scores, since the male sample in the study of Jorm et al. were an elderly sample (age 70+ years), while all the males in the study of Lynn, et al. were adolescents (age 15-16 years).

Contrary to the two previous studies, sex differences were not found to be important in explaining the correlation between neuroticism and intelligence scores. For example, Chamorro-Premuzic, Furnham, and Petrides (2006) investigated the relationship between Eysenck's personality dimensions, using the Eysenck Personality Profiler

(EPP), and verbal and numerical cognitive ability, measured by the Employee Aptitude Survey (EAS). After administering the materials to 118 job applicants in New Zealand, the findings showed that verbal cognitive ability were positively correlated with emotional stability (low neuroticism scores), while numerical ability scores were not related significantly to emotional stability. Sex had no effect on the correlations between emotional stability and both verbal and numerical cognitive abilities since both correlations remained stable even after controlling for sex differences.

With one exception (Lounsbury et al., 2005) the majority of previous work has not fully considered the role of age differences in the relationship between neuroticism and intelligence. However, some findings from previous studies have contributed to our understanding of the importance of age differences in explaining the relationship between intelligence and neuroticism, and the importance of further examination for the role of age differences on the relationship between both variables. For example, Furnham, et al. (2006) has carried out two studies which support the importance of age difference on explaining the relationship between both factors. In Study 1, 240 secondary school students (187 females and 53 males, mean age = 18.66, *SD* = 4.06) completed a brief measure of the big five factors and the Baddeley Reasoning Test (BRT), which measures fluid intelligence (Gf). Neuroticism was negatively correlated with fluid intelligence However, in Study 2, which involved 70 undergraduates (54 females and 16 males, age ranged from 18 to 26 years), the correlation between neuroticism and fluid intelligence, using the BRT, was positive and non significant.

However, age differences were not found to be effective in two other studies that used the same materials to investigate the relationship between neuroticism and intelligence among the same population. Chamorro-Premuzic, Furnham, and Ackerman (2006) administered the revised NEO Personality Inventory and the Baddeley Reasoning Test (BRT) to measure personality traits and fluid intelligence respectively, to 201 British University students (134 female, 67 males, mean age = 20.31 yeare, *SD* = 3.67). The results showed that neuroticism was not related to fluid intelligence, $r = .00$. Using the same tests, Furnham and Monsen (2009) also found no relationship between neuroticism and fluid intelligence among 334 British secondary school students.

2.13 Cross Cultural differences in the Relationship between Neuroticism and Intelligence

As argued in the previous section of this chapter, intelligence and personality traits are likely to vary cross-culturally, and to fully investigate the relationship between personality and intelligence, studies need to fully examine the role of cultural differences when assessing the relationship between personality and intelligence scores.

The findings from previous studies have contributed to our understanding of the role of cultural diversity on explaining the relationship between intelligence and neuroticism; however, further research is required. For example, among Cypriot secondary students, Demetriou, et al., (2003) found that correlations between neuroticism scores and five cognitive abilities (such as verbal and numerical abilities) were small, positive, but not significant. By contrast, Chamorro-Premuzic, Furnham, and Petrides (2006) reported among an adult New Zealand sample, that the correlation coefficients of emotional stability, and low neuroticism scores, were positive and significantly associated with verbal reasoning ability, but not with numerical ability scores. Lounsbury et al. (2005) reported different results among an American students sample showing a negative correlation between neuroticism scores and verbal and numerical abilities. Finally, Ettinger and Corr (2001) and Di Fabio and Palazzeschi (2009) found no relationship between neuroticism, measured by Eysenck Personality Questionnaire-Revised, and intelligence, measured by Raven's Progressive Matrices, among British university and Italian high school students, respectively, while, among Greek university students, Moutafi et al. (2006) found a negative and significant relationship between neuroticism and intelligence scores measured by Raven's Progressive Matrices.

Using the Wechsler Adult Intelligence Scale-Revised (WAIS-R), Holland et al. (1995) investigated the relationship between neuroticism and intelligence among an American sample and reported that all the correlation coefficients were almost zero. In particular, the correlation between neuroticism and Verbal Intelligence IQ was negative and almost zero and the correlation between neuroticism and Performance Intelligence IQ was positive and very small. In contrast, Stough, et al., (1996) administered the same scale to 68 Australian university students and found that the correlation between

neuroticism and the Verbal Intelligence IQ was also negative but much higher than it was in the study of Holland et al. (1995). Moreover, in this study the correlation between neuroticism and performance IQ was negative and higher than it was in the study of Holland et al. However, in both studies, correlations were not significant.

The role of culture can be also inferred from the different results of two studies that were conducted among American and Australian samples. In the first, Baker and Bichsel (2006) found that neuroticism was not related to fluid intelligence (Gf) and crystallised intelligence (Gc) among an adult American sample, while in the second study, Jorm et al. (1993) found negative correlations between neuroticism and fluid intelligence in an Australian sample. Specific associations differed by sex: neuroticism was negatively and significantly related to a measure of Gf among males, whereas negative but not significant in women (see Section 2.12)

2.14 Chapter Summary

The current chapter reviewed previous literature on personality traits and intelligence theories with a particular focus on the role of neuroticism in explaining an individual's intelligence test scores. It also reviewed the literature on the possible influence of age, sex and cultural differences in both neuroticism and intelligences scores and on the relationship between both variables.

It is clear that there is still no agreed statement about the meaning and nature of intelligence. Most theories of intelligence are based on hierarchical models. These models were created by Spearman, who argued that there is one general factor 'g' underlying all specific abilities. Influenced by the work of Spearman, Cattell (1971) distinguished between two types of 'g': fluid intelligence and crystallised intelligence. The first is not relatively influenced by environmental factors; therefore fluid intelligence decreases with age. By contrast, crystallised intelligence depends on environment factors; therefore increases with age as increasing of knowledge and experience. Further, instead of a general factor, Thurstone (1938) proposed seven primary mental abilities and claimed that general intelligence is the result of these seven abilities. Inconsistent with the notion of general factor, Howard Gardner in his theory of multiple intelligences, refused the relationship between mental abilities, and claimed

that these abilities are independent, and that each of them constitutes a different type of intelligence. Such is the case of Robert Sternberg's theory of intelligence.

Although there appears to be considerable evidence for the existence of a general factor of intelligence, it is only a combination of specific mental abilities (e.g., abstract reasoning, visual and auditory perception, speech flow, general memory and place memory) (Chamorro-Premuzic, 2003; Wechsler, 1950). Wechsler (1950, 1975) argued that intelligent behaviour requires these specific mental factors but also requires other necessary factors which he called non-intellective factors, such as personality traits. Other researchers (e.g., Ackerman & Heggestad, 1997; Ackerman & Beier, 2003; Chamorro-Premuzic, Furnham, & Ackerman, 2006; Chamorro-Premuzic, Furnham, & Petrides, 2006; Sternberg et al., 2000) have supported the importance of non-cognitive factors in intelligence. However, the majority of intelligence scales, according to Wechsler (1975) measure just a variety of mental abilities. Wechsler therefore published his tests of intelligence, which were designed to measure a wider range of cognitive and non-cognitive abilities in addition to the general factor of intelligence 'g' (Wechsler, 1975). Besides, Wechsler intelligence tests, such as WAIS-III, are considered to be the most widely-used tests by psychologists, who are evaluating cognitive performance (Greve et al., 2003; Maleka, 1996). Therefore, the current thesis will use the WAIS-III to examine the relationship between neuroticism and intelligence, and will employ the term intelligence scores to refer to individual performance on the WAIS-III IQ scales and subtests.

The role of sex and age differences in intelligence scores seems to be relatively unclear. Whereas researchers (e.g.,Furnham & Monsen, 2009; Lynn & Dai, 1993; Rushton et al., 2007) supported the advantage of males in general intelligence, findings of others researchers (e.g., Holland et al., 1995; Maleka, 1996) have not found sex differences in general intelligence. Similarly, researchers who examine the role of age differences in intelligence scores have reached conflicting results. Some of them have reported that performance of individuals on tests measure fluid abilities, such as the Performance IQ scale of WAIS**,** tends to decline with age (Tucker-Drob & Salthouse, 2008), and that performance on tests measuring crystallised abilities, such as the Verbal IQ scale of WAIS, tends to increase with age (Kaufman & Horn, 1996). However, the findings of other studies did not confirm these results either for fluid abilities (Moutafi

et al., 2003) or for crystallised abilities (Shuttleworth-Edwards et al., 2004). These conflicting results offer good evidence about the importance of further investigation of the effect of sex and age differences and the interaction between both sex and age variables in intelligence scores.

Cultural differences are another factor that has contributed to intelligence scores, particularly crystallised abilities, which depend on information and skills that are acquired through experience and education within a culture (Chamorro-Premuzic, 2003; Kaufman & Lichtenberger, 2002). Researchers, therefore, have expected differences in intelligence across cultures as result of differences between cultures in terms of education and technology (Greenfield, 1998), economy (Rushton & Čvorović, 2009) and customs and life style (Westen, 1999). Nevertheless, and with some exceptions (Lynn & Vanhanen, 2006), the findings of most cross cultural studies in intelligence are essentially confined to studies of Europeans, East Asians and North Americans; the Arabic culture is a culture that has not received much attention although it may significantly differ from these cultures in terms of education, economy, interests, and customs, (Hofstede, 2001; Keddie, 2007). Furthermore, the interaction between sex, age and cultural differences in influencing intelligence scores has not received attention from researchers in the field of intellectual behaviour although the effect of each factor in intelligence scores has received some support. Therefore, the extent to which cultural differences can explain the sex and age differences in intelligence scores still requires further consideration. One of the current aims of the thesis is to further examine the effect of sex and age differences in intelligence scores, and to examine the extent of the role of cultural differences between Libya and Britain on the magnitude of any sex and age differences in intelligence scores.

Sex, age and culture are three factors proposed to influence scores of people in neuroticism scales. Indeed, there is a tendency among researchers in the field of personality traits to assume that females are more neurotic than males (e.g., Cattell & Kline, 1977; Huffman, 2004; Matthews et al., 2003) and that neuroticism scores reduce with age (e.g., Costa et al., 2000; H. Eysenck & Eysenck, 1991a) across difference cultures (Fung & Ng, 2006; McCrae et al., 2004). Moreover, researchers (e.g., Costa et al., 2001; Lynn, 1981; Lynn & Martin, 1997) suggested that the magnitude of level of neuroticism and sex differences in neuroticism scores may vary as a function of cultural

expectations. Nonetheless, these findings are not conclusive because other researchers have not confirmed either sex differences in neuroticism scores (e.g., Abdullatief, 1990; Rubinstein, 2005) or the relationship between age and neuroticism scores (e.g., Aboalniel & Doosoki, 1986; Kim et al., 2009). Therefore, further research is required.

This chapter was also concerned with the possible relationship between personality and intelligence scores and the possible influence of age, sex and cultural differences in this relationship. It has summarised a number of studies that have previously examined this relationship between neuroticism and intelligence scores in typical student populations (e.g., Furnham et al., 2006; Furnham & Monsen, 2009; Lounsbury et al., 2005). However, previous researchers have reached different results. For example, while neuroticism was not found to be significantly correlated with general intelligence (Furnham & Chamorro-Premuzic, 2004), fluid intelligence (Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001), crystallised intelligence (Baker & Bichsel, 2006), and a number of cognitive abilities (Demetriou et al., 2003), neuroticism was reported to be correlated with general intelligence and a number of intellectual abilities in 135 studies (Ackerman & Heggestad, 1997). Moreover, the relationship between neuroticism and intelligence was found to be mediated by test anxiety (Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2005; Moutafi et al., 2006).

It was noticed that the aim of most of these previous studies was to investigate the magnitude of the linear relation between cognitive abilities and neuroticism trait as a whole. However, few researchers have considered the impact of level of neuroticism on the performance of participants on measures of intelligence and also reached conflicting results. The low level of neuroticism, for example, was not found to be an effective factor in intelligences scores while the high level of neuroticism was found to be either a positive factor (Austin et al., 1997) or a negative factor in intelligences scores (Escorial et al., 2006). Therefore, the current work will investigate the impact of level of neuroticism on the performance of participants on the Wechsler's intelligence scales, which were designed to measure a wider range of fluid and crystallised abilities in addition to the general factor of intelligence 'g' (Wechsler, 1997). Moreover, although typically the performance of an individual on the subtests of Wechsler's intelligence scales differs across different subtests; an assessment of the variability helps the examiner identify the strengths and weaknesses of the individual's performance

(Wechsler, 1997). Similarly, the amount of difference between the IQs scores of Wechsler's intelligence scales is an important consideration in interpreting the performance of individuals. It is very important to determine that the difference between the scores is a true difference or by chance (Maleka, 1996; Wechsler, 1997). In this respect, Maleka (1996) reported that differences between the Verbal IQ and the Performance IQ scores increase among individuals who have difficulties in adaptation or have neurotic disorders. Therefore, the current work examines whether differences between the Verbal IQ and the Performance IQ scores, and the difference between a single subtest score and average of subtest scores, will increase among participants with high level of neuroticism.

Although there is growing evidence for sex, culture and age differences in individuals' neuroticism and intelligence scores across different cultures, very few studies (Jorm et al., 1993; Lynn et al., 1984) have considered sex and age differences in the relationship between neuroticism and intelligence. Results of these studies however were contradictory. For example, while neuroticism was found to be correlated with intelligence among males more than among females (Jorm et al., 1993; Lynn et al., 1984), the direction of theses correlations was not similar. Moreover, Chamorro-Premuzic, Furnham, and Petrides (2006) found that sex was not important on the correlation between neuroticism and intelligence. Similarly, neuroticism was found to be negatively correlated with fluid intelligence among secondary school students, while was not correlated with fluid intelligence among undergraduate students (Furnham et al., 2006). The findings of such studies have contributed to our understanding of the importance of sex and age difference on explaining the relationship between intelligence and neuroticism and the importance of further examination for the role of sex and age differences on the relationship between both variables.

Moreover, although none of the previous studies (as the best knowledge of the researcher) have aimed to examine cultural differences in the relationship between neuroticism and intelligence, the findings from previous studies have contributed to our understanding of the importance of cultural diversity on explaining the relationship between intelligence and neuroticism. For instance, neuroticism was significantly correlated with general intelligence among a Greek university sample (Moutafi et al., 2006), while, using the same materials, was not correlated with general intelligence

among a British university sample (Ettinger & Corr, 2001).

All in all, it is noteworthy that the specific nature of the relationship between neuroticism and intelligence scores and the mediating nature of age, sex and cultural differences on this relationship in both neuroticism and intelligence scores require further consideration. Therefore, the current thesis examines the effect of neuroticism scores on students' performance on the WAIS scales and subtest and the role of sex, age and cultural differences on this effect. The next chapter will describe the tools of the research, which will used to do this investigation.

CHAPTER 3: Methodology

3.1 Introduction

This chapter will outline the description and psychometric properties of the research tools that are used within the current thesis in addition to the procedures that will be applied to address the aims in the current thesis. As outlined in Chapter 2, researchers (e.g., Escorial et al., 2006; Stough et al., 1996) have suggested that the best way to investigate the relationship between personality and intelligence is to use a range of tests of intelligence that cover a wide range of cognitive factors. In the current thesis, a psychometric approach is used to examine the relationship between neuroticism and intelligence scores across two different cultures; namely Libya and Britain. To address the relationship between neuroticism and intelligence scores, two specific measures will be developed and used. The first is the Wechsler Adult Intelligence Scale (WAIS), which is designed to measure a wider range of cognitive abilities (Wechsler, 1975) and is the most widely-used test by psychologists evaluating cognitive performance (Greve et al., 2003). The second is the Neurotic Behaviour Scale (NBS); this was designed by the author (Elmadani, 2001) to measure the trait of neuroticism separately from other personality traits. This chapter will begin by highlighting in brief the influence of culture on personality and intelligence, and then will outline the main differences between the Libyan and British samples of the current thesis before summarising the psychometric properties of the Wechsler intelligence scales. Finally, this chapter will summarise the procedures that were conducted to create the NBS and ascertain its psychometric properties.

3.2 Cultural Influence on Personality and Intelligence

According to the big five model (c.f., McCrae; 2001b, McCrae & Costa, 1999) personality traits representing basic tendencies are expressed in characteristic adaptations, such as habits, roles, attitudes, and relationships, which can be largely influenced by the culture in which a person exists and can vary greatly across cultures. McCrae (2001b) suggested that people develop these characteristic adaptations during their response to environmental pressures, which are consistent with their personality traits. The role of culture on neuroticism scores has been supported by researchers who

have investigated the role of cultural differences on neuroticism scores and the cultural variations in sex and age differences in neuroticism scores. Neuroticism scores are found to be highly variable across different cultures; amongst Russian males they were significantly higher than scores of English males (Hanin et al., 1991), and Canadian participants' neuroticism scores were significantly lower than the English participants (Eysenck et al., 1993). In an early study, Lynn (1981) compared the mean neuroticism scores of nine developed countries with six developing countries of the Middle East on the neuroticism scale of the EPQ and found that the mean neuroticism scores of the individuals in Middle East countries were significantly higher than those individuals in more advanced countries. The explanation that was given by Lynn for these differences refers to differences in stress between developed and developing countries: "Life in the advanced Western democracies is relatively unstressful. They are politically stable … and there are no violent revolutions or military coups. The economies are long established and free from the worst ravages of hyperinflation" (Lynn, 1981, p. 273).

Sex differences appear to play a key role in explaining individual differences in neuroticism scores as a function of cultural expectations. Although there is a tendency among researchers in the field of personality traits to assume that females are more neurotic than males (e.g., Cattell & Kline, 1977; Huffman, 2004; Matthews et al., 2003; Rubinstein & Strul, 2007), the magnitude of sex differences in neuroticism scores was found to vary across different cultures. Costa et al. (2001) argued that cultures differ in the degree to which sex roles are emphasized, which should lead to differences in personality traits. In line with the social role model, sex differences in personality traits might be greater in developing countries (Matthews et al., 2003), where differences in norms for sex roles are generally larger and there is less equality between the sexes (Lynn & Martin, 1997). On the other hand, Costa et al. (2001) analysed data obtained from 23,031 participants in 26 cultures and found that sex differences were most marked among European and American cultures and most attenuated among African and Asian cultures. They also reported that sex differences were positively and significantly associated with individualism; Western countries with individualistic values have greater sex differences in self-reported personality traits than non-Western countries. Individualism refers to the characteristic of cultures in which each person is "expected to look after him/herself and his/her immediate family only. Collectivism

stands for a society in which people from birth onwards are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (Hofstede, 2001, p. 225). Similar findings were also reported by McCrae and Terracciano (2005) who asked participants from 50 cultures to complete the NEO-PI-R. The results showed that the smallest sex differences were among Asian and African cultures, while European and American cultures showed the largest sex differences in neuroticism scores.

It is possible that these sex differences in neuroticism scores among European and American cultures reflect differences in cultural norms for sex roles between individualistic and collectivistic cultures, that is, cultures differ in the degree to which sex roles are emphasized (Costa et al., 2001; Matthews et al., 2003). In collectivistic cultures, such as African cultures, individuals doing their duties as defined by the in-group, and carrying out their roles in the in-group in the best possible way (Triandis, 1994); thus, men should do the heavier chores and the duty of men is to provide a better life for those who live with them, while the main duty of women is to home and family (Berry, Poortinga, Segall, & Dasen, 1992); this may reduce stress and anxiety among women and thus their level of neuroticism. In contrast Costa et al. (2001) argued that variations in sex differentiation in neuroticism scores may be a result of differences in gene pools between European and non-European countries. They argue that if the magnitude of sex differences in neuroticism is the result of culture, one would expect US-born African Americans, Asian Americans, and European Americans to show the similar patterns of sex differences. Instead, "A preliminary study (McCrae, Herbst, & Masters, 2001) of African American samples … showed small gender differences that more closely resembled those of Asian and African cultures than of European cultures" (Costa et al., 2001, p. 329). The finding of McCrae et al. (2001), however, may refer to traditional sex role ideology of African American subculture rather than gene pools.

As highlighted in Chapter 2, there are contradictory findings with regard to the role of cultural differences on patterns of age differences in neuroticism scores. Researchers argue that the degree of neuroticism among individuals is not equal at all ages (H. Eysenck & Eysenck, 1991a), with the highest level appearing in adolescence (Schultz & Schultz, 2005), and that an individual's neuroticism score reduces with age, and this decline begins almost at the age of 18 (McCrae, 2001a; 2001b). McCrae et al. (1999)

found that this decrease in the degree of neuroticism with age occurs similarly for males and females, and across different cultures. Costa et al. (2000) argued that age differences in personality appeared to reflect maturational changes rather than cohort differences; men and women aged between 18 and 30 years becoming more emotionally stable, more socially independent, more conventional, and goal-directed. Millsap and Hartka (1986) argued that personality traits change between adolescence and young adulthood "When most people make the profound role shifts entailed by entry into full-time work and marriage" (Haan et al. 1986, p. 225). However, cultures may differ in the factors that affect maturational processes, such as work, marriage, and education, and therefore, patterns of age differences in neuroticism scores were not similar among British and German samples (c.f. Donnellan & Lucas, 2008), and among American and Russian samples (c.f. Costa et al., 2000). Cultural variations in age differences in neuroticism scores also appeared in the study of McCrae and Terracciano (2005); who examined age differences in neuroticism scores in 42 cultures. They reported that "only six cultures show the hypothesized decline of [neuroticism] with age, and in two cultures – Estonia and Slovakia – adults scored significantly higher than the college-aged group" (p. 557) (see Section 2.9.1).

Cultural diversity may play an important role in explaining differences in intelligence scores. As discussed in chapter 2, there has been an increasing interest in research questions about the influence of cultural background on individuals' intelligence. Neisser et al. (1996) argued that the cultural environment that people live in is an important factor, not just on intelligence scores, but also on the type of intelligence that might develop. The meaning of intelligence differs across cultures (Matsumoto & Juang 2008, Maltby et al., 2007), that is, different cultures value different traits and have various views concerning which traits are useful in predicting future important behaviour. People in different cultures disagree not only about what comprises intelligence, but also about the appropriate way to show those abilities. These differences are important because successful performance on a task of intelligence may require behaviour that is considered unpleasant and arrogant in culture 'A', but desirable in culture 'B'. Such different attitudes toward the same behaviour could lead cross-cultural researchers of intelligence to draw inaccurate conclusions about the difference in intelligence between culture 'A' and 'B' (Matsumoto & Juang, 2008).

While the level of Fluid intelligence (gf) in an individual is determined by the degree of complexity of relations that an individual can insightfully respond to, regardless of what cultural domain the complexity exists (Cattell & Horen, 1978), the Crystallised intelligence (gc) is a product of environmental variation and depends on information and skills that are acquired through experience and education within a culture (Cattell, 1963; 1971). Therefore, whereas gf will decline from about the age of 22 continuously to old age, the gc will increase with age, as there is an increase in knowledge and experience. However, cultures differ in terms of the level of change and the beginning of a decline, which depends on education and the cultural learning period (Cattell, 1963).

Cross-cultural research on cognitive abilities highlights some interesting cultural difference in many cognitive processes including perception, attention, numerical abilities, and problem-solving. Matsumoto and Juang (2008) believed that the demonstration of differences in any cognitive process between cultures cannot be used to make claims about any specific cultural factors causing those differences. Nonetheless, Matsumoto and Juang (2008) proposed the amount and the types of technologies used in the countries today may provide a possible explanation for cross-cultural differences in an individual's cognitive abilities. They also believed that differences observed may be attributed to differences in educational style between cultures. The role of education and technology on cross-cultural differences in cognitive abilities were also proposed by Greenfield (1998). The economy according to Rushton and Čvorović (2009) is another factor; they reported that as the trend towards a more global economy continues, national differences in IQ scores are likely to become greater.

Since there are extreme differences between Libya, as one of the developing countries, and Britain, as one of the more advanced countries, in terms of education and technology (Greenfield, 1998, Hofstede, 2001), economy, sex roles (United Nations Development Programme, 2009, Keddie, 2007, Matthews et al., 2003), individualism/collectivism dimension (Hofstede, 2001), then examining the role of cultural differences on the relationship between neuroticism and intelligence scores seems worthwhile. The next section will outline the main differences between Libya and Britain before reviewing the psychometric features of the proposed research tools.

3.3 Data Sample

3.3.1 Libyan Sample

Libya is part of the Arab world, which is officially composed of twenty-one states inhabited by a relatively young population. The Arab states are relatively similar in several aspects. For example, Islam is the religion followed by the majority of the Arab peoples and Arabic is the official language of all states; however, there is a local dialect in each one that distinguishes them from the others. Collectivism is seen as a blessing and a source of well-being (Hofstede, 2001), and the Arab-Islamic culture is the dominant culture in most Arab states (Barakat, 1993).

Libya has one of the most decentralised political systems in the Arab world; local governmental institutions serve education, industry, and community; women have significant opportunities for education and employment, but like other Arabic countries, they still face social discrimination (United Nations Development Programme, 2009).

The population of Libya according to the latest census in 2006 was 5,320,894 with a fertility rate of 6.0. Of that total population, 49.27% were females, and 32.33% were aged between 15 and 29 years. Illiteracy in Libya has seen a remarkable decrease from 28.35% in 1995 to 11.5% in 2006. Most of the Libyan population, 62.32%, live in urban areas while 38.68% live in rural areas. Libya is a developing country, whose economy entirely depends on the oil resources that enable the state to provide free health care and education services to all Libyan citizens; 97.12% of the Libyan population aged between 6 and 15 years attend primary and secondary schools (General Information Authority, 2008). There is almost no scientific information about the ethnic and religious minorities in Libya; nonetheless, tribe occupies a prominent place in the Libyan society and the Islamic culture is the dominant culture; 98% of the population are Muslims (Keddie, 2007). The Libyan participants in this current research (Study 2, $N = 75$) were all aged between 15 and 26 years; all were attending secondary school or university in Misurata, where the Neurotic Behaviour Scale (NBS) was originally constructed and standardised (on Libyan samples). The researcher has identified three criteria for the selection of the Libyan student sample: participants should (a) be between 15 and 26; (b) have been born and be living in Libya and; (c) be a Libyan citizen.

3.3.2 British Sample

The United Kingdom is a constitutional monarchy and unitary state consisting of four countries: England, Northern Ireland, Scotland and Wales. According to the International Monetary Fund, it is a developed country; it is the world's sixth largest economy by nominal gross domestic product and the seventh largest by purchasing power parity (International Monetary Fund, 2009). In the most recent census in 2001, the total population of the UK was 58,789,194, and Christianity is the main religion (71.6%), followed by Islam, Hinduism, Sikhism and Judaism in terms of the number of adherents (National Statistics, 2009). The 2001 census also showed that 91.3% of the England and Wales population classified themselves as white, 1.3% were of mixed race, 4.4 % Asian, 2.2% black, 0.4% Chinese and 0.4% were from other ethnic groups (BBC news, 2009). English is the main language in the UK, which is monolingual by an estimated 95% of the population (Crystal, 2003).

The British participants in this research (Studies 3, $N = 77$) were all aged between 16 and 26 years; all were attending secondary school or university in Nottinghamshire, UK. The researcher has identified three criteria for the selection of the British student sample: participants should (a) be between 16 and 26; (b) have been born and be living in Britain; and (c) have English as their mother tongue. It should be noted that this sampling will relate appropriately to the sample that was used to develop the NBS in Libya, and will be allowed to use norms of the NBS in the current research. Moreover, a number of researchers (e.g., H. Eysenck & Eysenck, 1991a; McCrae et al., 1999; Schultz & Schultz, 2005) have reported that this is a good population to work with, since it has a reasonably high naturally-occurring level of neuroticism, and during this age period neuroticism begins to decline (almost from the age of 18), which permits the study of age differences in individuals' neuroticism scores. The significant cultural differences between Libya and Britain allow an examination of the role of culture in the relationship between neuroticism and intelligence scores.

3.4 Research Tools

As mentioned previously in this chapter, data collection in the current thesis was divided into two main phases according to whether it was collected from a Libyan population (Study 2), or a British population (Study 3). *The Wechsler-Bellevue*

Intelligence Scale – Arabic Version (WBIS; Maleka, 1996) and *the Neurotic Behaviour Scale* (NBS; Elmadani, 2001) were administered to the Libyan sample, while *The Wechsler Adult Intelligence Scale – Third Edition* (WAIS-III; Wechsler, 1997) and the NBS were administered to the British sample. These scales are considered to be appropriate to the aims in the current thesis for more than one reason. Firstly, in Libya, there are only two intelligence scales that are available for use among Libyan adult populations, namely the WBIS and the Cattell's Culture Fair Intelligence Scale III, form A (CFIS, Elponi, 1999). Moreover, the WBIS is the only version of the Wechsler intelligence scales that are available for use in Libya. Secondly, while the CFIS is a measure of fluid abilities and is not intended to assess crystallised abilities (Cattell, 1963, Cattell & Horen, 1978), the WBIS is a measure of fluid and crystallised abilities in addition to the general intelligence 'g' (Wechsler, 1997). As such, the WBIS will allow examination of the possibility that estimations of different aspects of intelligence are differentially related to the trait of neuroticism (Chamorro-Premuzic, 2003). Thirdly, Wechsler intelligence tests are designed based on the Wechsler theory of intelligence (see section 2.3.6), where Wechsler asserted that non-intellective factors, such as personality traits, are required for intelligence behaviour as well as intellective factors (Wechsler, 1975). Wechsler demonstrated that his scales contained both factors, and that the influence of non-intellective factors, appear as differences in individuals' scores on the subtests and in the difference between verbal and performance subtests scores (Maleka, 1996; Wechsler, 1943, 1950). Since the current study aims to examine the influence of the trait of neuroticism on an individual's intelligence scores, using the WBIS and WAIS-III will allow testing of these assumptions. Finally, although there are a number of scales for assessing neuroticism (e.g., Eysenck Personality Inventory), the NBS was chosen because it was devised by the author (Elmadani, 2001) to measure the neuroticism trait separately from other personality traits, and for use with a student population (individuals aged between 15 and 25), which is compatible with the characteristics of the samples of the current thesis. The NBS consists of 39 items so that it can be answered in one session. The following sections describe the research tools, namely the WBIS, WAIS and the NBS.

3.4.1 Wechsler Adult Intelligence Scale

In 1939, Wechsler published the Wechsler-Bellevue Intelligence Scale (WBIS). In this scale, Wechsler integrated both individual verbal and performance scales as well as an overall score. Moreover, this scale provided deviation IQ scores that were based on standard scores. In 1955, Wechsler revised his scale and published the findings of this revision under the title: Wechsler Adult Intelligence Scale (WAIS), and in 1981 published a new revision for the WAIS, which was called the WAIS-R. The third edition was published in the US in 1997 under the name WAIS-III (Wechsler, 1997). The Psychological Corporation recently published the fourth edition of WAIS in the US in 2008, and in the UK in 2010 under the name WAIS-IV and WAIS-IV^{UK}, respectively. All the Wechsler test revisions included a number of changes, such as updating the norms and replacing the outdated items. However, "Features and the structure of the test have remained intact through the years since the Wechsler-Bellevue" (Wechsler, 1997, p., 7). The WAIS is considered to be the most widely-used test by psychologists evaluating cognitive performance (Greve et al., 2003).

3.4.2 Description of Wechsler's Scales

The WBIS is a measure of an adult's intellectual ability and consists of eleven subtests that measure many different mental abilities. Six of them measure verbal intelligence and five subtests measure performance intelligence. All of the subtests measure global intelligence. Wechsler believed that factors such as personality traits, attitudes and human motivations influenced a person's performance in these subtests (Wechsler, 1975). The names of the subtests that measure verbal intelligence are: Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities; those that measure performance intelligence are: Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol. The WBIS yields three composite IQ scores, which are: Verbal IQ, Performance IQ, and Full Scale IQ.

The WAIS-III consists of fourteen subtests that produce three IQ scores in addition to four Index scores: verbal comprehension, perceptual organization, working memory and processing speed. The new verbal subtest is called Letter-Number Sequencing, while the new performance subtests are called Matrix Reasoning and Symbol Search. The subtests that contribute to the three traditional IQ scores are the same subtests that are used with the WBIS. However, the Matrix Reasoning test has replaced the Object

Assembly test, where a researcher may substitute it for one of the other performance subtests (Wycherley et al., 1999). Table 4 presents a summarized description of the subtests that are used to calculate the three IQ scores, as reported in the administration and scoring manual of WAIS-III^{UK} (Wechsler, 1999).

Table 4

Description of the WAIS-III and WBIS Subtests

Subtests	Description
Picture Completion	A set of pictures of common objects and settings, each of which is missing an important part that the examinee must identify.
Vocabulary	A series of orally and visually presented words that the examinee orally defines.
Digit Symbol	A series of numbers, each of which is paired with its own corresponding hieroglyphic-like symbol. Using a key, the examinee writes the symbol corresponding to its number.
Similarities	A series of orally presented pairs of words for which the examinee explains the similarity of the common objects or concepts they represent.
Block Design	A set of modeled or printed two-dimensional geometric patterns that the examinee replicates using two-color cubes.
Arithmetic	A series of arithmetic problems that the examinee solves mentally and responds to orally
Digit Span	A series of orally presented number sequences that the examinee repeats verbatim for Digits Forward and in reverse for Digits Backward
Information	A series of orally presented questions that tap the examinee's knowledge of common events, objects, places, and people
Picture Arrangement	A set of pictures presented in a mixed-up order that the examinee rearranges into a logical story sequence
Comprehension	A series of orally presented questions that require the examinee to understand and articulate social rules and concepts or solutions to everyday problems
Object Assembly	A set of puzzles of common objects, each presented in a standardized configuration, that the examinee assembles to form a meaningful whole

Source: (Wechsler, 1999, p., 2)

3.4.3 Psychometric Properties of the WAIS-III

3.4.3.1 Reliability

According to the Technical Manual of the WAIS-III (Wechsler, 1997), the reliability sample of the WAIS-III IQs and subtests included 394 participants, with approximately 30 participants from each of the 13 age groups. The findings showed that the split-half reliability coefficients of the subtests (except Picture Arrangement and Object Assembly) ranged from 0.82 to 0.93. The lowest coefficients were 0.74 and 0.70, for Picture Arrangement and Object Assembly, respectively. The average split-half reliability coefficients for WAIS-III IQ scores were 0.98 for the Full Scale IQ, 0.96 for the Verbal IQ, and 0.94 for the Performance IQ, where all were considered to be high reliability coefficients. The 394 participants were retested from 2 to 12 weeks. Test-retest coefficients of the verbal subtests ranged from 0.81 to 0.94, while the performance subtests ranged from 0.76 to 0.86, which are relatively high for test-retest reliability. The lowest coefficients were 0.69 for Picture Arrangement. Test-retest coefficients of the WAIS-III IQ scores were 0.96 for the Full Scale IQ, 0.96 for the Verbal IQ, and 0.91 for the Performance IQ. Inter-scorer agreement was very high, averaging in the high 0.90s. The lowest inter-scorer reliability coefficient was 0.91, for Comprehension.

3.4.3.2 Validity

The technical manual of the WAIS-III (Wechsler, 1997), provided different types of validity, such as content validity, concurrent validity and construct validity. In order to ensure content validity, a number of steps to review the WAIS-R were conducted, such as: comprehensive literature reviews, and the use of consultants to review the WAIS-R.

Evidence of the concurrent validity of the WAIS-III was based on their correlation with a number of other measures. Correlations with the WAIS-R (N = 192) were 0.93 for the Full Scale IQ, 0.94 for the Verbal IQ, and 0.86 for the Performance IQ. Correlations with the Wechsler Intelligence Scale for Children-Third Edition (N = 184, 16 year-olds) were statistically significant: 0.88, 0.78, and 0.88 for the Full Scale IQ, Performance IQ, and Verbal IQ scores, respectively. These correlations indicated that the scales were measured using the same, or very similar, constructs. Moreover, correlations with the Standard Progressive Matrices scale (N = 26) were statistically

significant: 0.64, 0.79, and 0.49 for the Full Scale IQ, Performance IQ, and Verbal IQ scores, respectively. Correlations of WAIS-III scores with the Stanford-Binet Intelligence Scale-Fourth Edition (SB-IV) were calculated among a sample of 26 adults. The results showed high correlations between the Full Scale IQ, Performance IQ, and Verbal IQ scores and the global SB-IV composite scores: 0.88, 0.89, and 0.79, respectively.

Wechsler (1997) also reported the construct validity of WAIS-III; inter correlations of the subtests and IQ scales were calculated. Significant correlations were found between all the subtests, which supported the notion of general intelligence, or the g factor. Also, correlations of verbal subtests with other verbal subtests were higher than with performance subtests. A similar result was found between the performance subtests. Correlations of the Full Scale IQ scores with the Verbal IQ and the Performance IQ scores were very high, 0.95 and 0.92, respectively. The correlation coefficient between the Verbal IQ and Performance IQ scores was also high, 0.75.

3.4.3.3 Norms of WAIS-III

The standardization sample included 2,450 participants aged 16 to 89 years, and divided into 13 age groups. This was intended to be representative of the general American population based on the 1995 USA census and stratified by age, sex, occupation, geographical distribution, education, and urban–rural residence. In the WAIS-III, the scaled score for each subtest was based on the scores obtained by the examinee's same-age normative group. The distribution of the sums of scaled scores of each scale was converted to a scale with a mean of 100 and a standard deviation of 15. This method was in contrast to the method that was used in the WAIS-R, where the scaled score for each subtest was based on the scores of individuals aged 20–34 years. This change was because, "Adults in the older age groups tend to obtain much lower scores than the reference group [20–34 years] at the subtests scaled-score level" (Wechsler, 1999, p., 21).

3.4.3.4 Transformation of Scores of WAIS-III

For each subtest, transformations were carried out to transform each individuals raw scores to scaled scores (M = 10 and SD = 3), and these were based on age-appropriate comparison norms. The sums of the scaled scores for the Verbal IQ and Performance IQ

were calculated by adding the scaled scores of each individual score onto the relevant subtest, and then onto all the eleven subtests for the Full Scale IQ, and then transforming them to a value with a mean of 100 and a standard deviation of 15.

3.4.4 The Appropriateness of the WAIS-III to the Population of the United Kingdom (UK)

In order to anglicize the WAIS-III and to investigate the suitability of the US norms to the population of the UK, a comparative study was conducted between the test scores of the UK sample and the US norms (Wycherley et al., 1999). In order to make it suitable for the UK, minor changes (e,g., automobile changed to car; Dollars and Cents changed to Pounds and Pence) were undertaken and the anglicized WAIS-III was given to 332 participants. Of these, 163 were male and 169 were female. Their ages ranged from 16 to 80 years. The UK sample was intended to be representative of the UK population on a range of different levels, including: education, ethnic group, socio-economic status, sex, age, and geographic region[1]. Their scores were processed using US norms. The results of the UK study showed that means and standard deviation for the IQs, and the subtests, form a relatively flat profile and that they were close to the US norms. Although there were slight differences between the UK and US means, the study concluded that these differences, "Are unlikely to be large enough to have any significant influence in the practical application of the test, and the US norms can be applied to the UK population with confidence" (Wycherley et al., 1999, p. 33). This finding has been supported by other researchers who reported that "USA norms can be safely used with the UK population" (Wycherley, Lavender, Holttum, Crawford, & Mockler, 2005, p., 279).

3.4.5 Standardization of the WBIS

In Arabic society, Maleka and Ismail (1960) published the Arabic edition of the WBIS. Since that time, the WBIS has become the most widely-used measure of intelligence in Arabic society (Maleka, 1996). Maleka and Ismail continued to update the norms, items, and age ranges of the scale and the latest revision of the WBIS was in 1996. As there are cultural differences between the Arabic environment and the original (USA) environment of the scale, the authors had modified some of the items in the

[1] For more details see (Wycherley, Benjamin, Crawford, & Mockler, 1999, p. 221-228)

scale, particularly the Information, Picture Arrangement and the Vocabulary scales, to ensure it was suitable for Arabic society. It should be noted that there were some differences between the WAIS-III and WBIS regarding the number of items, bonus points for quick performance, and the starting point; however, the scale still maintains characteristics of the original edition (Maleka, 1996). Appendix A describes the differences between WAIS-III and WBIS.

The standardization sample included 910 participants aged 15 to 65 years, and divided it into 11 age groups. It was stratified by age, sex, occupation, education, and urban–rural residence. The scaled score for each subtest in the WBIS was based on the scores of individuals aged 20 to 34 years. The sum of scaled scores of each scale, for each age group, was converted to a scale with a mean of 100 and a standard deviation of 15.

The technical manual of the WBIS (Maleka, 1996) reported on a number of studies that confirmed the reliability and validity of the WBIS. In this respect, test-retest reliability coefficients (N = 40) of the verbal subtests (except for Arithmetic), ranged from 0.72 to 0.93, while for the performance subtests, they ranged from 0.63 to 0.94, which are statistically significant and relatively high for test-retest reliability. The lowest coefficients were 0.58 for Arithmetic. The Full Scale IQ, Verbal IQ, and the Performance IQ test-retest coefficients were 0.94, 0.87, and 0.89. Similarly, the split-half reliability coefficients of the subtests (N=70), except Comprehension, ranged from 0.66 to 0.91. The lowest coefficients were 0.45 for Comprehension; the split-half reliability of the Digit symbol subtest and the WBIS IQ scores, were not calculated.

In order to investigate the construct validity of the WBIS, Maleka (1996), calculated the inter correlations of the subtests and IQ scales among a sample of 114 participants aged 20 to 35 years. He reported that correlations between the subtests and the Full Scale IQ scores were high. Also, correlations of verbal subtests with other verbal subtests were higher than with performance subtests. A factor analysis was conducted for the correlation coefficients of Maleka's study and three factors were identified; two of these can be related to the Verbal IQ and Performance IQ (Maleka, 1996).

3.4.6 Neuroticism Scale

The Neurotic Behaviour Scale (NBS) is a specifically-designed test by the author for neuroticism, which measures neuroticism trait among the Libyan population (see Elmadani, 2001). The test consists of 39 individual items designed to assess seven facets of anxiety, inferiority complex, reactive sensitivity, body disorder, thinking, social relations and sleeping disorder. Each participant is required to provide a "yes" or "no" answer to each statement and it has no set time limit for completion of the scale. In this task, 33 items measured neuroticism and the remaining six items measured the seriousness of response.

3.4.7.1 Procedures for the Scale of Construction

In light of reviewing theories and studies relating to neuroticism (e.g., Eysenck's theory and Cattell's theory) alongside a review of a number personality scales (e.g., Eysenck Personality Inventory, Eysenck Personality Questionnaire, and Eysenck-Wilson Personality Questionnaire), a new scale of neurotic behaviour was developed in this thesis to include seven distinct domains (facets):

1 Anxiety, a state of restiveness accompanied by blues and somatic signs.
2 Inferiority complex, lack of self-reliance, vulnerability to others, ready for failure.
3 Reactive sensitivity, ease of excitement and intensity of anger.
4 Body disorder, a complaint from somatic symptoms, and exaggerated concern for health.
5 Thinking problems, depth reflection before performing any work, delays in decisions-making.
6 Social relations, a neurotic person, who seeks to please others, may suffer from problems in dealing with the opposite sex, and can be aggressive towards others.
7 Sleeping disorder, disturbances in the amount, quality and timing of sleep.

In order to determine the significance of these facets, which is important in determining the number of items for each facet, the author prepared a questionnaire containing a list of the seven domains, listed above, along with descriptions of the

neuroticism trait, and the seven domains. The author asked 11 arbitrators[1] to arrange these facets according to their importance in the detection of neurotic behaviour, and also to add any other important facets that were not listed. Level one facet (most important) was given a value 7, and level seven facet (least important) was given a value of 1. The relative importance of each facet was shaped by adding the values of each facet that were given by each of the eleven arbitrators and by dividing these values by the total values of the facets. Table 5 shows the relative importance of each facet, which guided the author to determine the number of items for each facet (where the number of items reflects the percentage of their importance).

Table 5

Percent Importance of the NBS Facets

Facets	Percentage
Anxiety	24%
Inferiority complex	18%
Reactive sensitivity	15%
Body disorder	13%
Thinking problems	12%
Social relations	10%
Sleeping disorder	8%
Total	100%

3.4.7.2 Writing the Items of the Scale

Compared with other personality scales (e.g., Minnesota Multi-phases Personality Inventory, 1989, which had 567 items), the newer scales, (e.g., Goldberg's Big-Five Factor Markers of Personality, 1999, which had 50 items) tend to include a shorter number of items, which can simply be answered in one session. The NBS does not aim to obtain separate scores for constructs of neuroticism, but aims to obtain a total score for neuroticism; therefore, 30 items were identified to be the total target number of the

[1] All the arbitrators were specialist in the fields of personality, psycho-measurement and psychotherapy in four Libyan universities: 7th October, Al-mergeb, Al-fatah and 7th April. All of them have got a PhD.

scale. Furthermore, based on Eysenck's theory, the big five model, articles relating to the neuroticism trait, and on a number of previous scales, which measure the neuroticism trait, 60 items were written and distributed to the seven domains as follows: 10 anxiety, 12 inferiority complex, 9 reactive sensitivity, 7 body disorders, 7 thinking problems, 7 social relations, and 8 sleeping disorders.

The author prepared another questionnaire containing the 60 items, which were ordered according to the domains of the NBS, with a description of a typical neurotic person. The eleven individuals were asked to review the items and write their opinions about the validity of each item, in order to identify what items needed to be measured. Any item that was rejected by two or more of the individuals have been discarded (the difference between those who accepted an item [n = 9] and who did not [n = 2], was significant, $x^2 = 4.45$, $df = 1$, $p < .05$). As a result, the individuals approved 50 items. Of these, 35 were positive, and 15 were negative[1].

3.4.7.3 Preparing a First Draft of the Scale

In order to examine the face validity of the scale, the author prepared the instructions for the scale and sent it, with the 50 items, to eight arbitrators in the fields of personality and psycho-measurement. The arbitrators were asked to review the items and write their opinions about the clarity of the instruction and the items, and of the validity of the scale in relation to whether it could measure what it was designed to measure. All the arbitrators approved the clarity and validity of the scale.

3.4.7.4 The Pilot Study

A pilot study was conducted initially with a Libyan student population (Elmadani, 2001) to ascertain the clarity of the instructions and validity of the items amongst the target population of the scale (individuals of ages 15 to 25). This study consisted of a sample of 70 students (37 females and 33 males) with ages ranging from 15 to 21 years; all were university or secondary-school students. This study was carried out in two steps. Firstly, the scale was administered to a number of students (N = 20), and, based on their comments, minor amendments were made to four items. Secondly, the scale

[1] The positive and negative items mean that a response of "yes" (positive) or "no" (negative) refers to the trait of neuroticism.

was administered to another group of students (N = 50), to examine the clarity of the instruction and clarity of the item descriptions. This part of the study demonstrated that the scale's instruction and items were clear except that two items were not clear; these items were discarded because the author could not amend them. As result, the total number of items became 48.

3.4.7.5 The Seriousness of Response

In order to be sure that participants were responding seriously to the scale, six items were duplicated and placed at the end of the scale, to measure the consonance in participants' responses. Imam, Abdurrahman and Ojeali (1990) suggested that candidates, who scored between zero and the mean and standard deviation on this consonance measure, should be accepted. Based on this strategy, mean scores for the items analysis sample of the NBS (N = 355) on the duplicated items[1], was 1.35(1). As result, any participant, who received more than two scores on these items of the NBS, were discarded ($M + SD$ = 1.35 + 1 = 2.35, random down to 2).

3.4.7.6 Analysis of Items

This phase of the scale construction procedure aimed to examine the following issues: (a) item discrimination; (b) item validity; (c) validity and reliability of the scale; (d) standard error of the scale. The items analysis sample involved 355 students (163 males and 192 females, aged from 15 to 22 years), representing the target population of students according to sex, age, educational level, and geographical region of Misurata. However, the data from 51 participants were removed from the analyses because they scored more than two scores on the duplicated items (see Section 3.4.7.5). As result, the total sample in the study comprised 304 students.

3.4.7.6.1 Item Discrimination

Item discrimination "refers to the degree to which an item differentiates correctly among test takers in the behaviour that the test is designed to measure" (Anastasi & Urbina, 1997, p. 179). The "extreme groups" analysis is a common practice in item analysis (Anastasi & Urbina, 1997), where an item can be investigated by comparing

[1] To examine the scoring system of the duplicate items of the scale, see section 3.4.7.10

the number of examinees in the highest 27% of the test scores, who answer that item correctly, with the number of examinees on the lowest 27% of the test scores, who answer the same item correctly (Murphy & Davidshofer, 2005). Based on the method of extreme groups, two indicators of item discrimination were calculated: discrimination index, *D*, and *t*-test. The items that were not good, according to both indicators, were discarded. The number of participants in the upper (U) group was 82 (scores ranged from 26–39), and in the lower (L) group was 82 (scores ranged from 10–18).

Discrimination Index

The item discrimination index, *D*, is the difference between the percentage of individuals passing each item in the upper and in the lower groups. Anastasi and Urbina (1997) suggested that items closer to the 50*D* are preferable. Imam et al. (1990) also suggested that items lower than the 25*D*, are undesirable. The results showed that the *D* values of 38 items were ranged from 25–59, and that the *D* value of the remaining items (N = 10) was lower than the 25; this suggested that it did not discriminate between those who had high scores of neuroticism and those who had low scores of neuroticism.

T test

Differences between mean scores of individuals in the upper group and mean scores of individuals in the lower group were significant at the .01 significance level on 42 items, and at the .05 significance level on three items. Differences, however, on three items were not significant. The non-significant items were also lower on the *D* value.

3.4.7.6.2 Item-total Correlation

Another way to examine the validity of items is to measure what the test is designed to measure and is called item-total correlation. Here, a positive correlation indicates that the item discriminates between those who score high on the test and those who score low. Moreover, a positive item-total correlation means that the item measures the same factor that is being measured by the test. A correlation near zero indicates that the item does not distinguish between the high and low scores, while a negative correlation indicates that there is no agreement between the scores on the item and the scores on the test (Murphy & Davidshofer, 2005). The item-total correlations of the NBS (N = 48) were all positive and significant, except for three items, at the .01 significance level (r_s ranged from .27 to .59). The items that were not correlated significantly with the total

score of the scale also failed to distinguish between the high and low scores using the *D* value and the *t*-test. Therefore, based on the results of the discrimination index, *t*-test, and item-total correlation, 10 items were discarded. Therefore, the remaining number of items was 38. In order to follow the percentage importance of the NBS domains, the author also discarded five additional items, which were the weakest items of the domain. Thus, the final draft of the scale involved 33 items (see Appendix B) allocated among the seven domains of the scale, as shown in Table 6. The reliability and validity of the final draft will be the subject of the next section. To do so, and for a better understanding of the reliability and validity of the NBS, the next section will firstly outline different methods of estimation test reliability and validity, and then it will show the methods that were applied to examine the efficiency of the NBS.

Table 6

Number of Items in the Final Draft of the NBS

Facets	Percent importance of facet	N of items after items analysis	N of items (final draft)[1]
Anxiety	24%	8	8
Inferiority complex	18%	5	5
Reactive sensitivity	15%	7	5
Body disorder	13%	5	4
Thinking problems	12%	5	4
Social relations	10%	5	4
Sleeping disorder	8%	3	3
Total	100%	38	33

3.4.7.7 Reliability of the NBS

The concept of reliability refers to "consistency of scores obtained by the same persons when they are re-examined with the same test on different occasions or with different sets of equivalent items, or under other variable examining conditions"

[1] The number of items in each domain was based on the following formula: $n = P \times N / 100$

Where: n = number of items in each domain, P = the percent importance of facet, N = total number of items

(Anastasi & Urbina, 1997, p. 84). In contrast to physical measurements, results of psychological measurements can be affected by the psychological state of an individual, for example: their physical health, extreme changes in weather, or sudden sounds. Therefore, measurements for the same feature are repeated more than once, as each response of an individual will be slightly varied. Thus, it is possible to divide the observed test score of a person into two parts; the first is the true score, which is not affected by various external factors, and the second is the errors of measurement part, which is influenced by external factors. The purpose of reliability theory is to estimate errors in measurement. Thus,

> If errors are responsible for much of the variability observed in test scores, test scores will be inconsistent; if the test is given again, scores may not remain stable. On the other hand, if errors of measurement have little effect on test scores, the test reflect mainly those consistent aspects of performance we have labeled true scored. The reliability coefficient (r_{xx}) provides an index of the relative influence of true and error scores on obtained test scores. (Murphy & Davidshofer, 2005, p. 121)

There are four methods to estimate test reliability: (a) test-retest, (b) alternate forms, (c) inter-rater, and (d) internal consistency. However, the internal consistency estimates are the most commonly used because they are simply calculated from a single administration of a test (Henson, 2001). All these methods are concerned with the degree of difference between two independently derived sets of scores; therefore they can be expressed as a correlation coefficient. Moreover, any reliability coefficient may be understood in terms of the "percentage of score variance attributable to difference sources. Thus, a reliability coefficient of .85 signifies that 85 % of the variance in test scores depends on true variance in the trait measured, and 15% depends on error variance" (Anastasi & Urbina, 1997, p. 100). The reliability of the NBS was estimated by the internal consistency methods. Thus, the next section will consider this method as discussed by Anastasi and Urbina (1997) and Murphy and Davidshofer (2005).

Internal Consistency Reliability

The internal consistency method involves administrating a test to a number of individuals on one occasion to estimate reliability. It examines the items' homogeneity, or the extent to which each item measures the same factor, measured by the other test

items. So “if items are highly correlated, it is theoretically assumed that the construct of interest has been measured to some degree of consistency” (Henson, 2001, p. 180).

There are several common procedures for finding internal consistency such as split-half, Kuder-Richardson 20, White’s formula, and Cronbach alpha. The split-half reliability involves administrating a test to a number of individuals and splitting the test in half. There are no rules for splitting a test. However, there are two common practices, namely the first-second-half test and odd-even-split test. It should be noted that the correlation between the two halves gives the reliability of only a half-test. The Spearman-Brown formula is widely used to determine the reliability of a whole test. However, the most widely-used and the most generally-accepted form of internal consistency is the Cronbach alpha, which is the average of every possible split-half reliability measure that could be calculated on a scale.

Howitt and Cramer (2008) reported another way of estimating internal consistency, namely item analysis. In this technique, any item that does not correlate significantly with the total scores of the test is deleted because it is not measuring the same thing that is measured by the other items (this procedure is known as item-total correlation, see Section 3.4.7.6.2).

The magnitude of internal-consistency estimates will be different depending on the purpose of the research and the use of the scores, however, it is accepted that a scale should have a minimum-reliability coefficient of .80 (Henson, 2001; Howitt & Cramer, 2008). The reliability of the Arabic version of the NBS (Elmadani, 2001) was estimated by three measures of internal consistency: spilt-half, item-total correlation, and White’s formula. The reliability samples of the scale were drawn from the item analysis sample. Based on the odd-even-split method, the split-half reliability (N = 100, 50 females and 50 males) was 0.77, for the total sample, and 0.73 for males, and 0.80 for females. The internal consistency of the scale was acceptable since an item-total correlation was carried out on the items on the scale, and each item had a significant correlation with the total score of the scale. Any items that did not correlate significantly with the total scores were deleted. Another indicator for the internal consistency of the NBS was

estimated by using White's formula[1], which revealed that the internal consistency of the NBS was 0.90. All these estimations of reliability are acceptable and indicate that they are reliable scores obtained by the NBS.

3.4.7.8 Standard Error of Measurement (SE)

The reliability coefficient provides an indication of the accuracy of test scores. However, it does not give an idea of how accurate test scores really are. The Standard Error of Measurement (SE) provides a concrete indication of the accuracy of test scores and was therefore used in the analyses (Murphy & Davidshofer, 2005). The SE estimates the standard deviation of the difference between the measured scores and the true scores, and can be calculated from the reliability coefficient of the test. The standard error can be understood in terms of the normal curve frequencies. Approximately 68% of the cases in the normal curve are between mean and $\pm$ 1 *SD*, and approximately 95% are between mean and $\pm$ 2 *SD*, and approximately 99% are between mean and $\pm$ 3 *SD*. Thus, it can be stated that at 68%, 95% and 99% confidence levels, the examinee's score on any single administration of the test will fall between the observed score and $\pm$ 1 SE, the observed score and $\pm$ 2 SE, and the observed score and $\pm$ 3 SE, respectively.

The standard error of NBS was 1.54, based on the internal consistency reliability of 0.90, and was 3.15 based on the spilt-half reliability of 0.77. The average SE of the NBS was 2.35. Thus, it is assumed that the real score of the person, who scores 15 on the NBS, falls in the 12.65 to 17.35 range at 68% confidence level, and in the 10.30 to 19.70 range at 95% confidence level, and in the 7.95 to 22.05 range at 99% confidence level.

3.4.7.9 Validity of the NBS

Validity is one of the important principles of psychological test construction. This means that, "The ability of a test to measure what it is designed to measure" (Huffman, 2004, p. 303). A test designer gathers evidence from a variety of sources to show that

[1] White's formula= $\frac{\text{Error variance}}{\text{Variance between people}}$

the test measures what it is intended to measure. All the procedures for assessing test validity are concerned with the relationship between performance on the test and independently observable facts about the trait or function that is under consideration (Anastasi & Urbina, 1997). Four ways of assessing validity: content validity, predictive validity, concurrent validity, and construct validity, follow.

Content Validity

Content validity refers to the degree to which the test items sufficiently represent and relate to the behaviour characteristic under consideration. Although content validity offers a good method of assessing achievement tests, it is not appropriate for personality tests because, "personality tests are not based on a specified course of instruction or uniform set of prior experiences from which test content can be drawn" (Anastasi & Urbina, 1997, p. 117).

Criterion-Related Validity

This sort of validity aims to examine the extent to which a test can be valid in making decisions. Correlation between test scores and a criterion measure is the simplest method to determine whether a test can be valid in making decisions (Murphy & Davidshofer, 2005). Criterion measures are numerous; academic achievement, job performance, contrasted group and previously available tests are examples of criterion measures. To assess criterion-related validity, there are generally two methods: concurrent and predictive validation. Concurrent validity always exists at the time of testing, and is related to tests employed for diagnosis of an existing status, while predictive validity predicts future outcomes (Anastasi & Urbina, 1997). In the development of certain personality tests, previously-conducted tests are commonly used as evidence of validity. Using this strategy, correlation is calculated between new test scores and more elaborate tests, where the validity had previously been recognised; the new test should represent a simpler or shorter replacement of the earlier test (Anastasi & Urbina, 1997).

Construct Validity

In psychological measurement, psychologists are dealing with abstract attributes, such as intelligence and personality traits, which cannot be seen or heard. Such attributes are referred to as constructs and "represent ideas constructed by scientists to

help summarize a group of related phenomena or objects" (Murphy & Davidshofer, 2005, p. 163).

The construct validity of a test aims to determine the extent to which the test scores provide a good measure of a theoretical construct or trait. To assess construct validity, there are a number of strategies; one of these is the correlation with other previous tests that measure the same trait.

Internal consistency is another method to assess the construct validity. It tries to investigate whether or not all of the items on a scale, measure the same concept that is measured by the total score through the correlation of those items, with the total score of the scale (Domino & Domino, 2006). Thus, the criterion in this method is the total score of the scale itself. Moreover, Anastasi and Urbina (1997) argued that evidence about the internal consistency could be based on the extreme groups (as mentioned in Section 3.4.7.6.1). So, on each test item, if the proportion of passes in the upper group was significantly greater than in the lower group, the item is considered valid. A scale that involves such items can be said to show internal consistency. Cronbach and Meehl (1955) reported that, for many constructs, the degree of homogeneity within the test, which measures internal consistency, is relevant to its construct validity.

Another method used to assess the construct validity by examining group differences. According to Cronbach and Meehl (1955), a test is valid if the theoretical ideas behind the personality trait under consideration mean that there is an expectation that two groups will respond differently in the test and the test scores distinguish across these groups. If this is so, this is "evidence of the usefulness of the test as a decision-making instrument" (Hattie & Cooksey, 1984, p. 295).

Validity of the Arabic version of the NBS was assessed using more than one method; content validity was the first step. Thus, during the construction procedures of the scale (see Section 3.4.7.1 and 3.4.7.2) the scale's designer had reviewed some theories and articles that were related to the trait of neuroticism. In light of this review, scale domains and items were determined. The domains and the first draft of the scale items (N = 60) were assessed by 11 arbitrators in the field of psychometric and personality testing. The arbitrators approved the domains and the 50 items, which formed the first draft of the scale.

Concurrent validity of the Arabic version of the NBS was conducted based on the scale's correlation with the neuroticism scale of the Eysenck Personality Inventory (EPI), form A (as a criterion measure). The EPI is a paper-and-pencil test (yes or no response method), consisting of two forms, A and B, each of them involves 57 items measuring two dimensions of personality: extraversion and neuroticism, in addition to a lie scale. However, the concurrent validity study had used only the neuroticism scale, which involved 24 items. The EPI had been translated and standardised for the Arabic culture by Jaber and Fajr-Alasalam (n.d.). The concurrent validity study consisted of a sample of 100 Libyan students; their ages ranged from 15 to 20 years. Of those, 54 were females and 46 were males. The Pearson correlation between the NBS scores and the EPI scores was.74, which was significant at a .01 significance level.

Construct validity of the NBS was also assessed using three methods. Firstly, the correlation between the NBS scores and scores of the neuroticism scale of the EPI, was high (.74), indicating that both were measuring the same construct, which was the neuroticism trait. Second, the internal consistency of the scale was investigated and approved, since the items that did not correlate significantly with the total score of the scale had been discarded. Moreover, based on the extreme groups method, the proportion of passes on each test item in the upper group was significantly greater than in the lower group. Items that did not distinguish between those who had high scores of neuroticism and those who had lower scores of neuroticism were deleted.

Finally, construct validity of the NBS has been supported using the group difference method. In this respect, Eysenck and Eysenck (1991a) believed that people with extreme neuroticism are highly susceptible to neurotic disorders, and a number of researchers (e.g., McWilliams, Becker, Margraf, Clara, & Vriends, 2007; Saulsman & Page, 2004) support this theory. Based on this hypothesis, it is expected that differences should be found between normal and neurotic outpatient groups. To examine this hypothesis, the researcher administrated the NBS to 102 participants. Of these, 75 were students representing the normal sample, their mean age was 19.27 years, and 27 were outpatients, with a mean age of 26.26. All the participants of the normal sample were Libyan students, while the outpatients were from the Misurata Educational Hospital and a number of psychological clinics in Misurata. All the outpatients were attending psychological clinics for help in eliminating neurosis problems and were diagnosed by

their psychologist as suffering from a type of neurosis. The mean scores of the outpatients sample on the NBS was 21.63 (3.68), which was significantly higher than the mean of the student sample (M = 14.20, SD = 4.90), t (100) = 7.17, p =.001 (two tailed). These findings indicate that the NBS was able to discriminate between groups that were theoretically different. Moreover, Faraj (1990) argued that, within one group, the scale will be considered as valid if the scale discriminates between those who achieved high scores (the highest 27 % of the scores) and between those who achieved low scores (the lowest 27 % of the scores) on the scale. In light of this, the researcher examined the NBS by calculating the independent t-test on the student sample, N = 75. The findings supported the validity of the NBS, since the mean scores of the high group (N = 20) was M = 20.15 (3.36) which was significantly higher than the mean scores of the low group (N = 20, M = 8.35, SD = 2.16), t (38) =13.21, p =.001 (two tailed).

3.4.7.10 Scores from the NBS (the Arabic Version)[1]

The following steps were applied in order to obtain the scores of participants:

1. To ensure that participants are answering the items seriously, the duplicate items[2] were analysed as follows:
    a) One mark was awarded for each item that did not match the other answer (duplicate) and a zero was awarded if the answers were the same.
    b) According to the norms of the original scale, the Libyan version, the response of any individual who receives more than two marks for these items was omitted.
2. The scores of the participants were calculated by:
    a) One mark was awarded when the participant responded “yes” to the following items: (1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 15, 16, 18, 21, 22, 24, 25, 27, 28, 29, 31, 32, 33) and zero when the participant responded “no” to the same items.

[1] See Appendix B

[2] The duplicate items are: (6, 34), (8, 35), (16, 36), (18, 37), (21, 38), (28, 39).

b) One mark was awarded when the participant responded “no” to the following items (3, 7, 11, 14, 17, 19, 20, 23, 26, 30) and zero when the participant responded “yes” to the same items.

3. The total scores of all items was assumed to represent the total score of the participant on the NBS; the possible rang of scores was 0 to 33.

3.4.7.11 Norms of the Scale

The normative sample of the NBS were all from Sha’biyat Misurata[1], Libya, and was formed on the basis of random sampling according to three variables: age (15 to 25 years), sex (female and male), and congress or district (Tawargha, Tamina, Kasr-Ahmed, Misurata centre, Ghiran, Zarrok, Mahjob, and Dafnia). The total number of the normative sample was 619 participants. Of those, 343 were female and 276 were male, mean age was 18.91 and 19.23, respectfully.

In order to examine the homogenous features of the normative sample, differences between participants’ scores on the NBS according to the variables of age, sex, and congress, were investigated using a one-way ANOVA and *t*-test. The results showed that there were no significant differences between means throughout ages and congresses. Participants from both variables failed to reach the specified .05 significance level, F (9, 609) = 1.70, $p > .05$, and F (7, 611) = 1.50, $p > .05$, respectively. However, a significant difference was found between males and females *(*M = 13.8, SD = 4.31, and M = 16.4, SD = 4.40, respectively), t = 7.357 (617), p = .001. As result, raw scores were converted to T scores (M = 50, SD = 10) for males and females. Table B.1 (Appendix B) presents the raw scores of the NBS and their equivalent T norms scores. Based on the normal distribution, where approximately two-thirds of the scores fall within a range of mean $\pm$ one standard deviation, the T scores can be classified into three classifications: low (< 40), moderate (between 40–60) or high (> 60) (Domino & Domino, 2006). As a result, the cut-off scores that separated the raw scores into the three levels for males were low (< 9), moderate (between 10–18) or

[1] Sha’biyah in Arabic means popularity, and is used by the Libyan authorities to refer to Libyan municipalities. It is equivalent to a county and each one is divided into a number of Basic Peoples Congresses.

high (> 19), and for female was low (< 12), moderate (between 13–20) or high (> 21), according to the *T* norms of the NBS.

In summary, this chapter has confirmed the reliability and validity of the research tools, specifically the WBIS and WAIS-III, and illustrated their appropriateness for data collection among the Libyan and British samples. However, the creation and validation of the NBS is only appropriate to a Libyan population and not generalisable to a British sample. Therefore, Study 1 (presented in Chapter 4 in the current thesis) examines the validity of the NBS among a British sample and examines the psychometric properties of the NBS for inclusion in later studies in the thesis.

CHAPTER 4 STUDY 1: Reliability and Validity of the Neuroticism Scale on a British Sample

4.1 Introduction

The Neurotic Behaviour Scale (NBS) is a paper-and-pencil test (yes or no response method), designed by the author (Elmadani, 2001) to measure the neuroticism trait among the Libyan population (individuals of ages 15 to 25). The test consists of 39 individual items; 33 items measured neuroticism and the remaining six items measured the seriousness of response. As outlined in Chapter 3, many steps had been taken for selection and examine the scale's items, such as item discrimination and item validity. The reliability and validity of the NBS among the Libyan population have been investigated in several ways. For example, the split-half reliability has been shown to be high (.77, N = 100) as well as the internal consistency (.90, N = 100), and the concurrent validity, which is based on the scale's correlation with the Eysenck Personality Inventory (EPI, r = .74, N = 100, P < .01). Moreover, as Chapter 3 confirmed, the NBS was significantly able to discriminate between psychological patients and student samples, which were theoretically different.

The current thesis will examine the effect of cultural differences between Libya and Britain in examining the relationship between neuroticism and intelligence scores, using the NBS as a measure of neuroticism. Therefore, the current chapter examines the psychometric properties (e.g., reliability and validity) of an English translation of the NBS in a student population.

It is argued that even when the reliability and validity of an existing scale is high in a population, translation alone is an inadequate justification for applying the scale and is not an indication that the two scale versions are equivalent in content, reliability, and validity (Fernandez, Boccaccini, & Noland, 2007). Therefore, a translation of an existing scale should be developed and evaluated through exact methods, such as back-translation and validation for the population with which the translated scale will be used (Brace, Kemp, & Snelgar, 2006; Wyss, Voelker, Cornock, & Hakim-Larson, 2003).

Fernandez et al. (2007) stressed that the most frequent approach to ascertaining validity for translated tests is to demonstrate that the properties of the translated version

are equivalent or comparable with the original version in term of function and construction. While function equivalence examines the extent to which the concept being measured has the same meaning across cultures, construct equivalence research examines whether the translated scale and original scale are measuring a similar construct. Indeed, functional equivalence is a goal of the translation process, which can be examined by administrating both versions of the test to bilingual participants, differences between scores on the two versions "can be attributed to the linguistic differences between the tests or items" (Sireci, 2004, p. 123). One method to investigate the construct equivalence is through correlation with other tests that measure the same construct. (Anastasi & Urbina, 1997). Fernandez et al. (2007) suggested that evidence for construct equivalence is strong when the translated scale correlates with earlier tests that measure the same construct.

The present study examines specifically the psychometric properties of an English version of the NBS in a student population. Specifically, the current chapter will evaluate the author's English translation of the NBS, and to examine the construct and functional equivalence of both versions of the scale including internal consistency, and construct and concurrent validity, given that this will be a tool that will be used in the remaining studies in the thesis (see Chapter 6, Study 3).

4.2 Method

4.2.1 Participants and Procedures

The procedures of this study have been undertaken in three stages. In the first stage, the scale is translated from Arabic into English. Both the Arabic and English version of the NBS were then administered to an arbitrator, who was a native Arabic speaker and held a master's degree in the English language, to review the translation. The revised copy was given to another arbitrator; who was also a native Arabic speaker and held a PhD degree in the English language. This person was asked to retranslate the scale from English into the Arabic language in order to ascertain whether or not the meaning of the items had changed from the original and the translated copies. The comparison showed that the meaning of the items remained relatively stable.

The second stage examines validity of the scale's items and reliability of the NBS. This study consisted of a sample of 77 students (58 female and 19 male), their average age was 18.10 years, *SD* = 1.17. All participants were undergraduate students from Nottingham Trent University. The scale[1] was administered initially to a number of students (*N* = 18) in order to examine the clarity of the instructions and nature of the items. Participants were asked to read the introduction carefully and decide whether or not they understood the test instructions. All participants then read the items and were told to ask about any word or phrase that was unclear. This part of the study demonstrated that the scale's introduction and items were clear. The scale was then administered to another group of undergraduate students (*N* = 59), and the responses of both samples (*N* = 77) were analysed in order to assess the sufficiency of the scale. In this respect and as the neuroticism scale includes six items that ascertained that participants responded seriously, five answer sheets were omitted because they scored more than two scores[2]. Therefore, the total number of the reliability sample became *N* = 72 students, (53 were female and 19 were male), their mean age was 18.94 years, *SD* = 1.17.

Finally, the final draft of the NBS (*N* of items = 30)[3] was administered collectively along with the Eysenck Personality Questionnaire-Revised (EPQ-R; H. Eysenck & Eysenck, 1991b, as a criterion measure), to another sample of undergraduate British students to examine the concurrent validity of the translated version of the NBS. This sample consisted of 80 British students (56 females and 24 males), all of them were from the Nottingham Trent University; their ages ranged from 18 to 23 years (*M* = 18.59, *SD* = 0.91).

4.2.2 Materials

In addition to the NBS, this study employed the Eysenck Personality Questionnaire-Revised (EPQ-R; H. Eysenck & Eysenck, 1991b). The EPQ-R is a paper-and-pencil test (yes or no response method), involving 106 items measuring three dimensions of personality: psychoticism (P), extraversion (E) and neuroticism (N), in addition to the

[1] See Appendix B
[2] To examine the seriousness of response see Chapter 3 section 3.4.7.10
[3] See Appendix C.

lie scale (L). However, the current study only used the neuroticism scale (24 items). Manual of the EPQ-R shows a number of indicators for validity and reliability of the scale. For example, the scores of 902 participants on the EPQ-R were factor-analysed. Four factors were found and were identified as P, E, N, and L scales. The Cronbach's alpha reliability value of the neuroticism scale of the EPQ-R was high for both males and females (.88, *N* = 408 and .85, *N* = 494, respectively).

4.3 Results

4.3.1 Quality of the Translation of the NBS

In order to examine the quality of the translation of the scale, the researcher administered the original and the translated version of the NBS to 29 bilingual students from the English language department of 7th of October University, in Libya, who can speak both languages fluently. Correlations between the items of both versions were calculated and are presented in Table 7. The findings show that all the correlations were significant at the .01 level.

Table 7

Correlations between Neuroticism Scale's Items in the Bilingual Study

N of item	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Correlation	.73	.74	.79	.68	.84	.81	.68	.60	.75	.78	.65
N of item	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
Correlation	.72	.76	.64	.63	.88	.86	.81	.76	.79	.67	.79
N of item	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33
Correlation	.84	.74	.84	.73	.85	.79	.62	.72	.73	.72	.85

Note. All the correlations are significant at the 0.01 level

4.3.2 Reliability of the NBS in the British Sample

There are a variety of methods of reliability coefficients; however, internal consistency estimates are the most commonly used because they are calculated from a

single administration of a test (Henson, 2001). Therefore, internal consistency is the type of reliability that was calculated in this study. In particular, item analysis and Cronbach's alpha were two conservative ways of assessing the internal consistency of the NBS in the British sample.

4.3.2.1 Item Analysis

Item analysis aims to ensure that all of the scale's items correlate with the total score of the scale, the item-total correlation. By analysing data of this study, two items, numbers 8 and 22[1], were omitted because all the participants scored zero on these items, which meant that those who had high or low neurosis could not be distinguished (Imam et al., 1990); as a result, the total number of items of the neuroticism scale became 31. Table 8 summarises the correlations of each individual item against the total of the NBS score. As Table 8 shows, all the correlations are significant, except for item one, indicating that all the items, except number one, are good measures of what the total score on the scale is measuring, although their correlations with the total score are reduced when an item is excluded. However, the relationships remained significant except for item 14. As result of these findings, item 1 was discarded since it had the smallest and a non-significant correlation with the total score, in both cases.

As item 1 had been deleted, it was necessary to repeat the reliability analyses on the remaining items (Brace et al., 2006). Table 9 shows the outcome of the new reliability analyses. It can be seen that compared to the correlation in Table 8, the shortened scale, *N* of the items, is 30 and has slightly different item-total correlations; some of them were increased and the others had decreased. Importantly, all the correlations were significant even when an item was excluded.

[1] See Appendix A the Arabic version.

Table 8

Correlations of Items with the Total Score on the NBS

Number of item	Correlation with total score	Correlation with total score excluding item in question
1	.14	.07
2	.44**	.41**
3	.41**	.39**
4	.36**	.29*
5	.35**	.26*
6	.38**	.31**
7	.30**	.24*
9	.43**	.39**
10	.37**	.31**
11	.40**	.35**
12	.32**	.24*
13	.50**	.46**
14	.29*	.22
15	.36**	.26*
16	.60**	.55**
17	.37**	.26*
18	.47**	.47**
19	.50**	.45**
20	.36**	.28*
21	.43**	.35**
23	.34**	.26**
24	.47**	.40**
25	.54**	.49**
26	.47**	.38**
27	.35**	.28*
28	.36**	.27*
29	.51**	.43**
30	.34**	.28*
31	.42**	.34**
32	.45**	.38**
33	.35**	.24*

* $p < .05$, ** $p < .01$ (2-tailed).

Table 9

Correlations of Items with the Total Score on the Shortened Neuroticism Scale

Number of item	Correlation with total score	Correlation with total score excluding item in question
2	.46**	.41**
3	.43**	.38**
4	.36**	.30*
5	.35**	.27*
6	.40**	.32**
7	.28*	.23*
9	.42**	.37**
10	.38**	.30*
11	.41**	.36**
12	.32**	.23*
13	.50**	.46**
14	.31**	.23*
15	.34**	.26*
16	.60**	.54**
17	.36**	.27*
18	.50**	.46**
19	.52**	.46**
20	.37**	.28*
21	.43**	.35**
23	.34**	.26*
24	.49**	.42**
25	.54**	.47**
26	.46**	.37**
27	.37**	.28**
28	.35**	.28*
29	.51**	.43**
30	.36**	.30*
31	.42**	.35**
32	.45**	.37**
33	.33**	.24*

* $p < .05$, ** $p < .01$ (2-tailed).

4.3.2.2 Alpha Reliability

Cronbach's alpha for the NBS, (*N* of items is 30, from the current sample, *N* = 72) was .82 which provides evidence of strong reliability of the translated NBS scale.

4.3.3 Validity of the NBS in the British Sample

The validity of the NBS in the British sample was assessed using two methods: concurrent and construct validity. Concurrent validity of the scale was assessed based on the scale's correlation with the neuroticism scale of the Eysenck Personality Questionnaire-Revised (EPQ-R) (as a criterion measure). Pearson correlation between the NBS scores and the EPQ-R scores (*N* = 80) was 0.82, which was significant at the .01 significance level.

Throughout the reliability sample (*N* = 72), construct validity of the NBS was also investigated using three indicators. Firstly, the internal consistency of the scale was supported since all the scale's items correlated significantly with the total score of the scale (see Table 8 and Table 9). Secondly, the correlation between the NBS scores and the scores of the neuroticism scale of the EPQ-R was high (.82), indicating that both were measuring the same construct. Finally, the construct validity has been supported using the extreme groups method. Thus, an independent *t*-test had been calculated on the reliability sample, *N* = 72, in order to identify the significant difference between mean scores of the high group, the highest 27 % of the scores, where *n* = 19, and mean scores of the low group, the lowest 27 % of the scores, where *n* = 19. The findings showed that the mean score of the low group was 6.16 (1.07), which was significantly lower than the mean score of the high group (*M* = 19.11, *SD* = 2.85), *t* (36) = 18.57, *p* = .0005 (two tailed).

Thus, the NBS was developed in readiness for use with the British sample. The total number of the scale's items is 30[1]. In addition, six items were used to measure the seriousness of response. To obtain the scores of participants the following steps are applied:

1. To ensure that participants are answering the items seriously the duplicate items[2] were analysed as follows:
    a) One mark was awarded for each item that did not match the other answer (duplicate) and a zero was awarded if the answers were the same.
    b) According to the norms of the original scale, the Libyan version, the response of any individual who receives more than two marks for these items was omitted.
2. The scores of the participants were calculated by:
    a) One mark was awarded when the participant responded "yes" to the following items: {1, 3, 4, 5, 7, 8, 10, 11, 13, 14, 16, 19, 21, 22, 24, 25, 26, 28, 29, 30}and zero when the participant responded "no" to the same items.
    b) One mark was awarded when the participant responded "no" to the following items {2, 6, 9, 12, 15, 17, 18, 20, 23, 27} and zero when the participant responded "yes" to the same items.
3. The total scores of all items was assumed to represent the total score of the participant on the NBS; the possible range of scores was 0 to 30.

4.4 Discussion and Conclusions

The present study examined the psychometric properties of the author's English translation of the NBS among a student population. The NBS was translated from Arabic into English and then a back-translation was conducted; two arbitrators approved these translations. In addition to that bilingual speakers obtained very similar scores on both versions of the scale, with some variation expected as result of random error

[1] See Appendix C

[2] The duplicate items are: (5, 31), (7, 32), (14, 33), (16, 34), (19, 35), (25, 36).

(Fernandez et al., 2007), this means that the translation was competent and had conveyed the correct meaning of each item. Sireci (2004) reported that functional equivalence between the translated scale and original scale is a goal of the translation process, which can be examined by administrating both versions of the test to bilingual participants. Item analysis of the NBS revealed that 30 items were significantly correlated with the item-total scores, which means that similar factors are measured by these items. Moreover, Cronbach's alpha reliability value of the NBS was acceptable and robust.

Validity of the English version of the NBS was assessed using more than one method; concurrent validity was the first method. The concurrent validity of the NBS was examined based on the scale's correlation with the Eysenck Personality Questionnaire-Revised. The results showed significantly high correlations between the NBS and EPQ-R. This result supports the concurrent validity of the NBS as well as the construct equivalence of both versions of the NBS since the Arabic and English version were highly correlated with the neuroticism scale of the Eysenck personality measures indicating that all are measuring the same construct. Moreover, the construct validity of the NBS had been supported using the extreme groups method. The findings indicate that the scale distinguishes between those who have high scores of neuroticism and those who have low scores of neuroticism; they reflect the theoretical framework on which the NBS was designed (the Eysenck's theory and Costa and McCrae model, see Chapter 2), which assume that the dimension of neuroticism reflects differences in the degree not type of neuroticism.

In summary, given the reliability and validity of the NBS scale for English population, this scale was included in the remaining studies in the thesis. The following chapters will present the findings of these studies which examine the relationship between intelligence and neuroticism scores across student populations in Libya (Study 2) and in the UK (Study 3).

CHAPTER 5 STUDY 2: Intelligence and Neuroticism Scores among a Libyan Student Sample

5.1 Introduction

There is considerable support that levels of neuroticism vary across different cultures, with evidence from several cross-cultural studies (e.g., Barrett, Petrides, Eysenck, & Eysenck, 1998; S. Eysenck et al., 1993; Hanin et al., 1991; Lynn & Martin, 1997; McCrae, 2001a). However, as outlined in Chapter 2, while the relationship between neuroticism and intelligence scores has been well documented (e.g., Ackerman & Heggestad, 1997; Escorial et al., 2006; Moutafi et al., 2005), there are claims that this link between neuroticism and an individual's intelligence scores also varies across different cultures (Chamorro-Premuzic, Furnham, & Ackerman, 2006; Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006).

Study 2 specifically examines the relationship between intelligence scores and levels of neuroticism within a Libyan student sample to consider the relationship between the two variables among an Arabic culture. This is important because in Libyan students, there are strong cultural differences compared to western cultures especially in terms of language, religion, economy, gender roles, interests, and customs, all of which may vary significantly (Hofstede, 2001; Keddie, 2007). Study 2 also examines the influence of age and sex differences in the relationship between neuroticism and intelligence scores among this Libyan population to extend earlier findings by exploring how neuroticism and intelligence scores may vary as a function of sex and age.

As outlined in Chapter 2, neuroticism can affect individuals across all ages and across different cultures (Jylhä et al., 2009; Laidra, Pullmann, & Allik, 2007; Schmitt et al., 2007). There are close links found between an individual's scores on intelligence tests, and different types of an individual's performance, such as academic and job performance (Moutafi et al., 2005). However, the role of personality traits particularly the trait of neuroticism in an individual's scores on intelligence tests is still inconclusive; the results of studies that have examined the relationship between neuroticism scores and intelligence are somewhat conflicting. For example, while some researchers (e.g., Baker & Bichsel, 2006; Demetriou & Kazi, 2000; Demetriou et al., 2003; Escorial et al., 2006; Moutafi et al., 2003) have found that neuroticism is not

related to intellectual abilities, other researchers (e.g., Ackerman & Heggestad, 1997; Moutafi et al., 2005) have reported that neuroticism is negatively correlated with general intelligence. In contrast, positive correlations have been found between neuroticism and different measures of intelligence, for example, crystallised ability (Gc) (Pearson, 1993) and fluid intelligence (Gf) (Furnham et al., 2006). Therefore, the specific nature of the relationship between neuroticism and intelligence scores remain unclear. There is still debate among researchers about whether the results of measures of intelligence can be considered an accurate indicator of an individual's true capability (e.g., Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001; Zeidner & Matthews, 2000), or whether they also reflect the impact of personality traits on intelligence scores (e.g., Ackerman & Hegesstad, 1997; Moutafi et al., 2006; Wechsler, 1950, 1975).

There is growing support for the identification of cross-cultural differences in the relationship between neuroticism and intelligence scores (c.f., Chamorro-Premuzic, Furnham, & Petrides, 2006; Demetriou et al., 2003). As discussed previously in Chapter 2, there are conflicting results with regard to cross-cultural differences in the extent to which neuroticism levels directly (or indirectly) affects an individual's performance on intelligence tests, and such results have contributed to our understanding with regard to the importance of assessing cultural diversity on intelligence tests. For example, utilising a sample of Cypriot secondary-level school students, Demetriou et al. (2003) found that neuroticism was not related to cognitive ability. Chamorro-Premuzic et al. (2006) reported that the correlation coefficient of emotional stability among an adult New Zealand sample was positive and significant with verbal cognitive ability, and positive, but not significant, with numerical ability scores. Ettinger and Corr (2001) have not found any relationship between neuroticism and intelligence as measured by Raven's Advanced Progressive Matrices among British university students, while Moutafi, Furnham, and Tsaousis, (2006) found, among Greek university students, a negative and significant relationship between neuroticism and intelligence as measured by Raven's Standard Progressive Matrices. It is noteworthy that any differences in these two research findings could be explained by differences in cultural norms and expectations.

Moreover, as outlined in Chapter 2, there is growing evidence that sex and age differences can help to explain the relationship between intelligence and neuroticism

scores (e.g., Costa et al., 2001; Lynn & Dai, 1993; McCrae, 2001b; Ready & Robinson, 2008; Rubinstein & Strul, 2007; Shuttleworth-Edwards et al., 2004; Snow & Weinstock, 1990; Wechsler, 1997). It is consistently found that the neuroticism score of females is significantly higher than the neuroticism scores of males (e.g., H. Eysenck & Eysenck, 1991a; S. Eysenck et al., 1993; Furnham et al., 2006; Rubinstein & Strul, 2007) and that the general IQ of males is higher than that of females (Furnham & Monsen, 2009; Rushton et al., 2007), and that mean score of females is significantly higher than the mean score of males on the Performance IQ scale of the Wechsler Adult Intelligence Scales (Snow & Weinstock, 1990) and on the Digit Symbol subtest (Lynn & Dai,1993; Snow & Weinstock, 1990).

With regard to age differences, there is evidence that neuroticism scores decrease with age, with the highest level of neuroticism appearing during adolescence (H. Eysenck & Eysenck, 1991a; Schultz & Schultz, 2005) and that this decline begins almost at the age of 18 (McCrae, 2001a; 2001b) for males and females across different cultures (McCrae et al., 1999). There are also age differences in intelligence scores. For example, scores on tests measuring fluid abilities, such as the Performance scale of Wechsler's tests, tend to decline with age, while performance on tests measuring crystallised abilities, such as the Verbal scale of Wechsler's tests, tends to increase with age (Maltby et al., 2007; Moutafi et al., 2003). Therefore, the extent to which students' age and sex differences can explain the relationship between neuroticism and intelligence scores still requires further consideration. Moreover, the effect that age and sex differences have on the relationships between intelligence and neuroticism scores among a Libyan population is currently unknown and requires further detailed investigation.

The current study examines the complex relationship between intelligence and neuroticism scores across a sample of Libyan students to explore how age and sex differences contribute to this relationship. Moreover, the current work examines the effect of neuroticism on students' cognitive abilities after the effects of sex and age have been taken into account to fully characterise the nature of the relationship between neuroticism and intelligence scores. The current work addresses three important research questions. Firstly, are there age and sex differences in the Libyan students' neuroticism scores? Secondly, does students' performance on the WBIS scales and

subtests differ according to their sex, age and levels of neuroticism? Thirdly, is there a relationship between neuroticism scores and intelligence scores after the contribution of age and sex have been partialled out of the analyses?

5.2 Method

5.2.1 Participants

Seventy-five Libyan students between the ages of 15 to 25 years participated in the study. Of these participants, 37 were males with a mean age of 19.37 years (*SD* = 3.27) and 38 were female with a mean age of 18.79 years (*SD* = 2.93). All the participants were attending secondary school or university settings and all spoke the Arabic language as native speakers. Full informed consent was gained for each individual's participation in the study.

Table 10

Number of Participants in Study 2 by Age and Sex

	Sample size		
Age categories	Female	Male	Total
15-17	08	07	15
18-19	18	13	31
20-24	11	13	24
25-29	01	04	05
Total	38	37	75

5.2.2 Materials

5.2.2.1 Neurotic Behaviour Scale (NBS)

As shown in Chapter 3, the Neurotic Behaviour Scale (NBS) is a specifically designed test of neuroticism. The test consists of 39 individual items designed to assess seven facets of neuroticism: anxiety, inferiority complex, reactive sensitivity, body disorder, thinking, social relations and sleeping disorder. Each participant is required to provide a yes or no answer to each statement and there is no set time limit for completion of the scale. In this task, 33 items measure neuroticism and the remaining 6

items are a measure of social desirability. As found in Elmadani (2001) the internal consistency and the split-half[1] reliability of the scale among a Libyan population are high (.90, N = 100, and .77, N = 50, respectively) as well as the concurrent validity which is based on the scale's correlation with the Eysenck Personality Inventory (r = .74, N = 100, P < .01).

5.2.2.2 Wechsler-Bellevue Intelligence Scale (WBIS), the Arabic version

The Wechsler-Bellevue Intelligence Scale *(*WBIS) is the most widely used measure of intelligence among Arabic societies (Maleka, 1996). The WBIS was designed to measure global intelligence scores alongside separate measures of verbal intelligence and performance intelligence. The WBIS consist of 11 subtests, six of which are measures of verbal intelligence and five subtests are measures the performance intelligence. The verbal intelligence subtests comprise of Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities. The performance intelligence subtests comprise of Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol. To calculate Verbal and Performance intelligence scores separately, the scaled scores of each subtest item is summed and then converted to a standard score (M = 100 and SD = 15). The Full Scale intelligence score is obtained by combining the scaled scores of the 11 subtests and converting the sum to a standard score.

5.2.3 Procedure

Students were selected randomly from their schools' registers and tested individually in their schools by the author using the Arabic language. Full written informed consent was obtained from the participants or their parents or guardians for those under 18 years of age before testing. All the participants first completed the NBS followed by the WBIS. Participants were divided into four age groups (group one: 15-17, group two: 18-19, group three: 20-24 and group four: 25-29) according to the age groups of the WBIS. Neuroticism scores were categorised as low (< 40), moderate (between 40 – 60) or high

[1] By an odd-even spilt.

(> 60) according to the norms of the NBS norms (*M* = 50 and *SD* = 10) for the purpose of analysis.

5.3 Results

5.3.1 Differences in Neuroticism Scores according to Sex and Age

The first set of analyses examines age and sex differences on the students neuroticism scores (NBS). Table 11 summarises the means (and standard deviations) of the students' neuroticism scores according to sex and age group. As shown in Table 11, there appears to be differences in neuroticism scores according to sex; the mean scores of females are higher than those of males, while there are slight differences between means across age groups. The standard deviations appear relatively homogenous among males and females, and there are slight differences across age groups; using the Levene's test of equality of error variances showed that the differences were not significant (F (1, 73) = .568, p = .454, and F (3, 71) = .828, p = .483, respectively).

Table 11

Means (and SDs) for Neuroticism Scores according to Age and Sex

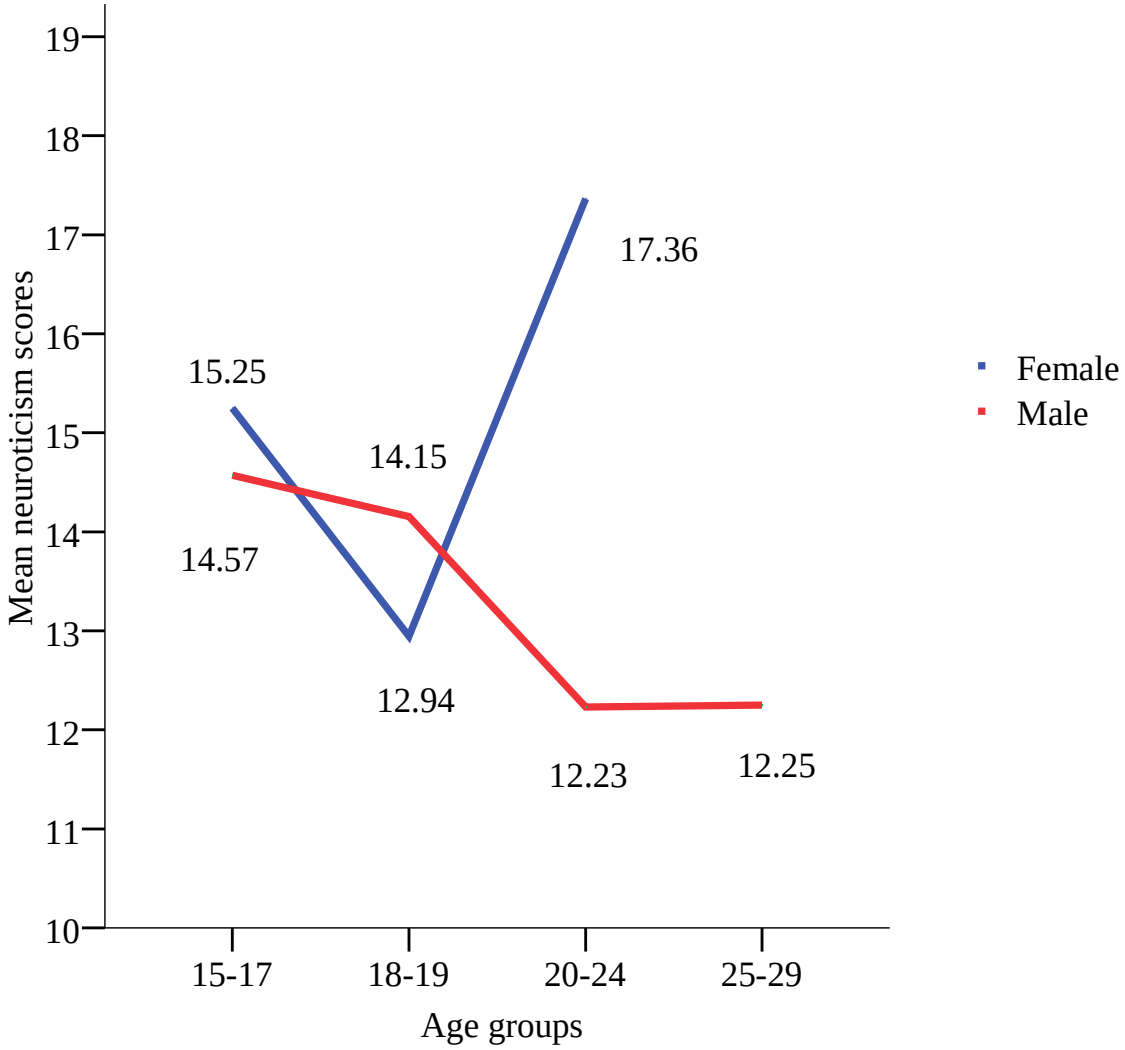
Categories of age	Mean neuroticism score		Sample size	
	Male	Female	Male	Female
15 -17	14.57 (3.91)	15.25 (4.13)	7	8
18 -19	14.15 (4.86)	12.94 (4.70)	13	18
20 -24	12.23 (3.59)	17.36 (5.85)	13	11
25 -29	12.25 (5.19)	0 (0)	4	1

Note. The 25-29 year group involves only one female volunteer; therefore, the mean has not been calculated.

A two- way ANOVA was carried out with sex (males vs. females) and age (15-17 vs. 18-19 vs. 20-24 vs. 25-29) as the between group variables and neuroticism scores as the DV. The main effect of sex on neuroticism scores was significant (F (1, 67) = 7.67, p = .007, partial η^2 = .103), showing higher levels of neuroticism for females than males, irrespective of age group. The main effect of age was not significant (F (3, 67) = 1.33, p

= .271, partial η^2 = .056). The interaction between sex and age group was significant (F (3, 67) = 3.63, p = .017, partial η^2 = .140). The interaction (*Figure 2*) shows that while the average degree of neuroticism in males tended to decrease with age, the average degree of neuroticism for females rose sharply in the 20:24 age group. The difference between mean scores of females in the 18:19 age group and in the 20:24 age group was significant, t (27) = 2.24, p = .034 (two tailed), d = .80. Moreover, differences between males and females throughout the age groups were not significant except in the 20:24 age group: t (22) = 2.636, p = .015 (two tailed), d = .96.

Figure 2 Means plots of neuroticism scores of males and females according to age



5.3.2 Sex and Age Differences in Students' Intelligence Scores

The next stage was to compare the students' performance on WBIS intelligence scales across sex and age. The means (and standard deviations) of the intelligence scores according to sex and age differences are summarised in Table 12.

Table 12

Means (and SDs) of the Libyan Sample on WBIS according to Sex and Age Groups

Variables	Mean score					
	Sex		Age groups			
	M	F	15-17	18-19	20-24	25-29
F IQ	99.4 (10.78)	93.5(8.02)	94 (10.1)	94.1 (7.2)	99.5 (11)	103 (13.5)
VIQ	97 (12.23)	88.9(8.69)	89.1(9.8)	88.9 (8.7)	98.3(11.1)	103.2 (15.9)
PIQ	100.5 (11.13)	97.7(9.43)	98.7(8.8)	96.6 (8.9)	101.6(11.2)	103 (16.9)
V	10.6 (2.12)	9.4 (1.95)	9.1 (2.2)	9.6 (1.8)	10.8 (1.9)	11.6 (2.6)
S	10.5 (2.09)	11.2(2.09)	9.5 (2.5)	11.2 (1.7)	11.2 (2.2)	10.4 (1.7)
A	8.4 (3.05)	5.2 (1.58)	6.4 (2.1)	6.1 (2.5)	7.7 (3.6)	8 (2.6)
DS	10.1(2.98)	9.9 (2.61)	8.7 (2.1)	9.6 (2.6)	10.5 (2.7)	14 (2.7)
I	9.4 (2.50)	7.9 (2.19)	8.2 (2.8)	8.5 (2.4)	9.2 (2.3)	8.6 (2.9)
C	10.5 (3.15)	9.6 (2.31)	8.9 (3.6)	9.8 (2.1)	10.8 (2.6)	11.4 (3.8)
PC	10.1 (2.30)	8.7 (1.74)	9.3 (2.3)	9 (1.9)	9.8 (2.2)	9.6 (2.9)
CD	11 (1.74)	11.3(2.13)	10.7(1.9)	11.1 (2.1)	11.5 (1.8)	11.6 (1.7)
BD	10.9 (2.90)	10.3(2.24)	10.7(1.6)	10.0 (2.5)	11.3 (2.9)	10.4 (3.9)
OA	11.5 (2.33)	10.5(2.37)	10.7(2.6)	10.8 (2.2)	11.5 (2.4)	10.8 (2.8)
PA	9.1 (2.00)	9.6 (2.18)	9.03(2)	9.7 (1.8)	10 (2.4)	9 (3.1)

Note. FSIQ = Full Scale IQ, VIQ = verbal IQ, PIQ = performance IQ, V = Vocabulary, S = Similarities, A = Arithmetic, DS = Digit Span, I = Information, C = Comprehension, PC = Picture Completion, CD = Digit Symbol-Coding, BD = Block Design, OA = Object Assembly, PA = Picture Arrangement. Means on the full, verbal and performance scales are for IQs, while on the all subtests for scaled scores. *N* of males was 37. *N* of females was 38. Number of students in the 15-17 age group = 15; 18-19 = 31; 20-24 = 24; 25-29 = 5.

As shown in Table 12, males' performance on all the WBIS IQ scores and most of subtests were higher than the mean scores of females. The standard deviations appear

slightly different among males and females; however the differences were significant only on the Full Scale IQ, Performance IQ scale and Arithmetic subtest (F (1, 73) = 4.546, p = .036; F (1, 73) = 4.159, p = .045, and F (1, 73) = 15.455, p = .0005, respectively). Similarly, the performance of the older students (in the 20-24 and 25-29 age groups) on all the WBIS IQ scales and most of the subtests was higher than the performance of the younger students in the other groups. The standard deviations throughout all groups appear different, particularly on the WBIS IQ scales. However, the only significant difference was on the Full Scale IQ (F (3, 71) = 2.803, p = .046).

Next individual differences in students' intelligence scores across sex and age groups were examined using a two-way ANOVA. The WBIS scores (and subtests scores) were the DV, and sex and age as the IV. The results from the ANOVA found that the main effect of sex was significant, with males having significant higher scores than females on Verbal IQ, F (1, 67) = 8.594, p = .005, partial η^2 = .114, and on Vocabulary, F (1, 67) = 7.605, p = .007, partial η^2 = .102; Arithmetic, F (1, 67) = 13.9, p = .0005, partial η^2 = .172, and on Information, F (1, 67) = 8.442, p = .005, partial η^2 = .112. However, the main effect of sex on the Full Scale IQ, the Performance IQ scale and on the remaining subtests of the WBIS was not significant.

The main effect of age was significant for the Verbal IQ, F (3, 67) = 4.263, p = .008, partial η^2 = .160, and on Vocabulary, F (3, 67) = 2.758, p = .049, partial η^2 = .110; Similarities, F (3, 67) = 2.765, p = .049, partial η^2 = .110, and on Digit Span, F (3, 67) = 4.481, p = .006, partial η^2 = .167. In order to determine which difference between each two groups is significant, the researcher used Post Hoc tests (Tukey HSD test) for multiple comparisons. The results from the Tukey HSD test found that, for the Verbal IQ scale, the mean scores of the 20-24 and 25-29 age groups were significantly higher than the mean scores of the 15-17 and 18-19 age groups; all the differences were significant at the .05 significance level. However, there were no significant differences between the 20-24 and 25-29 age groups, and between the 15-17 and 18-19 age groups. On Vocabulary, the mean difference between the 20-24 and 15-17 age groups was significant (MD = 1.725, P = .049), while there were no significant differences between other groups. On the Similarities subtest, the mean scores of the 18-19 age group was higher than for other groups. The mean differences, however, were significant only

between the 15-17 and 18-19 age groups (*MD* = -1.692, *P* = .047). Finally, on Digit Span, the mean differences between the 25-29 age group and the 15-17, 18-19, 20-24 age groups were significant (*MD* = 5.333, 4.419, 3.458; *P* = .001, .003, .034, respectively). However, there were no significant differences between the other groups. A two-way ANOVA was also used to examine whether the sex and age of the participants combine to affect their intelligence scores. The results from ANOVA revealed that there was no significant interaction between sex and age on all the IQs and subtests scores of the WBIS.

5.3.3 Differences in Intelligence Scores According to Levels of Neuroticism

To further examine the role of neuroticism on an individual's intelligence score, individuals level of neuroticism (indicative of low, medium or high levels) was compared against the different sub-tests on the intelligence measure (as measured on the WBIS). The means (and standard deviations) for intelligence scores according to their level of neuroticism is summarised in Table 13.

The results showed that the number of participants with medium levels of neuroticism scores (mean =46), is the largest compared with the number of participants with low and high levels (mean = 19 and 10, respectively), indicating that the neuroticism scores are normally distributed among the research sample which reflects the distribution of neuroticism within the whole research population. Using the Explore procedure, the researcher examined this supposition and found that the mean, trimmed mean and median (14.20, 14.07, and 14.00, respectively) for the neuroticism scores were nearly equal and that the skewness and kurtosis statistics were close to zero (0.338 and 0.238, respectively). This is good evidences that neuroticism is normally distributed. Moreover, results of tests of normality which aim to compare between the current distribution of neuroticism scores and a normal curve on actual data, to assess the fit, showed that the tests was not significant, Kolmogorov-Smirnov = .097 (75), *p* = .076, and Shapiro-Wilk = .970 (75), *p* = .074, they fit the normal curve well.

Table 13 shows that the mean scores of the high-neuroticism group were lower than the other two groups on the WBIS Full IQ scores and Verbal IQ scores. However, one-way ANOVAs revealed no significant differences among the three neuroticism groups

(low vs. medium vs. high) on the Full Scale IQ scores, F (2,72) = .68, p = .511, η^2 = .018, Verbal IQ scores, F (2,72) = 1.11, p = .335, η^2 = .030 or Performance IQ scores, F(2,72) = .076, p = .927, η^2 = .002, suggesting that the level of neuroticism did not differ between scores on different intelligence measures.

Table 13

Means (and SDs) of the Libyan sample on the WBIS According to their Level of Neuroticism

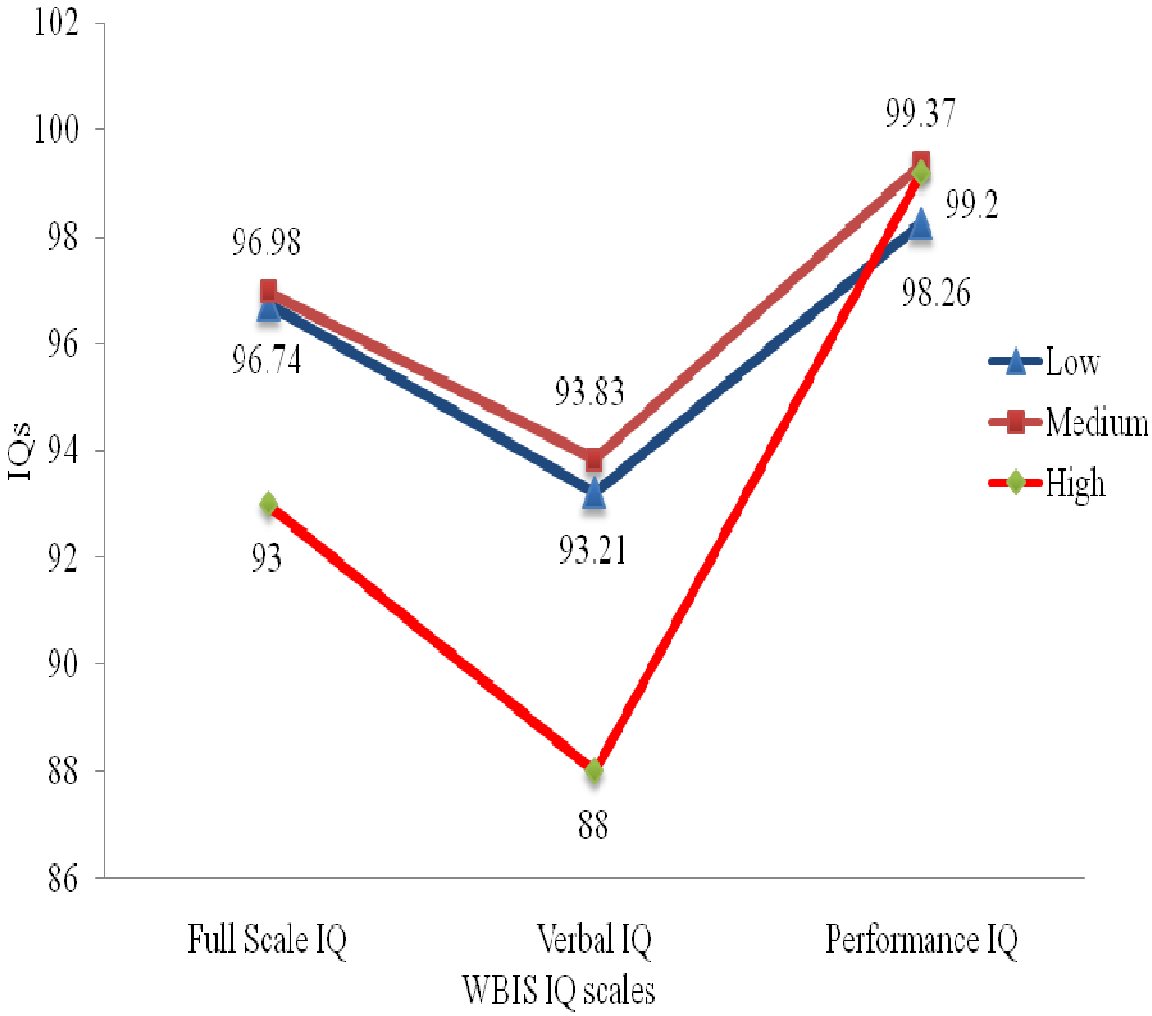
Subtests	Mean score		
	Low	Medium	High
Full Scale IQ	96.74 (12.53)	96.98 (9.15)	93 (9.87)
Verbal IQ	93.21 (13.56)	93.83 (10.80)	88 (8.01)
Performance IQ	98.26 (11.76)	99.37 (9.85)	99.20 (10.64)
Vocabulary	10 (2.31)	10.01 (2.13)	9.60(1.65)
Similarities	11.47 (1.95)	10.74 (1.98)	10 (2.71)
Arithmetic	7.05 (2.84)	6.98 (2.89)	5.30 (2.63)
Digit Span	10.16 (2.41)	10.04 (3.02)	9.50 (2.46)
Information	9 (2.45)	8.87 (2.48)	7 (1.83)
Comprehension	9.68 (2.73)	10.09 (2.87)	10.50 (2.59)
Picture Completion	9.68 (2.29)	9.35 (1.95)	8.90 (2.73)
Digit Symbol	10.74 (2.05)	11.30 (1.94)	11.60 (1.65)
Block Design	10.16 (2.83)	10.80 (2.60)	10.50 (2.12)
Object Assembly	11.37 (2.45)	10.91 (2.44)	10.60 (2.12)
Picture Arrangement	9.53 (1.98)	9.24 (1.86)	9.60 (3.24)

Note. Means on the full, verbal and performance scales are for IQs, while on all the subtests means are for scaled scores. *N* of low group = 19; medium group = 46; high group = 10.

As shown in Table 13 and *Figure 3*, the means of Performance IQ scale of the three groups are higher than the means of the Verbal IQ scale. Using the Paired Samples *t*-test, the differences between them were significant among the low group, t (18) = 3.550, p = .002 (two-tailed), d = 0.81; medium group, t (45) = 3.418, p = .001 (two-tailed), d =

0.50; and the high group, t (9) = 2.830, p = .02 (two-tailed), d = 0.90. However, the only difference that was clinically significant was among the group with a high level of neuroticism where the mean difference between the Verbal IQ and Performance IQ was 11-IQ points.

Figure 3 Means of WBIS IQ scores according to level of neuroticism (Study 2)



Moreover, although there were no significant differences between the three groups on all the subtests of intelligence, the differences between the means of the scaled scores within each group had clinical significance. In this respect, one of the methods that have been used to analyse the performance of individuals on the WBIS is the *test profile scatter* (Maleka, 1996), which is the difference between the scaled scores that

are obtained by the examinee on all the subtests. One of the ways of measuring test profile scatter is called the “Vocabulary Scatter”. It is estimated by computing the differences between the scaled scores of each subtest and the scaled score of the Vocabulary test. This method assumes that Vocabulary is the best measure of the original level of an individual's mental abilities in which is able to estimate the deterioration in the present time. As a result, a difference of 2-scaled scores or more between the scaled scores of each subtest and the scaled score of the Vocabulary is a clinically important indicator (Maleka, 1996). Using the method of test profile scatter, it appeared that the scaled scores of the high group on the WBIS subtests were more scattered than the other groups. Comparing the vocabulary scatter, the Arithmetic test is the only subtest that significantly deviated from the Vocabulary subtest among the low and medium groups (-2.95 and -3.03, respectively), while among the high group there were clinical signification deviations on the Arithmetic = -4.3, Information = -2.6, and on the Digit Symbol = 2.01.

5.3.4 Sex and Age Differences in the Relationship between Neuroticism and Intelligence Scores

The final step was to analyse differences in sex and age in the students’ neuroticism scores and WBIS IQ scores (and the associated subtests). As Table 14 reveals, males’ correlations were higher on the majority of the WBIS IQ and subtests than females. For example, the correlation between the Full Scale IQ and the neuroticism scores for female was almost zero while for males it was higher and significant (r = -.36, N = 37, P = .031, two-tailed), with a moderate effect size. However, using the Fisher’s z transformation of the correlation coefficient, there was no significant difference between both correlations. The z value was 1.32, p = .09, indicating that the correlations were not significantly different. Similarly, on the Object Assembly, the correlation for females was almost zero while for males, it was higher and significant (r = -.35, N = 37 P = .033, two-tailed), with a moderate effect size, z = 1.22, p = .11. Nevertheless, the correlations between neuroticism and intelligence scores among the female sample were higher than those of males on the Arithmetic and Digit Symbol subtests. As shown in Table 14, the Pearson correlation of females on the Arithmetic was significant and higher than the correlation of males on the same scale (r = -.33, N = 38, P = .031, two-tailed, and r = -.23, N = 37, P = .170, two-tailed, respectively). Moreover, on the Digit

Symbol, the correlation for males was almost zero, while for females it was higher and significant (r = -.34, N = 38, p = .035, two-tailed). However, using the Fisher's z test, there were no significant differences between these correlations on both the Arithmetic and the Digit Symbol subtests, z = .453, p = .32, and z = .30, p = .10, respectively.

Table 14

Pearson's Correlation between Neuroticism and WBIS IQs and Subtests among the Libyan Sample

Subtests	Sex		Age groups			
	Male	Female	15-17	18-19	20-24	25-29
Full Scale IQ	-.36*	.06	.210	-.133	-.342	-.698
Verbal IQ	-.32	.04	.232	-.159	-.296	-.94*
Performance IQ	-.27	.18	.093	.082	-.310	-.053
Vocabulary	-.22	.08	.220	-.113	-.080	-.93*
Similarities	-.20	-.11	.070	.020	-.171	-.712
Arithmetic	-.23	-.33*	-.078	-.251	-.387	-.91*
Digit Span	-.27	.08	-.110	-.036	-.125	-.465
Information	-.23	-.23	.028	-.134	-.41*	-.97**
Comprehension	-.03	.25	.68**	.061	.005	-.798
Picture Completion	-.32	-.06	.113	-.155	-.63**	.103
Digit Symbol	-.04	.34*	.374	.247	.062	.280
Block Design	-.19	.10	-.200	.091	-.135	-.428
Object Assembly	-.35*	-.07	.110	-.210	-.51*	.097
Picture Arrangement	-.22	.17	-.179	.022	.136	-.212

Note. Number of Female = 38; Male = 37; 15-17 = 15; 18-19 = 31; 20-24 = 24; 25-29 = 5.
* $p < .05$. ** $p < .01$.

With respect to chronological age, correlations of the older students were considerably higher on the majority of the WBIS IQ and subtests than for the younger students, particularly among the 25-29 age group, where there were negative and significant correlations on the Verbal IQ, Vocabulary, Arithmetic and Information. Among the 15-17 age group, there was only one significant correlation on the Comprehension subtest.

To identify the relationship between neuroticism and WBIS IQ and subtests scores without the effect of sex and age, partial correlations were calculated and these are presented in Table 15. As shown in Table 15, the correlation coefficients were lower when sex was controlled for. However, there were very slight differences when controlling for age. The correlation between neuroticism and Arithmetic subtest was the only correlation that remained significant.

Table 15

Partial Correlations between Neuroticism and WBIS IQs and Subtests among the Libyan Sample, Having Controlled for Sex and Age

	Pearson correlation	Controlled variables		
		Age	Sex	Age & sex
Full Scale IQ	-.19	-.20	-.15	-.16
Verbal IQ	-.19	-.20	-.14	-.16
Performance IQ	-.06	-.06	-.04	-.04
Vocabulary	-.10	-.10	-.06	-.07
Similarities	-.12	-.11	-.15	-.15
Arithmetic	-.30**	-.30*	-.25*	-.26*
Digit Span	-.09	-.09	-.08	-.10
Information	-.27*	-.27*	-.22	-.23
Comprehension	.07	.07	.10	.10
Picture Completion	-.23*	-.23*	-.19	-.19
Digit Symbol	.20	.21	.20	.20
Block Design	-.06	-.06	-.04	-.05
Object Assembly	-.22	-.22	-.19	-.20
Picture Arrangement	.02	.03	.00	.00

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

5.4 Discussion and Conclusions

The current study examined the role of neuroticism on an individual's intelligence score as measured by the 11 subtests of WBIS among a Libyan population. Specifically, the role of age and sex in explaining the relationship between intelligence and neuroticism scores was examined. The first aim of this study explored whether the mean

scores of individuals on the neuroticism scale differed according to sex and age. In line with most previous studies (e.g., Elmadani, 2001; H. Eysenck & Eysenck, 1991a; S. Eysenck et al., 1993; Rubinstein & Strul, 2007), the results showed significantly higher levels of neuroticism for females than males.

The main effect of sex on neuroticism scores was medium and significant, while the main effect of age was small and not significant. Moreover, the interaction between sex and age was significant with a large effect size. The interaction appeared clearly on the 20-24 age group where the difference between sexes was significant in favour of females, with a large effect size; 96% of the overall variance was accounted for by sex. Moreover, among the female sample, there was a significant difference between the 18-19 and 20-24 age groups in favour of the latter group with a large effect size; 80% of the overall variance being accounted for by age. These findings are in contrast with previous studies (i.e., H. Eysenck & Eysenck, 1991a; McCrae et al., 1999; McCrae, 2001a; 2001b) which have argued that neuroticism decreases with advancing age, and that this decline occurs similarly for males and females across different cultures.

McCrae et al., (1999) suggested that "personality traits change in response to social tasks" (p., 474). Therefore, these differences could be due to social and cultural factors in Libya, which might increase the level of neuroticism among females in this age group. One of these factors could be that at age 20–24, females graduate from universities or higher institutes and begin looking for a suitable job. In Libya, and most of other Arab countries, there is little demand for women's employment (Keddie, 2007); males in Libya have more chance of finding a job (Elmesrati, 2003). Another factor could be that, in Libya, this age is critical with respect to marriage and family formation. Girls are under the control of parents until they marry. This situation is completely different for males, as at this age they are mostly set free from the control of parents and are not under pressure to marry (Althir, 2005).

The second question was whether the performance of individuals on the WBIS differs according to sex, age and their level of neuroticism. The findings showed that the individuals' sex had a significant effect on the performance on the Verbal scale subtests with males performing significantly better than females on measures of Verbal IQ, Vocabulary, Arithmetic and Information. While these findings support the previous

findings by Lynn and Dai (1993), they appear inconsistent with other findings, especially those by Maleka (1996) in this study, Maleka found that the mean scores of males of the Arabic standardisation sample of the WBIS were not significantly higher than the mean scores of females on all WBIS IQ scores and subtests (except Picture Arrangement). However, in contrast they did find evidence of age difference on the WBIS IQ tests. The main effect of age shows significantly better performance for older individuals on the Verbal IQ, Vocabulary, Similarities and Digit Span. One possible explanation for the effect of sex and age on the Verbal scale of the WBIS is that the Verbal scale of WBIS, as a measure of crystallised abilities, refers to information and skills that are acquired through experience, education and cultural influences; therefore, the performance on this scale tends to increase with age as there are increasing of knowledge and experience (Maltby et al., 2007; Moutafi et al., 2003). However, this case is not similar among Libyan student males and females; in Libyan society the sex roles are generally more distinct and there is less equality between the sexes (Hofstede, 2001; Keddie, 2007). As a result, males have more opportunities than females to participate in various social and scientific activities within and outside their community (Althir, 2005). This increases the experience of males and develops their skills, and thus their verbal intelligence, more than females.

With regard to the level of neuroticism, the findings showed that neuroticism had no significant effect on the individual's performance on all the WBIS IQs and associated subtests, since there were almost no differences between the three groups (low, medium, and high) on the performance on the IQ scales. These findings support the results of a study by Stewart, Deary, and Ebmeier (2002), who found no significant difference between mean scores of individuals with low neuroticism and individuals with high neuroticism scores on the Digit-Symbol and the Digit Span subtests. Similarly, these findings are in line with the other studies (e.g., Escorial et al., 2006) that administered cognitive tests rather than WAIS and found that there were no significant differences between the averages of the three levels of neuroticism groups.

A possible explanation for the low affect of neuroticism on the performance of the participants on the WBIS may relate to the level of arousal among the participants in completing the intelligence and neuroticism tests within the current study. Previous researchers reported that the negative relationship between neuroticism and intelligence

scores is largely observable under stressful or arousing conditions (Chamorro-Premuzic, 2003; Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006), and intelligence would decrease with negative affectivity such as anxiety, worry, tension (Zeidner & Matthews, 2000). Bishop, Fossella, Croucher, and Duncan (2008) reported that performance on intelligence tests increases conscious activity in the cerebral cortex; this high activity may increase the cortical arousal as Eysenck (1967) suggests, performance may be influenced by cortical arousal and stimulation on the task. However, the participants in this study were all volunteers, and they know in advance that the results of their performance on the neuroticism and intelligence tests will not affect them personally; this may reduce test anxiety and conscious activity in the cerebral cortex. Therefore, the level of cortical arousal among the participants in the current study may have not increased to the extent that negatively affects their performance on the WBIS.

Nevertheless, this study found that Verbal-Performance IQ discrepancy was only significantly large among the high neuroticism group. This finding supports the notion that differences between verbal IQ and performance IQ scores increase among individuals who have difficulties in adaptation or have neurotic disorders (Demsky, Gass, & Golden, 1998; Maleka, 1996). However, it is remarkable that although all the participants in this study were university and secondary school students, their performance on the Verbal IQ scale was significantly lower than their performance on the Performance IQ scale; in particular, on the Arithmetic subtest where their mean scores was under the subtest's norms mean of 10 among all the three groups. One possible interpretation is that performance on the Verbal IQ subtests may rely more on knowledge and skills that are influenced primarily by environmental and cultural factors and therefore more susceptible to cultural change (H. Eysenck, 1995; Maltby et al., 2007; Wechsler, 1997).

The third question in this study examined how sex and age may mediate the relationship between neuroticism and intelligence test scores. The results showed that there were small negative correlations between neuroticism and most of the WBIS IQs and subtests scores; indicating that the trait of neuroticism has a slight affect on the participants' intelligence scores. This may because the low level of arousal among the participants in the current study as mentioned in a previous section, which discussed the

role of level of neuroticism on intelligence scores. These findings supports the study of Holland et al. (1995), and Stough et al. (1996), who found that neuroticism has a little affect on an individual's intelligence scores as measured by the Wechsler Adult Intelligence Scale-Revised.

The current study examined the role of age and sex in the magnitude of the relationship between neuroticism and intelligence scores. The conclusion that arose from the correlation analyses was that the relationship between neuroticism and intelligence was stronger among males as compared to females, particularly for the Full Scale IQ, Verbal IQ, Vocabulary, Picture Completion and Object Assembly, and was stronger among females as compared to males on Arithmetic and Digit Symbol subtests, and that was stronger among the older students than the younger ones, particularly on the Full Scale IQ, Verbal IQ, Arithmetic and Information subtests. However, using the Fisher's z transformation of the correlation coefficient, there were no significant differences between females' correlations and males' correlations, and between correlations of the younger students and the older students on all the WBIS IQ scales and subtests. Thus, the observed sex and age differences in the relationship between neuroticism and intelligence scores might be the result of chance factors; therefore it may be limited to the current sample. Moreover, using the partial correlation, findings of this study indicate that both sex and age had a little effect in the relationship between neuroticism and all the WBIS IQ scales and subtests scores, since there were very slight differences when controlling for sex and age.

Overall, the findings from this study have illustrated how sex and age differences are important in explaining differences in neuroticism and intelligence scores separately but they have a little affect on the relationship between neuroticism and intelligence scores. However, It should be noted that this study utilised a student sample, and given that the materials of the study need about 90 minutes to be completed, and the difficulties in recruiting this sample, the range of age of participants (15-26) and the size of sample (N = 75) were relatively small, which may restricts the generalisability of the present results. The next step of the current thesis is to examine further the role of cultural differences between Libya and Britain on the relationship between neuroticism and intelligence scores and to compare the findings of Study 2 against those from a British sample.

CHAPTER 6 STUDY 3: Neuroticism and Intelligence Scores among a British Student Sample

6.1 Introduction

As outlined in Chapter 2, several researchers have examined the role of sex and age differences in an individual's intelligence (e.g.,Furnham & Monsen, 2009; Lynn & Dai, 1993; Rushton et al., 2007) and neuroticism scores (e.g., Cattell & Kline, 1977; Costa et al., 2000; H. Eysenck & Eysenck, 1991a; Maltby et al., 2007; Ready & Robinson, 2008), however, their findings were inconclusive. Similarly, the influence of neuroticism on the performance of individuals on intelligence tests, as outlined in Chapter 2, has received much attention (e.g., Ackerman & Heggestad, 1997; Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001; Furnham et al., 2006; Furnham & Monsen, 2009; Lounsbury et al., 2005). However, relatively few studies (e.g., Jorm et al., 1993; Lounsbury et al., 2005) have considered the role of age and sex differences on the relationship between neuroticism and intelligence scores.

Moreover, findings from previous research with regard to the potential relationship between neuroticism and intelligence scores were conflicting not just across different cultures, such as the Cypriot culture (Demetriou et al., 2003) and the New Zealand culture (Chamorro-Premuzic, Furnham, & Petrides, 2006) but within the same culture such as the English culture. For instance, Ettinger and Corr (2001) examined the relationship between neuroticism and fluid intelligence scores among undergraduate English students and found that neuroticism was not related to fluid intelligence scores. On the other hand, Furnham, Rawles, and Iqbal (2006) investigate the relationship between the performance of 240 English students on a neuroticism scale and a measure of fluid intelligence and found that neuroticism was significantly and negatively correlated with fluid intelligence scores. Therefore, specific nature of the relationship between neuroticism and intelligence scores remain unclear, and further clarification is required to fully understand whether intellectual abilities are distinct characteristics and hence unrelated to well-established personality traits, or whether the performance of individuals on IQ tests may be influenced by non-intellective factors such as their personality traits.

It was argued in Chapter 2 that despite clear evidence of both sex and age differences in explaining an individual's intelligence and neuroticism scores separately, relatively few researchers (e.g., Chamorro-Premuzic, Furnham & Petrides, 2006; Jorm et al., 1993; Lounsbury et al., 2005) have considered how age and sex differences influence the relationship between neuroticism and intelligence together. Thus, there is some evidence to suggest that both sex and age differences may be important in explaining the relationship between intelligence scores and neuroticism. For example, Lynn, Hampson, and Magee (1984) found that the relationship between neuroticism and intelligence scores was negative, but not significant among a British female sample, while among males, the relationship was positive and significant. This indicates that the influence of sex was not just in terms of the magnitude of the correlation but also in the direction. On the other hand, Jorm et al. (1993) found that neuroticism was negatively and significantly correlated with fluid intelligence scores just among males. The correlation between neuroticism and fluid intelligence scores among females was very small within Jorm et al's sample.

Moreover, most studies outlined in Chapter 2 (e.g., Ackerman & Heggestad, 1997; Demetriou et al., 2003; Di Fabio & Palazzeschi, 2009) did not consider the role of age in explaining the relationship between neuroticism and intelligence scores. However, some findings from previous studies have contributed to our understanding of the importance of age differences in explaining the individual differences in intelligence and neuroticism scores, and at least some understanding with regard to the role of age differences in explaining the relationship between both variables. For example, Furnham et al. (2006) found that neuroticism was negatively correlated with fluid intelligence among 240 English secondary school students, while among 70 undergraduates neuroticism was positive and non significant. By contrast, age differences were not found to be effective in two other studies that used the same materials to investigate the relationship between neuroticism and intelligence among the British population. In the first, Chamorro-Premuzic, Furnham, and Ackerman (2006) administrated the Revised NEO Personality Inventory and the Baddeley Reasoning Test (BRT), to measure personality traits and fluid intelligence respectively, to 201 university students (age ranged from 18 to 31). The results showed that neuroticism was not related with fluid intelligence. Using the same tests, Furnham and Monsen (2009)

also found no significant relationship between neuroticism and fluid intelligence scores among their sample of 334 British secondary school students. On the basis of these research findings (e.g., Chamorro-Premuzic, Furnham, & Ackerman, 2006; Furnham et al., 2006; Furnham & Monsen, 2009), it remains clear that further work is required to fully examine the role of age and sex in explaining this relationship between neuroticism and intelligence scores. The effects of sex and age in the relationship between neuroticism and intelligence scores lead to predictable differences in the performance of men and women of all ages on measures of intelligence.

Most of the previous studies outlined in Chapter 2 in the current thesis investigated the relationship between intelligence and neuroticism scores but failed to consider how the different levels of neuroticism may play a more subtle role in explaining individual differences in an individual's intelligence scores. The considering different levels of neuroticism is important given that the correlation coefficient between intelligence and neuroticism scores does not tell us about the point at which the effect of the relationship began. Previous researchers (e,g., Ackerman & Heggestad, 1997; Austin et al., 2002; Escorial et al., 2006; Lounsbury et al., 2005) reported negative correlations between neuroticism and intelligence scores. However, their results did not explain whether the performance on intelligence scales will be negatively affected even by the low levels of neuroticism, or wither it will only be affected by the high levels of neuroticism. Few researchers (e.g., Austin et al., 1997; Escorial et al., 2006), have considered the impact of different levels of neuroticism on the performance of participants on measures of intelligence but none of them have examined the influence of the level of neuroticism in the performance of individuals on Wechsler's intelligence test (WAIS) although it is the most widely used test by psychologists who are evaluating cognitive performance (Greve et al., 2003; Maleka, 1996), and was designed to measure both individual verbal and performance abilities in addition to the general factor of intelligence 'g'. The numerous subtests of the WAIS provide an extensive understanding of the overall intelligence of the individual, as well as their particular strengths and weakness (Maltby et al., 2007). Therefore, the current study will investigate the impact of the level of neuroticism on the performance of participants on the WAIS-III scales and subtests scores.

The current study provides a further investigation of the specific nature of sex and age differences in individuals' neuroticism and intelligence scores. It also further investigates the relationship between intelligence and neuroticism using WAIS-III which has not been extensively used in such studies so far, but which is of interest as the WAIS-III is one of the most widely used tests by psychologists who are evaluating cognitive performance (Greve et al., 2003; Maleka, 1996). This study will extend the findings from previous work by examining how age and sex differences mediate the relationship between neuroticism and intelligence scores among a British student sample. The findings of this study along with the findings of Study 2 (Chapter 5) will allow the investigation of the role of cultural differences between Libya and Britain in neuroticism and intelligence scores and in the relationship between neuroticism and intelligence scores, which will be discussed in Chapter 7 in the current thesis. In particular, Study 3 addresses three key research questions. First, are there age and sex differences on the British students' neuroticism scores? Second, do the students' performance on the WAIS-III scales and subtests differ according to their sex, age and level of neuroticism (low, medium, and high)? Third, is there a relationship between neuroticism scores and intelligence scores after the contributions of age and sex have been taken into account?

6.2 Method

6.2.1 Participants

The sample comprised 77 students who attended either secondary school or in the Nottingham Trent University and all spoke the English language as their mother tongue. The participants comprised 43 females, with ages ranging between 18 to 26 years (M = 19.63 years, SD = 2.06), and 34 males between the ages of 16 to 26 years (M = 19.12 years, SD = 2.79). (See Table 16)

Table 16

Number of Students in the Sample by Age and Sex

Age categories	Sample size		
	Female	Male	Total
15-17	0	13	13
18-19	29	12	41
20-24	11	6	17
25-29	3	3	6
Total	43	34	77

Note. There were no female participants in the 15-17 age group

6.2.2 Materials

6.2.2.1 Neurotic Behaviour Scale (NBS)

As described in Study 2, the Neurotic Behaviour Scale (Elmadani, 2001) is a specifically designed test of neuroticism. The researcher has anglicised the NBS in order to use it in this study (see Chapter 4). The English version of the NBS consists of 36 individual items designed to assess seven facets of anxiety, inferiority complex, reactive sensitivity, body disorder, thinking, social relations and sleeping disorder. Each participant is required to provide a yes or no answer to each statement and there is no set time limit for completion of the scale. In this task, 30 items measure neuroticism and the remaining 6 items are a measure of social desirability. As outlined in Chapter 4 in the current thesis, the validity and reliability of the NBS on a British sample was good, with Cronbach's alpha reliability value of the NBS being high (.82, N = 72) as well as the concurrent validity which is based on the scale's correlation with the Eysenck Personality Questionnaire-Revised (r = .82, N = 80, P < .01).

6.2.2.2 Wechsler Adult Intelligence Scale–Third Edition (WAIS-III)

The Wechsler Adult Intelligence Scale (WAIS-III) is the most widely used test by psychologists, who are evaluating cognitive performance (Greve et al., 2003). The WAIS-III consists of 14 subtests that produce three traditional IQ scores in addition to four index scores (i.e., verbal comprehension, perceptual organization, working memory and processing speed). However, for the purpose of the current study, only the 11

subtests that contribute to the three traditional IQ scores have been used, which are the same subtests that are used with the WBIS. Of those, six subtests are measures of Verbal intelligence (VIQ) and five subtests are measures the Performance intelligence (PIQ). The Verbal intelligence subtests comprise of Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities. The Performance intelligence subtests comprise of Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol. To calculate Verbal and Performance intelligence scores separately, the scaled scores of each subtest item is summed and then converted to a standard score (M = 100 and SD = 15). The Full Scale intelligence score is obtained by combining the scaled scores of the 11 subtests and converting the sum to a standard score.

6.2.3 Procedure

Students were invited to participate anonymously in a study to examine the impact of emotional behaviour of individuals on their thinking behaviour. They were informed that participation was voluntary and full written consent was obtained from them or their parents, or guardians for those under 18 years of age, before testing. The instruments were administered individually within the schools by the author. All the participants first completed the NBS followed by the WAIS-III. The procedure lasted between 70 to 90 minutes to complete both scales. Participants were divided into four age groups (group one: 15-17, group two: 18-19, group three: 20-24 and group four: 25-29) according to the age groups of the WAIS-III. Neuroticism scores were categorised as low (< 40), moderate (between 40 – 60) or high (> 60) according to the norms of the NBS norms (M = 50 and SD = 10) for the purpose of analysis.

6.3 Results

6.3.1 Differences in Neuroticism Scores according to Sex and Age

The first stage in this study examines the role of age and sex differences in the neuroticism scores of participants. As shown in Table 17, there appears to be differences in neuroticism scores according to sex indicating that, on average, males in the sample scored 11.71 compared to 14.12 for females, while there are slight differences between means according to age groups, particularly among males. Finally,

as Table 17 suggests, there may be an interaction effect between sex and age, because the neuroticism scores across age groups vary between males and females. Therefore, to examine age and sex differences in individual neuroticism scores, a two- way ANOVA was carried out with sex (males vs. females) and age (15-17 vs. 18-19 vs. 20-24 vs. 25-29) as the between group variables and neuroticism scores as the DV.

Table 17

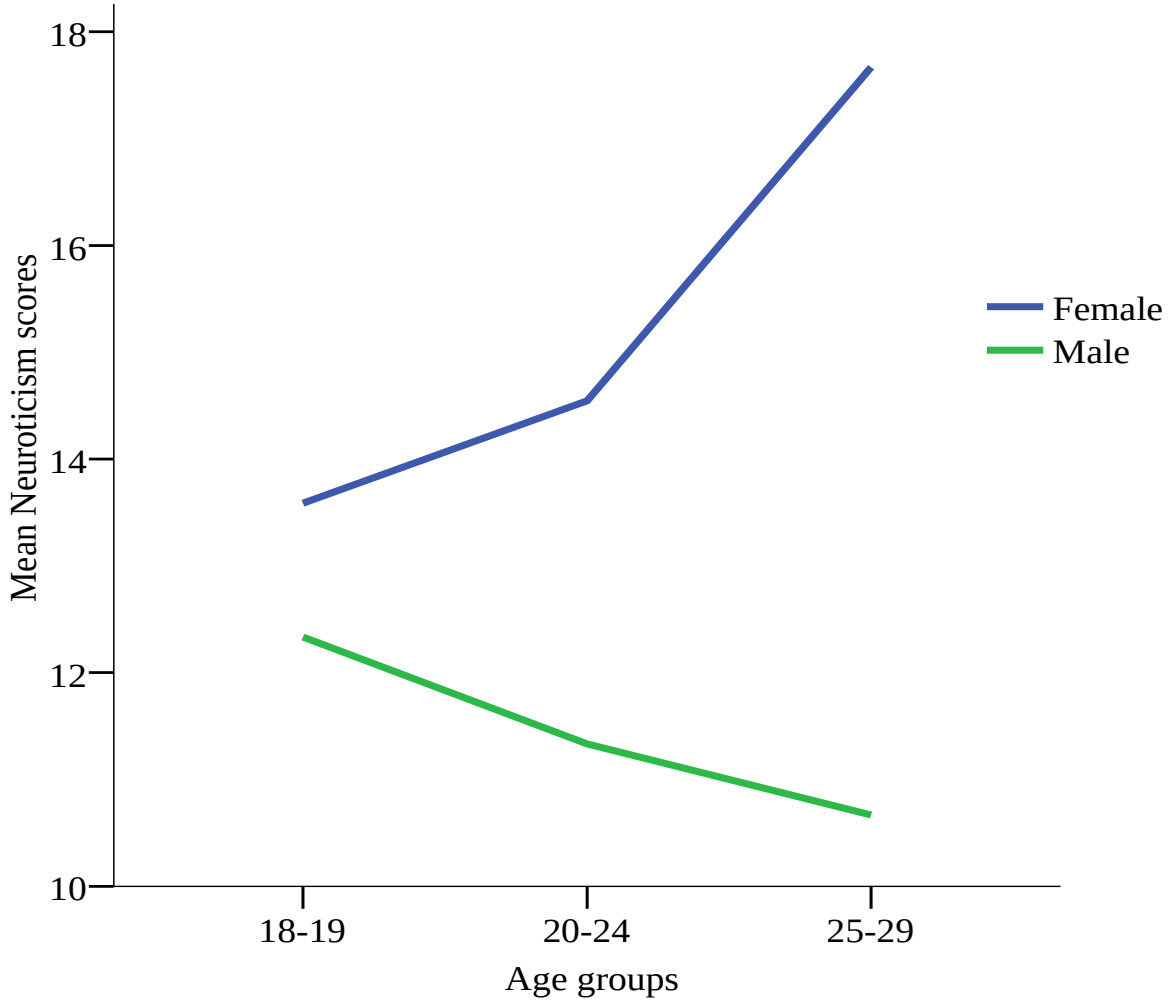
Means (and SDs) for Neuroticism Scores according to Age and Sex (the British sample)

	Mean neuroticism scores on the NBS		
Age categories	Female	Male	Total
15-17	0 (0)	11.54 (3.95)	11.54 (3.95)
18-19	13.59 (3.85)	12.33 (4.08)	13.22 (3.91)
20-24	14.55 (4.57)	11.33 (2.88)	13.41 (4.26)
25-29	17.67 (4.51)	10.67 (2.08)	14.17 (4.97)
Total	14.12 (4.12)	11.71 (3.61)	13.05 (4.06)

Note. There were no female participants in the 15-17 year group.

The main effect of sex on neuroticism scores was significant (F (1, 70) = 8.143, p = .006, partial η^2 = .104), showing higher levels of neuroticism for females than males, irrespective of age group. The main effect of age was not significant (F (3, 70) = .188, p = .907, partial η^2 = .008) suggesting equivalent scores on the neuroticism scale across all age groups. The interaction between sex and age group was not significant (F (2, 70) = 1.467, p = .238, partial η^2 = .040), that is, the differences in neuroticism scores are fully accounted for by age and sex acting independently. Nonetheless, patterns of age differences in neuroticism scores were not similar among males and females. As *Figure 4* suggests there are higher neuroticism scores among males within the younger age groups, and the lowest scores of neuroticism was for the older age groups in males. For females, this pattern is reversed and the higher neuroticism scores were for the older age groups only. It is simply that these differences are not large enough to find a significant main effect as outlined in the ANOVA.

Figure 4 Pattern of age differences in neuroticism scores of the British sample according to sex.



6.3.2 Sex and Age Differences in Students' Intelligence Scores

The next step was to examine the role of sex and age differences in students' intelligence scores. The means (and standard deviations) of the individuals intelligence scores on the WAIS III according to sex and age are summarised in Table 18.

As shown in Table 18 it seems to be that there are very few sex differences in intelligence scores since most of the means were relatively similar among males and females. Nonetheless, males' performance on the Full Sale IQ, Verbal IQ scores and the Similarity and Information subtests were somewhat higher than the means of the females. The standard deviations appear relatively homogenous among males and females.

Table 18

Means (and SDs) of the British Sample on WAIS-III according to Sex and Age Groups

IQs and subtests	Mean Intelligence scores on WAIS-III					
	Sex		Age groups			
	F	M	15-17	18-19	20-24	25-29
F IQ	100.1 (8.49)	104.2 (8.66)	106.6 (7.40)	100 (8.63)	103.1 (9.47)	101.2 (7.30)
PIQ	100(9.90)	99.38 (9.98)	101.2 (9.75)	98.88 (9.92)	100.5 (10.43)	100 (10.26)
VIQ	100.5 (9.28)	106.9 (10.3)	110.5 (10.59)	101 (9.22)	104.5 (10.98)	101.2 (7.47)
V	10.49 (1.73)	10.65 (1.86)	10.92 (2.02)	10.46 (1.54)	10.53 (2.27)	10.50 (1.38)
S	8.88 (1.99)	10.09 (3.03)	10.69 (4.13)	9.12 (2.19)	9.12 (1.96)	9.50 (1.52)
A	11.40 (2.44)	12.26 (2.57)	13.77 (2.95)	11.61 (2.30)	11.47 (2.06)	9.50 (1.64)
DS	10.84 (3.48)	11.56 (2.40)	12.46 (2.07)	10.66 (3.34)	11.24 (3.15)	11.50 (1.98)
I	10.33 (2.39)	12.24 (2.13)	12.08 (2.36)	10.61 (2.48)	12.00 (2.12)	10.67 (2.73)
C	9.35 (2.14)	9.87 (2.06)	9.50 (2.11)	9.42 (2.19)	10.20 (2.04)	9.17 (1.94)
PC	8.28 (2.32)	9.00 (2.41)	8.92 (2.25)	8.39 (2.47)	9.06 (2.44)	8.00 (2.00)
CD	12.02 (2.42)	11.24 (3.21)	12.38 (2.47)	11.80 (2.79)	11.18 (2.83)	10.67 (3.72)
BD	11.49 (1.86)	11.32 (2.71)	11.46 (2.54)	11.22 (2.06)	11.94 (2.63)	11.17 (2.14)
OA	9.24 (2.20)	8.47 (1.97)	8.23 (2.28)	8.85 (1.79)	9.12 (2.60)	10.0 (2.45)
PA	9.25 (2.57)	9.94 (1.98)	10.3 (2.46)	9.08 (2.11)	9.71 (2.44)	10.7 (2.81)

Note. FSIQ = Full Scale IQ, VIQ = verbal IQ, PIQ = performance IQ, V = Vocabulary, S = Similarities, A = Arithmetic, DS = Digit Span, I = Information, C = Comprehension, PC = Picture Completion, CD = Digit Symbol-Coding, BD = Block Design, OA = Object Assembly, PA = Picture Arrangement. Means on the full, verbal and performance scales are for IQs, while on the all subtests for scaled scores. *N* of males was 34. *N* of females was 43. Number of students in the 15-17 age group = 13; 18-19 = 41; 20-24 = 17; 25-29 = 6.

The next stage of the study was to examine differences in the students' intelligence scores according to sex and age using a two-way ANOVA with the WAIS-III scales and subtests scores as the DVs and sex and age groups as the IVs. The results from the ANOVA found that the main effect of sex was not significant on all IQ scales and the most subtests (p >.05). However, the performance of males was found to be significantly higher than the performance of females on the Information subtest, F (1, 70) = 11.446, p = .001, partial η^2 = .141, while the performance of females was significantly higher than the performance of males on the Digit Symbol subtest, F (1,

70) = 4.738, p = .033, partial η^2 =. 063. Similarly, the main effect of age was not significant on all the WAIS-III scales and subtests except on the Arithmetic subtest, where the age differences were significant, F (1, 70) = 3.486, p = .020, partial η^2 =. 130. In order to determine which difference between each two groups on the Arithmetic subtest was significant, the Tukey HSD test for multiple comparisons was carried out. The results revealed that the mean scores for the youngest age group (16-17 year-olds) had the highest mean score on the Arithmetic subtest of WAIS-III and differed significantly from the remaining three age groups. There were no significant differences between the other remaining age groups.

The interaction between the factors of sex and age were not significant. However, the pattern of age differences was not similar among males and females on a number of subtests. To investigate the pattern of age difference among the student sample, Pearson correlation between age of participants and their scores on the WAIS-III scales and subtests were calculated according to sex and are summarised in Table 19.

As shown in Table 19, although all the correlations were not significant except on the Arithmetic for males, the direction of correlations among females and males was not similar across many subtests. For example, the scores on Vocabulary, Digit Span and Picture Completion subtests were negatively associated with age in the males sample, while they were positively associated with age in the females sample. By contrast, the scores on the Block Design were positively associated with age in the males sample, while they were negatively associated with age in the female sample.

Table 19

Pearson Correlation between Age of Participant and Intelligence Scores of WAIS-III according to Sex

	Pearson Correlation	
Variables	Female	Male
Full Scale IQ	.086	-.028
Performance IQ	.050	.022
Verbal IQ	.031	-.086
Vocabulary	.211	-.120
Similarities	-.051	-.037
Arithmetic	-.231	-.371*
Digit Span	.111	-.109
Information	-.043	.194
Comprehension	.137	.154
Picture Completion	.162	-.117
Digit Symbol	-.036	-.273
Block Design	-.113	.203
Object Assembly	.061	.298

* $p < .05$.

6.3.3 Differences in Intelligence Scores According to Levels of Neuroticism

In order to examine the role of neuroticism on an individual's intelligence score, differences in the students' performance on the NBS neuroticism scale against each of the WAIS-III scales (and subtests) were analysed. Analyses were carried out according to the individuals' level of neuroticism (low, medium or high). The means (and standard deviations) for WAIS III intelligence scores according to their level of neuroticism are summarised in Table 20.

Table 20

Means (and SDs) of the British Sample on the WAIS-III according to their Level of Neuroticism

Variables	Mean intelligence scores on WAIS-III		
	Low	Medium	High
Full Scale IQ	105.56 (9.30)	101.58 (8.34)	96.82 (7.08)
Performance IQ	104.13 (10.63)	99.52 (9.53)	94.09 (6.74)
Verbal IQ	106.31 (10.89)	102.94 (9.61)	101.27 (8.50)
Vocabulary	11.20 (2.04)	10.49 (1.74)	10.00 (1.41)
Similarities	9.75 (2.67)	9.40 (2.42)	9.00 (3.16)
Arithmetic	12.88 (1.75)	11.52 (2.68)	11.36 (2.46)
Digit Span	12.19 (4.17)	11.18 (2.74)	9.55 (1.92)
Information	10.81 (3.08)	11.36 (2.16)	10.82 (2.86)
Comprehension	10.50 (2.28)	9.35 (2.05)	9.11 (1.83)
Picture Completion	9.06 (2.86)	8.54 (2.19)	8.18 (2.56)
Digit Symbol	12.56 (2.39)	11.60 (2.91)	10.73 (2.72)
Block Design	12.75 (1.69)	11.22 (2.29)	10.36 (2.11)
Object Assembly	9.31 (2.50)	8.84 (2.04)	8.55 (2.02)
Picture Arrangement	9.94 (2.24)	9.72 (2.45)	8.36 (1.63)

Note. Means on the full, verbal and performance scales are for IQs, while on the all subtests means are for scaled scores. *N* of low neuroticism group = 16; medium group = 50; high group = 11.

The distribution of neuroticism scores among the British sample revealed that the mean, trimmed mean and median neuroticism scores (13.05, 12.98, and 13.00 respectively) were nearly equal and that the skewness and kurtosis statistics were close to zero (0.525 and 0.319 respectively) showing that the neuroticism scores were normally distributed across the sample. As shown in Table 20, the mean scores of the high-neuroticism group were lower than the other two groups on all WAIS-III IQ scales. One-way ANOVAs revealed significant differences among the three neuroticism groups (low vs. medium vs. high) on Full Scale IQ scores, F (2,74) = 3.560, p = .033, η^2 = .088, and Performance IQ scores, F (2, 74) = 3.491, p = .036, η^2 = .086. However,

differences among the three groups on Verbal IQ scores were not significant, F (2, 74) = 1.009, p = .369, η^2 = .027. Using the Tukey HSD test for multiple comparisons revealed that the mean scores for the high-neuroticism group on the Full Scale IQ and Performance IQ scales were significantly lower than for the low-neuroticism group (p < .05). This shows that neuroticism scores did not affect individuals' performance on IQ scales those in the low or medium levels. However, the differences between the low and medium neuroticism groups, and the medium and high neuroticism groups on both scales were not significant.

The next step in the analyses was to compare differences in the individuals' performance on the Performance IQ scale against the Verbal IQ scales across the three neuroticism groups using a series of Paired Samples *t*-tests. These were conducted in order to examine the effect of neuroticism on the homogeneity of individuals' performance on the WAIS-III IQ scales. The results showed that the means of the Verbal IQ scale were higher than the means of the Performance IQ scale among the three groups, and that the differences between them were not significant among the low group, t (15) = .709, p = .489 (two-tailed), d = 0.47, while were significant among the medium group, t (49) = 2.241, p = .030 (two-tailed), d = 0.63; and the high group, t (10) = 2.332, p = .042 (two-tailed), d = 0.65, indicating that high neuroticism scores negatively affected the individuals' performance on the WAIS-III IQ scales. Compared to the standardization sample of the WAIS-III, none of differences were significant since the mean differences that were obtained by participants in the low (*MD* = 2.188), medium (*MD* = 3.420), and high-neuroticism group (*MD* = 7.182) were not equal or exceeded the value of 8.76[1] to be significant at .05 level of significance.

As shown in Table 20 the mean scores of the high-neuroticism group were also lower than the other two groups on all WAIS-III IQ subtests except the Information subtest (p >.05). However, the only significant differences (using one-way ANOVA) among the three neuroticism groups (low vs. medium vs. high) was on the Block Design subtest, F (2,74) = 4.578, p = .013, η^2 = .110. The Tukey HSD test for multiple comparisons revealed that the mean scores of the low-neuroticism group on the Block Design subtest

[1] This value for all ages

were significantly higher than the other groups ($p < .05$), while the difference between high and medium neuroticism groups was not significant.

The role of levels of neuroticism on the participant's strengths and weaknesses on each subtest of WAIS-III were not found to be important. As shown in Table 21, the differences between a single subtest score and the mean of subtest scores among the participants with the three levels of neuroticism were not significant on all the WAIS-III scales and subtests. Moreover, the patterns of participant's strengths and weaknesses on the WAIS-III subtests were all similar across the three levels of neuroticism.

Table 21

Differences between Single Subtest Scores and the Mean of Subtest Scores on the WAIS-III according to Levels of Neuroticism

Subtests	Difference from mean			Statistical significance at .05
	Low	Medium	High	
Vocabulary	-0.02	-0.06	0.03	1.99
Similarities	-0.97	-1.15	-0.97	2.6
Arithmetic	1.66	0.97	1.39	2.47
Digit Span	0.97	0.63	-0.42	2.26
Information	0.09	0.81	0.85	2.21
Comprehension	-0.72	-1.2	-0.86	2.78
Picture Completion	-1.66	-1.44	-1.06	2.86
Digit Symbol	1.84	1.62	1.49	2.76
Block Design	2.03	1.24	1.12	2.68
Object Assembly	-1.41	-1.14	-0.69	2.39
Picture Arrangement	-0.78	-0.26	-0.88	3.36
Mean VIQ scale subtests	11.22	10.55	9.97	
Mean PIQ scale subtests	10.72	9.98	9.24	

6.3.4 Sex and Age Differences in the Relationship between Neuroticism and Intelligence Scores

While the relationship between neuroticism and intelligence scores has been examined, the extent to which age and sex may influence this relationship has not been investigated. Therefore, to examine age and sex differences in the relationship between neuroticism and intelligence scores, Pearson's correlations between neuroticism and WAIS-III IQ scales and subtests scores among the participants were calculated sub-divided by sex and the four age groups (See Table 22).

Table 22

Pearson's Correlation between Neuroticism and WBIS IQs and Subtests among the British Sample

	Sex		Age groups			
	Female	Male	16-17	18-19	20-24	25-29
Full Scale IQ	-.33*	-.28	-.02	-.29	-.49*	-.77
Performance IQ	-.24	-.50**	-.44	-.26	-.38	-.24
Verbal IQ	-.32*	-.04	.28	-.21	-.47	-.94**
Vocabulary	-.18	-.31	-.33	-.27	-.15	-.10
Similarities	-.23	-.01	.20	-.22	-.30	-.84*
Arithmetic	-.31*	.01	-.09	-.03	-.57*	-.18
Digit Span	-.25	-.14	.10	-.210	-.30	-.62
Information	-.12	.11	.28	.01	-.44	-.92**
Comprehension	-.38*	-.18	-.50	-.21	-.37	-.36
Picture Completion	-.14	-.16	-.10	-.24	-.22	.26
Digit Symbol	.07	-.50**	-.60*	-.04	-.20	.28
Block Design	-.40**	-.28	-.24	-.24	-.34	-.80
Object Assembly	-.10	-.10	-.07	-.04	-.16	-.18
Picture Arrangement	-.27	-.40*	-.22	-.31*	-.22	-.40

Note. Number of Female = 43; Male = 34; 15-17 = 13; 18-19 = 41; 20-24 = 17; 25-29 = 6
* $p < .05$. ** $p < .01$.

As Table 22 shows, the majority of correlations for males and females across the four age groups illustrate a negative relationship with all intelligence measures. Correlations between neuroticism and general intelligence (Full Scale IQ) were relatively similar among males and females, both of which were moderate. However, correlations between neuroticism and WAIS-III IQ scales and subtests scores among males' were considerably higher on the Performance IQ scale and the majority of the Performance scale subtests except the Block Design subtest. For example, the correlation for females on the Performance IQ scale was small (r = -.24) while for males it was higher and significant (r = -.50, N = 34, P = .003, two-tailed), with a moderate effect size. Nonetheless, using the Fisher's z transformation of the correlation coefficient, the differences between both correlations on the Performance IQ scale were not significant, the z value was 1.270, p = .10. Similarly, on the Digit Symbol, the correlation for females was almost zero while for males, it was higher and significant (r = -.50, N = 34 P = .003, two-tailed), with a moderate effect size. However, the z value in this case was significant, z = 2.002, p = .02, indicating that the effect size of the two samples (male vs. female) are not similar but significantly different from each other.

In contrast, females' correlations were considerably higher on the Verbal IQ scale and the majority of the Verbal scale subtests. For example, Pearson correlation between neuroticism and the Verbal IQ scale was almost zero for males, while for females was higher and significant (r = -.32, N = 43, P = .039, two-tailed). Similarly, the correlation between neuroticism and the Arithmetic subtest scores of females was significant and higher than the correlation of males on the same scale (r = -.31, N = 43, P = .043, two-tailed, and r = .012, N = 34, P = .947, two-tailed, respectively). However, differences between correlations of males and females were not statistically significant either on the Verbal IQ scale, z = 1.222, p = .11, or on the Arithmetic subtest, z = 1.30, p = .10.

With respect to chronological age, correlations of the older students were considerably higher on the majority of the WAIS-III IQ scales and subtests scores than for the younger students, particularly among the 25-29 age group. For example, the correlations on the Verbal IQ scale and on the Similarity, and Information subtests among the 25-29 age group were very high and significant, while among the other groups were small and not significant. Nonetheless, although the correlation of the youngest age group on the Performance IQ scale was not significant, this correlation

was higher than the correlations among the other three groups on the same scale. Moreover, the correlations of the younger students in the 16-17 age group on the Digit Symbol, and in the 18-19 age group on the Picture Arrangement subtests were higher than the correlations of the older students and were statistically significant.

The final set of analyses identifies the relationship between neuroticism and WAIS-III IQs and subtests scores without the effect of variables of sex and age. Table 23 shows the partial correlations between neuroticism and WAIS-III IQs and subtests controlling the sex and age variables.

Table 23

Partial Correlations between Neuroticism and WAIS-III IQs and Subtests among the British Sample Controlling for Sex and Age

Subtests	Neuroticism scores	Controlled variables		
		Age	Sex	Age & sex
Full Scale IQ	-.35**	-.36**	-.30**	-.31**
Performance IQ	-.32**	-.32**	-.34**	-.34**
Verbal IQ	-.27*	-.27*	-.19	-.19
Vocabulary	-.24*	-.24*	-.24*	-.24*
Similarities	-.17	-.17	-.11	-.11
Arithmetic	-.22	-.21	-.17	-.17
Digit Span	-.23*	-.24*	-.21	-.21
Information	-.14	-.15	-.03	-.04
Comprehension	-.30*	-.30**	-.30**	-.30**
Picture Completion	-.18	-.18	-.15	-.15
Digit Symbol	-.14	-.14	-.20	-.20
Block Design	-.30**	-.31**	-.33**	-.33**
Object Assembly	-.06	-.07	-.10	-.10
Picture Arrangement	-.28**	-.29**	-.23*	-.24*

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 23 shows that both sex and age had little effect on the relationship between neuroticism scores and most of the WAIS-III IQ scales (and subtests scores), since most

of the correlations remained similar when they were controlling for sex and age and the significant correlations remained significant. However, the role of sex was found to be more important than age on the relationship between neuroticism and the Verbal IQ scale and the Digit Span subtests scores; correlations on these tests were not significant when sex were controlling for. That is, sex was a positive factor in the relationship between neuroticism and scores on the Verbal scale and the Digit Span subtest.

6.4 Discussion and Conclusions

This study examined the influence of sex and age on an individuals' neuroticism and intelligence scores among a British UK sample. The study similarly investigated the relationship between intelligence and neuroticism scores and the influence of sex and age on this relationship. There were three main findings from the study. First, while the main effect of sex in neuroticism scores was significant, the main effect of age was small and not significant. Second, the performance of the individuals on the WAIS-III subtests was influenced by sex only on two subtests: Information and Digit Symbol, and by age only on the Arithmetic subtest scores. The high level of neuroticism had a significant negative effect on the performance of individuals on the general intelligence and performance intelligence scales of the WAIS-III; it also affected the homogeneity of individuals' scores on the Verbal and Performance scales. Third, the contribution of sex and age were found to have little or no effects on the correlations between neuroticism and all WAIS-III scores except the Verbal IQ scale and the Digit Span subtests scores, where sex had a positive effect on the relationship between neuroticism and these two subtests scores

The first question was to examine whether the mean scores of a British sample on the neuroticism scale differed according to sex and age. In line with most previous studies (e.g., Elmadani, 2001; H. Eysenck & Eysenck, 1991a; S. Eysenck et al., 1993; Furnham et al., 2006; Rubinstein & Strul, 2007), the results showed that the neuroticism scores of females were significantly higher than neuroticism scores of males, with sex accounting for 10% of the variance in neuroticism scores. However, the main effect of age was very small and not significant. Moreover, the interaction between sex and age was not significant and only 4% of the overall variance was accounted for by the interaction between sex and age. The pattern of age differences in neuroticism scores was not

similar among males and females. The findings revealed that while neuroticism scores trend to decrease with age in the male sample, neuroticism scores trend to increase with age in the female sample. These reversed patterns across males and females would provide evidence for a biological basis of sex differences in the neuroticism trait. One biological explanation for sex differences in neuroticism points to hormonal differences and their effects on mood and personality (Berenbaum, 1999; Costa et al., 2001). Robinson (1998) suggested that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; and that females are higher on cerebral arousal than males. These findings regarding age and sex differences in neuroticism scores support the importance of both variables in neuroticism scores; the effects of sex and age in the trait of neuroticism lead to predictable differences in the behaviour of men and women of all ages. Researchers (e.g., Donnellan & Lucas, 2008; Fung & Ng, 2006; Ready & Robinson, 2008) who investigated patterns of age differences in neuroticism scores across different cultures have not considered the role of sex in these patterns. Moreover, findings of this study are in contrast with previous studies (i.e., H. Eysenck & Eysenck, 1991a; McCrae et al., 1999; McCrae, 2001a; 2001b), which have argued that neuroticism decreases with advancing age, and that this decline occurs similarly for males and females across different cultures. Moreover, with regard to age differences, both Costa et al. (2000), and McCrae (2001a) argued that age differences in personality appeared to reflect maturational chances; men and women between age 18 and age 30 years becoming more emotionally stable, more socially independent, more conventional, and goal-directed. To support this argument, the pattern of age differences in neuroticism should be similar for males and females, however, this was not supported in the current findings.

The second research question was whether the performance of individuals on the WAIS-III differs according to sex, age and their level of neuroticism. The findings showed that although the effect of sex on the performance of students on all the IQ scores and subtest, with the exception of the information and Digit symbol, was not significant, the performance of males on the Verbal scale subtests was higher than the performance of females on the same subtests, and the difference between them was statistically significant on the Information subtest with a large effect size, sex accounting for 14% of the variance in Information scores. On the other hand, the

performance of females on the Performance scale subtests was higher than the performance of males on the same subtests, and the difference between them was statistically significant on the Digit Symbol. However, the effect size of sex in the Digit Symbol subtest scores was medium, with 6% of the overall variance being accounted for by sex. These findings supported the better performance of males on the Information subtest and the better performance of females on the Digit Symbol subtest, which have also been reported by previous researchers (e.g., Lynn & Dai, 1993; Snow & Weinstock, 1990). An explanation for the advantage of females in the Digit Symbol subtest may refer to the cognitive processes involved in completing this test. The Digit Symbol subtest involves looking for matches between the digits on the answer form and digits in the key, in addition to checking for matches between the given symbols and the symbols drawn. Therefore the performance on the Digit Symbol subtest is affected by clerical speed (Wechsler, 1997). Examinations of sex differences have constantly revealed females outperform males in clerical speed (Burns & Nettelbeck, 2005; Majeres, 1988; Majeres, 2007).

However, sex differences on general intelligence scores appear to reflect the type of tests that were administered to participants. For instance, using Wechsler's intelligence tests, the current research similar to other studies (e.g., Holland et al., 1995; Maleka, 1996) did not find significant sex differences on general intelligence, while researchers (e.g., Furnham & Monsen, 2009; Rushton et al., 2007), who used different general intelligence tests such as Raven's Standard Progressive Matrices (SPM), have found significant sex differences. The Standard Progressive Matrices (SPM) is a nonverbal test that assesses intelligence through abstract reasoning tasks (Maltby et al., 2007) and therefore any sex differences on this test may simply reflect differences on abstract reasoning ability rather than general intelligence per se. Unlike the SPM, the Wechsler intelligence tests are verbal and nonverbal tests designed to measure a wider range of cognitive abilities and therefore more indicative of intelligence ability (Wechsler, 1975). The numerous subtests of the Wechsler's tests provide an extensive understanding of the overall intelligence of the individual (Maltby et al., 2007). Females may be better performing than males in some of these subtests, while males outperform females on others. However, in the general IQ, as it is the product of performance on all the subtests of the Wechsler's tests, sex differences may not be found or at last may not be

found significant as has been revealed by the current study, and by Holland et al. (1995) and Maleka (1996).

In contrast with previous studies (e.g., Dessokey, 2003; Shuttleworth-Edwards et al., 2004; Tucker-Drob & Salthouse, 2008), there are no significant differences on the performance of students on all WAIS-III IQ scores (and associated subtests) across the different age groups. Indeed, the results showed that the main effect of age was not significant, except on the Arithmetic subtest, where 13% of the overall variance was accounted for by age. However, it is noteworthy that the narrow age-range of participants alongside the small sample size might be the factors that could explain these results. Moreover, it seems that sex and age variables independently affect individuals' performance on the WAIS-III IQ scales and subtests since the interaction between sex and age was not significant on any of the IQ and subtests.

With respect to individual differences in individuals' levels of neuroticism, the findings showed that a higher level of neuroticism had a negative effect on the participants' intelligence scores on the WAIS-III. The mean scores of the low neuroticism group were higher than the other groups on all the IQs and subtests, except Information, and the differences were significant in the Full scale IQ, Performance IQ and in the Block Design subtest. Neuroticism accounting for 9%, 9%, and 11% of the variance in the Full scale IQ, Performance IQ, and Block Design, respectively. Mean scores of the low-neuroticism group was significantly higher than means of the other two groups on the three tests, while the differences between the medium and high-neuroticism groups were not significant on the three tests; the largest difference (10.04 IQ scores) is observed for Performance scale between low and high neuroticism groups with a large effect size of 0.94. This finding supports researchers (e.g., Maleka, 1996; Saggino & Balsamo, 2003), who argued that neuroticism affects the performance of individuals on the Performance IQ scale more than their performance on the Full scale IQ, and Verbal IQ scales.

One explanation for finding that higher levels of neuroticism relate stronger to an individual's scores on the Performance IQ tests than the Verbal IQ tests may relate to the nature of these subtests and underlying cognitive skills required to complete these tasks. While Verbal IQ scales are more associated with formal education and schooling,

and assess an individual's language comprehension and arithmetical ability, performance on which is largely dependent on information and skills that are acquired through experience and education within a specific culture (Chamorro-Premuzic, 2003). However, performance of Performance IQ scales are more associated with efficient problem-solving and solving problems in a timed response. The underlying cognitive skills are different and, perhaps, more prone to levels of neuroticism. For example, it is likely that performance of fluid intelligence tasks increases conscious activity in the cerebral cortex more than crystallised tasks (Bishop, Fossella, Croucher, & Duncan, 2008), particularly in the timed tasks (Socan & Bucik, 1998), such as the Digit Symbol and Block design subtests of the WAIS-III; this high activity may increase the cortical arousal as Eysenck (1967) suggests, performance may be influenced by cortical arousal and stimulation on the task. Similarly, it is possible that those people with higher levels of neuroticism "are more likely than low neuroticism scorers to become autonomically aroused and to experience distress and agitation when subjected to stress" (Matthews et al., 2003, p. 170).

Despite this discrepancy between Verbal and Performance IQ scores for the high neuroticism group, this pattern was not evident among the low-neuroticism group. However, it was significant between the medium and high neuroticism groups, this finding supported the notion that differences between Verbal and Performance IQ scores increase among individuals who have difficulties in adaptation or have neurotic disorders (Demsky et al., 1998; Maleka, 1996). Nonetheless, this finding may be limited to the current study sample as none of the differences were significant when they were compared to the standardization sample of the WAIS-III. Moreover, neuroticism was found to be ineffective on the participant's strengths and weaknesses for the entire WAIS-III subtest. Therefore, it can be inferred that neuroticism does not affect the homogeneity of an individual's intelligence scores either on WAIS-III IQ scales or on subtests.

The final aim of this study explored whether sex and age moderate the relationship between neuroticism and intelligence scores as measured by WAIS-III. The results revealed that neuroticism was negatively correlated with all the WAIS-III scores, and that correlations were significant on the three IQs and on the Vocabulary, Comprehension, Block Design, and Picture Arrangement. The relationship between

neuroticism and most of the WAIS-III scores seems to be moderated by the sex of the participants since the correlations on the Verbal IQ, Arithmetic, Comprehension, and Block Design among females were quite substantial; while among males were quite small. By contrast, there were quite substantial correlations among males on the Performance IQ, Digit Symbol, and Picture Arrangement, while the correlations among females on the same tests were quite small.

The age of the participants also had an effect on explaining the relationship between neuroticism scores and WAIS-III scores. However, it is important to note that the effect of age was not similar across all WAIS-III scales and subtests. This effect was dependent on certain subscales of intelligence tests. Thus, the effect of age on the performance of participants on the WAIS-III appeared to be higher on the Full Scale IQ, Verbal IQ scale and on the Verbal scale subtests, more than on the Performance scale subtests. Nevertheless, using the partial correlation, sex and age variables were found to have little or no effects on the correlations between neuroticism and most of WAIS-III scores, since the changes on the correlations were small and the significant correlations remained significant. An exception to this conclusion, the relationship between neuroticism and the Verbal IQ scale scores was positively and substantially affected by the sex of students. However, it should be noted that this study utilised a student sample, and given that the materials of the study need about 90 minutes to be completed, and the difficulties in recruiting this sample, the range of age of participants (16-26) and the size of sample (N = 77) were relatively small, which may restricts the generality of the results

These findings regarding the correlations between neuroticism the WAIS-III scores are in contrast with previous studies (i.e., Holland et al., 1995; Stough et al., 1996), which found that none of the correlations between neuroticism and WAIS-R scores were significant, and with the study of Saggino and Balsamo (2003) which found small correlations between neuroticism and Full and Verbal IQs scores and most of the WAIS-R subtests scores. However, it should be noticed that there are differences between the current study and the previous researchers (i.e., Holland et al., 1995; Saggino & Balsamo, 2003; Stough et al., 1996) in the terms of culture and sort of population samples, which might play a role in the relationship between neuroticism and intelligence scores. Therefore, rather than simply comparing neuroticism and

intelligence scores across a British sample, the following study (Study 4, in Chapter 7), will critically examine the role of cultural differences between Libyan and British student populations in explaining the relationship between neuroticism and intelligence scores.

CHAPTER 7 STUDY 4, Intelligence and Neuroticism Scores among Libyan and British Student Samples: A Comparative Study

7.1 Introduction

The current chapter looks more specifically at the importance of culture in explaining the relationship between neuroticism and intelligence scores. As found in Studies 2 and 3, the high neuroticism scores were found to have a negative effect on the individual's performance on the Wechsler intelligence scales across both the British and Libyan populations when studying these two cultures separately. More importantly, while there does seem to appear to be clear differences across cultures in neuroticism scores (S. Eysenck et al., 1993; Hanin et al., 1991) and intelligence scores (Lynn & Vanhanen, 2006; Rushton & Čvorović, 2009) across different cultures, the extent to which these cross-cultural differences are moderated by other factors, including sex and age, requires further consideration. This is particularly important given that researchers who have investigated the effect of age and sex on neuroticism scores have obtained conflicting results. For example, while some studies show a significant relationship between sex and neuroticism scores (e.g., Elmadani, 2001; S. Eysenck et al., 1993), other studies have found that males and females do not differ in the level of neuroticism (e.g., Abdullatief, 1990; Rubinstein, 2005). Furthermore, there are inconsistent findings with regard to the age differences in neuroticism scores (e.g., Donnellan & Lucas, 2008; McCrae et al., 2004). Therefore, further examination of the impact of culture differences in explaining how sex and age may influence the relationship between intelligence and neuroticism scores is required.

It is argued that there are two reasons to expect such variation in sex differences in neuroticism scores across different cultures (Costa et al., 2001; Lynn, 1981). The first is that the level of neuroticism in developing countries is higher than the level of neuroticism in developed countries (Lynn, 1981; Matthews et al., 2003); and this is because stress, which is an important facet of neuroticism and may arise from different sources such as political, social and economic instability, or from war and occupation. "Life in the advanced Western democracies is relatively unstressful. They are politically stable … and there are no violent revolutions or military coups. The economies are long

established and free from the worst ravages of hyperinflation." (Lynn, 1981, p. 273). However, there are counter-arguments to the claim that differences in the level of neuroticism across cultures simply reflect the differences between developing and advanced countries. For instance, (see Section 2.10.2), Schmitt et al. (2007) investigated cultural differences in neuroticism scores across 56 nations and reported that the level of neuroticism among African participants was lower than the level of neuroticism among South American and Southern European participants.

Alongside differences in the level of neuroticism scores across different cultures, there is a need to recognise that cultures may differ in the degree to which sex roles are emphasised, which may lead to differences in personality traits and behaviours (Costa et al., 2001). For example, as discussed in Chapter 3, sex differences were positively and significantly associated with individualism; Western countries with individualistic values have greater sex differences in neuroticism scores than non-Western (Costa et al., 2001; McCrae & Terracciano (2005). These sex differences in neuroticism scores reflect differences in the norms for sex roles between individualistic and collectivistic cultures. For instance, in collectivistic cultures, such as African cultures, men should do the heavier chores and the duty of men is to provide a better life for those who live with them while the main duty of women is to the home and family (Berry, Poortinga, Segall, & Dasen, 1992); this may reduce stress and anxiety among women and thus the level of neuroticism. By contrast, it is argued that sex differences in personality traits might be greater in developing countries (Matthews et al., 2003), where differences in the norms for sex roles are generally larger and there is less equality between men and women (Keddie, 2007; Lynn & Martin, 1997). These conflicting results indicate that cultural differences and sex differences in neuroticism scores across different cultures is in need of further investigation, which the current study seeks to achieve.

Cultural differences also appear to have an effect on explaining age differences in an individual's neuroticism scores. Indeed, various researchers argue that the degree of neuroticism among individuals is not equal at all ages; it decreases with an individual's age (H. Eysenck & Eysenck, 1991a; Schultz & Schultz, 2005) and this decline begins almost at the age of 18 (McCrae, 2001a; 2001b) for males and females, and across different cultures (McCrae et al., (1999). Nonetheless, as previously mentioned in Chapter 2, many of the previous studies have found that this pattern of age differences

in neuroticism scores varies across different cultures. For example, McCrae et al. (2004) found that the pattern of age differences in neuroticism scores was similar in Russia and the Czech Republic; the high scores in both samples were for the younger age groups and the low scores were for the older age groups samples. Similarly, Fung and Ng (2006), found that correlations between age and neuroticism scores among Canadian and Hong Kong Chinese populations were negative and significant. In contrast, the study of Donnellan and Lucas (2008) revealed that the pattern of age differences in neuroticism scores was not similar across British and German samples; neuroticism scores were higher in younger adults in British sample, but found to be highest in older individuals among the German sample. These findings refer to the effect of cultural factors on the pattern of age differences in neuroticism scores.

The importance of cultural factors on explaining age difference in neuroticism scores was proposed by Costa et al. (2000) who argued that neuroticism scores tend to decrease with age and that this decline in neuroticism scores reflects maturational changes whereby men and women aged between 18 and 30 years become more emotionally stable, more socially independent, more conventional and goal-directed. Most of these changes are socially desirable; therefore, "different environments might be expected to give rise to different patterns of adult [males and females] development" (Costa et al., 2000, p. 237). However, this finding has not always been supported in cross-cultural research (e.g., Donnellan & Lucas, 2008; McCrae et al., 2004). Costa et al. (2000) examined this hypothesis by investigating age differences in neuroticism scores across four cultures: American, Russian, Japanese and Estonian (see Section 2.9.1). The findings revealed that age differences in neuroticism scores were significant in the American and Japanese samples, while they were not significant in the Russian and Estonian samples, indicating the important role of cultural differences on the age differences in neuroticism scores.

Questions remain with regard to the extent with which these patterns of age differences in neuroticism scores are similar among males and females across different cultures. These questions require further investigation. Moreover, many of the findings with regard to sex and age differences in neuroticism scores (and even in intelligence scores, see Chapter 2) across different cultures have been based largely on those derived from Western and Asian samples; the Arabic culture is one that has not received much

attention. Therefore, as there are strong cultural differences between Libya and Britain, especially in terms of individualism/collectivism, language, religion, economy, gender roles, interests, and customs, all of which may vary significantly (Hofstede, 2001; Keddie, 2007), the current study examines the role of cultural difference between both cultures on the sex and age differences in neuroticism and intelligence scores and on the relationship between neuroticism and intelligence scores.

Similar to neuroticism scores, there is an argument that additional work is also needed to clarify the contribution of age and sex in explaining intelligence scores across cultures. As mentioned in Chapter 2, there is considerable evidence (e.g., Lynn & Vanhanen, 2006; Neisser et al., 1996; Rushton & Čvorović, 2009; Westen, 1999) that supports the importance of cultural factors in intelligence scores. Nevertheless, the role of cultural factors in moderating age and sex differences in intelligence scores remains unclear and requires further investigation. Several researchers believe that sex (Furnham & Monsen, 2009; Lynn & Irwing, 2008; Rushton et al., 2007) and age (Moutafi et al., 2003; Ryan et al., 2000; Tucker-Drob & Salthouse, 2008) are important factors in explaining individual differences in intelligence scores across different cultures. However, very few researchers (e.g., Lynn & Irwing, 2008; Tsushima & Bratton, 1987) have investigated the effect of culture on the magnitude of sex and age differences in explaining an individual's intelligence scores. Lynn and Irwing (2008) investigated the effect of ethnicity on the sex difference in the Arithmetic and Digit Span of the Wechsler intelligence tests for adults in several studies and reported that while the difference between ethnic groups in the Arithmetic test was amplified, it was attenuated in the Digit Span. Sex differences in the Arithmetic test were greater in India, with a Cohen's *d* of .73, while for East Asians it was lower at .28, as compared with western cultures with a mean *d* of .47.

The current study considers cross-cultural differences in explaining the relationship between neuroticism and intelligence scores. As previously discussed in Chapter 2, several researchers (e.g., Chamorro-Premuzic, Furnham, & Petrides, 2006; Demetriou et al., 2003; Di Fabio & Palazzeschi, 2009; Holland et al., 1995; Moutafi et al., 2006; Stough et al., 1996) have found differences in the relationship between neuroticism and intelligence scores across different cultures. However, none of them have explicitly compared the relationship between neuroticism and intelligence scores of different

cultures within the same study. While some studies have supported the influence of cultural background on an individuals' intelligence scores (e.g., Lynn, 2006; Neisser et al., 1996; Rushton & Čvorović, 2009; Shuttleworth-Edwards et al., 2004) and neuroticism scores (e.g., Lynn, 1981; Lynn & Martin, 1997; Schmitt et al., 2007), a closer examination of cultural differences across different populations together within the same study and utilising the same tools is required.

The findings from previous studies (e.g., Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001; Moutafi et al., 2006) have contributed to our understanding of the importance of cultural diversity in explaining the relationship between intelligence and neuroticism. For example, utilising a sample of Cypriot secondary students, Demetriou, et al. (2003) found that neuroticism was positively correlated, but not significantly, with verbal and numerical cognitive abilities. By contrast, Chamorro-Premuzic, Furnham and Petrides (2006) reported that the correlation coefficients of neuroticism scores among an adult New Zealand sample were negative and significant with verbal reasoning ability, and negative, but not significant, with numerical ability scores. Among an American students sample, the study of Lounsbury et al. (2005) reached significant negative correlations between neuroticism scores and a measure of verbal and numerical abilities.

The role of culture in explaining individual differences in intelligence scores can be also inferred from the different results of two studies that were conducted among British and Greek university students. In the first, Ettinger and Corr (2001) did not find any relationship between neuroticism and intelligence as measured by Raven's Progressive Matrices, among a British sample, while in the second, Moutafi, Furnham and Tsaousis, (2006) found, among a Greek sample, a negative and significant relationship between neuroticism and intelligence as measured by Raven's Progressive Matrices. It is remarkable that any differences in these two research findings could be explained by differences in cultural norms and expectations.

Moreover, although many researchers have presented sex and age differences as possible explanations for individual differences in neuroticism (e.g., Elmadani, 2001; S. Eysenck et al., 1993; Heaven & Shochet, 1995; Rubinstein & Strul, 2007) and intelligence scores (e.g., Furnham & Monsen, 2009; Lynn & Irwing, 2008; Ryan et al., 2000; Tucker-Drob & Salthouse, 2008) across different cultures, few studies (e.g.,

Chamorro-Premuzic, Furnham, & Ackerman, 2006; Jorm et al., 1993; Lounsbury et al., 2005; Lynn et al., 1984) have considered the role of age and sex differences in the relationship between neuroticism and intelligence scores and none have examined the impact of cultural differences on the role of age and sex differences in the relationship between neuroticism and intelligence scores.

The current study therefore examines the effect of cultural differences between Libya and Britain on the magnitude of sex differences and on the pattern of age differences in neuroticism and intelligence scores. It also seeks to examine the role of cultural differences between Libya and Britain in the relationship between neuroticism and intelligence scores and on the effect of age and sex in this relationship. In particular, this study addresses the following theoretical questions. First, to what extent do the differences in neuroticism and intelligence among the Libyan sample differ from the differences in neuroticism and intelligence among the British sample, according to sex, age and level of neuroticism? Secondly, to what extent does the relationship between neuroticism and intelligence scores and the effect of sex and age on this relationship differ between the Libyan and British samples?

7.2 Method

7.2.1 Participants

The data for this study was drawn from the data of Study 2 and Study 3 in the current thesis. Participants in Study 2 were 75 Libyan students (37 males, 38 females) who were attending secondary school or university and all spoke the Arabic language as native speakers. Ages ranged from 15 to 25 years (Mean = 19.27; *SD* = 2.93). Study 3 comprised 77 British students (43 females, 34 males) who attended either secondary school or university in Nottingham and all spoke the English language as their mother tongue. Ages ranged from 16 to 26 years (Mean = 19.40; *SD* = 2.41).

7.2.2 Materials

7.2.2.1 Neurotic Behaviour Scale (NBS)

Participants in both samples completed the Neurotic Behaviour Scale (NBS), which was specifically designed by the researcher (Elmadani, 2001) to measure the trait of neuroticism. The test consists of 39 individual items in the Arabic version and 36 items

in the English version designed to assess seven domains of anxiety, inferiority complex, reactive sensitivity, body disorder, thinking, social relations and sleeping disorder. Each participant is required to provide a yes or no answer to each statement and there is no set time limit for completion of the scale. In this task, six items are a measure of social desirability. As reported in Study 2, the internal consistency[1] and the split-half[2] reliability of the Arabic version of the scale are high (.90, N = 100 and .77, N = 50, respectively), as well as the concurrent validity which is based on the scale's correlation with the Eysenck Personality Inventory (r = .74, N = 100, P < .01). Validity and reliability of the English version of the NBS was investigated among a British sample. As reported in Chapter 4 in the current thesis, the validity and reliability of the NBS on the British sample was good with Cronbach's alpha reliability value of the NBS being high (.82, N = 72) as well as the concurrent validity which is based on the scale's correlation with the Eysenck Personality Questionnaire–Revised (r = .82, N = 80, P < .01).

7.2.2.2 Wechsler-Bellevue Intelligence Scale (WBIS), the Arabic Version

The Wechsler-Bellevue Intelligence Scale *(*WBIS) is the only version of the Wechsler intelligence tests that were standardised in the Arabic culture by Maleka (1996). The WBIS was designed to measure global intelligence scores alongside separate measures of verbal intelligence and performance intelligence. The WBIS consists of 11 subtests, six of which are measures of verbal intelligence and five subtests are measures of performance intelligence. The verbal intelligence subtests comprise of Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities. The performance intelligence subtests comprise of Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol. To calculate Verbal and Performance intelligence scores separately, the scaled scores of each subtest item was summed and then converted to a standard score (M = 100 and

[1] By White's formula : $\frac{\text{Error variance}}{\text{Variance between people}}$

[2] By an odd-even spilt.

SD = 15). The Full Scale intelligence score was obtained by combining the scaled scores of the 11 subtests and converting the sum to a standard score.

7.2.2.3 Wechsler Adults Intelligence Scale –Third Edition (WAIS-III)

The Wechsler Adult Intelligence Scale- Third Edition *(*WAIS-III) is the latest version of the Wechsler intelligence tests (Wechsler, 1997), and consists of 14 subtests that produce three traditional IQ scores in addition to four Index scores (i.e., verbal comprehension, perceptual organization, working memory and processing speed). However, for the purpose in the current thesis, only the 11 subtests that contribute to the three traditional IQ scores have been used, which are the same subtests that are used with the WBIS. To calculate the IQ scores from the WAIS-III, the same procedures that are used with the WBIS were applied.

7.2.3 Procedure

In order to examine the size of relationships between the variables and the differences between sample means, the findings of the Libyan (Study 2) and British (Study 3) samples were converted into a standard measure of effect, which is the Pearson correlation coefficient or *r*. Comparing it to other measures of effect size such as Cohen's *d*, the Pearson correlation coefficient is much easier to estimate using the formulas that were reported by Howitt and Cramer (2008). It also allowed a comparison of effect sizes of the two studies using Fisher's *z* transformation of the correlation coefficient.

7.3 Results

7.3.1 Magnitude of Sex and Age Differences in Neuroticism Scores

The first set of analyses examined the differences in sex and age in neuroticism scores between Libyan and British students. As shown in Studies 2 and 3, the mean neuroticism scores for females were significantly higher than for males among both samples, while there were slight differences between means according to age groups. Table 24 shows the size of the effect of sex, age and the interaction between sex and age on individuals' neuroticism scores.

Table 24

Effect Sizes r of Sex and Age in Neuroticism Scores among Libyan and British Samples

	Effect sizes	
Variables	Libya	Britain
Sex	.27	.26
Age	.07	.08
Sex & age	.24	.08

As shown in 24, the size of the effect of sex and age in neuroticism scores is relatively similar among the Libyan and British samples. Using Fisher's *z* transformation of the correlation coefficient, there were no significant differences between the effect sizes of both sex and age variables with *z* values of .066, $p = .47$ and .060, $p = .48$, respectively, indicating that the effect sizes of the two studies are similar. The patterns of age differences in neuroticism scores were similar in the Libyan and British samples. Pearson correlation coefficients between the age of participants and their neuroticism scores were positive for the Libyan and British female samples ($r = .20$, $N = 38$, $p = .220$ and $r = .17$, $N = 43$, $p = .265$, respectively), while they were negative among the Libyan and British male samples ($r = -.18$, $N = 38$, $p = .299$ and $r = -.13$, $N = 43$, $p = .468$, respectively). However, these correlations for the Libyan and British samples were not statistically significant either among the female sample, $z = .134$, $p = .45$, or among the male sample, $z = .205$, $p = .40$. These findings indicating the lack of influence of the culture differences between Libya and Britain on the sex and age differences in neuroticism scores

However, the interaction between sex and age in neuroticism scores differed across the two samples. Indeed, the interaction was significant among the Libyan sample, while it was small and not statistically significant among the British sample. As shown in Table 24, while the effect size of the interaction among the Libyan sample is higher than among the British sample, Fisher's *z* test, confirmed that the difference between both effect sizes was not statistically different, $z = .997$, $p = .16$.

7.3.2 Magnitude of Sex and Age Differences in Intelligence Scores

The next stage was to examine the role of cultural differences between Libya and Britain in the magnitude of sex and age differences in intelligence scores. As shown in Table 25, the effect sizes of sex differences in the participants' intelligence scores were relatively similar across the Libyan and British samples on most of the IQ scales and subtests, particularly on the Performance scale IQ and subtests. The only differences that seem to be noteworthy were in the Verbal scale IQ scores and in the Vocabulary, Arithmetic and Digit Symbol subtests scores.

Table 25

Effect Sizes r of Sex Differences in Intelligence Scores of Libyan and British Samples

IQs and subtests	Effect sizes		Fisher's *z*
	Libya	Britain	
Full Scale IQ	.14	.06	0.552
Verbal IQ	.27	.17	0.637
Performance IQ	.02	.00	0.061
Vocabulary	.27	.04	1.437
Similarities	.02	.08	0.364
Arithmetic	.36	.02	2.232**
Digit Span	.09	.09	0
Information	.27	.35	0.534
Comprehension	.14	.04	0.673
Picture Completion	.05	.15	0.612
Digit Symbol	.01	.21	1.231
Block Design	.06	.03	0.121
Object Assembly	.08	.05	0.182
Picture Arrangement	.14	.03	0.673

** $p < .01$.

As reported in Chapters 5 and 6, the mean scores of males among both the Libyan and British samples were higher than the means of females in the Verbal IQ and in the

Vocabulary and Arithmetic subtest, and the means of the females in the Digit Symbol subtests were higher than those of the males among both samples. However, Table 25 shows that the effect sizes of sex differences in these subtests were not equal across the two samples. While the effect sizes of sex differences in the Verbal IQ, Vocabulary and Arithmetic subtest were higher among the Libyan sample than among the British sample, the effect sizes of sex differences in the Digit Symbol subtest scores were higher among the British sample than the Libyan sample. Using Fisher's *z* test, differences between these effect sizes were not found to be significant except in the Arithmetic subtest ($z = 2.232$, $p < .01$).

Table 25 also shows that the effect sizes of the sex differences were notable among Libyan and British samples only in the Information subtest ($r = .27$ and .35, respectively). In both samples, the mean scores of males were significantly higher than means for females; Fisher's *z* test revealed that the difference between both effect sizes was not statistically significant, $z = -.534$, $p = .70$.

With respect to age, Table 26 shows high correlations between the age of the Libyan participants and their intelligence scores on relatively all of the WBIS IQs and subtests. By contrast, almost all the correlation coefficients among the British sample, except the Arithmetic subtest, were relatively very small, indicating the role of cultural differences between Libya and Britain in the relationship between the age of participants and their intelligence scores. Using Fisher's *z* transformation of the correlation coefficient, there were significant differences between the correlations of the Libyan sample and the correlations of the British sample on the all IQs scales and on the Vocabulary and Digit Span subtests.

Moreover, the age differences in intelligence scores were higher among the Libyan female sample compared to the other groups. As shown in Table 26, while the correlations of the British female and male samples were relatively similar on almost all the IQ scales and subtests, the Pearson correlation coefficients of the Libyan female sample were relatively higher than the correlations of the Libyan male sample on most the of IQ scales and subtests.

Table 26

Pearson Correlations between Age of Participants and their Intelligence Scores According to Culture and Sex

IQs and subtests	Whole sample		Fisher's *z*	Female		Male	
	Libya	Britain		Libya	Britain	Libya	Britain
Full Scale IQ	.35**	.00	2.12*	.42*	.09	.26	-.03
Verbal IQ	.44**	-.06	2.43**	.40*	.03	.41*	-.09
Performance IQ	.31**	.04	1.76*	.47**	.05	.18	.02
Vocabulary	.31**	.02	1.76*	.28	.21	.29	-.12
Similarities	.13	-.07	.43	.26	-.05	.08	-.03
Arithmetic	.26*	-.32**	-.47	.24	-.23	.19	-.37*
Digit Span	.40**	.00	2.51**	.30	.11	.48**	-.11
Information	.14	.02	0.73	.14	-.04	.07	.19
Comprehension	.28*	.08	1.26	.15	.08	.33*	.10
Picture Completion	.15	-.00	0.85	.34*	.16	-.04	-.12
Digit Symbol	.26*	-.16	.12	.31	-.04	.23	-.27
Block Design	.18	.08	0.68	.32*	-.11	.07	.20
Object Assembly	.20	.20	0.00	.38*	.12	.01	.30
Picture Arrangement	.18	.14	0.25	.16	.24	.26	.09

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

Table 26 reveals that patterns of age differences on the Arithmetic and Digit Symbol subtests were not similar across the Libyan and British samples. *Figures 5* and *6* suggest there are higher scores in the Arithmetic and Digit Symbol subtest scores among the British sample within the younger age groups and the lowest scores of the same subtest were for the older age groups in the British sample. For the Libyan sample, this pattern is reversed and the higher scores on the same subtests were for the older age groups. A one-way ANOVA revealed significant differences across the four age groups (15–17 vs. 18–19 vs. 20–24 vs. 25–29) only among the British sample on the Arithmetic subtest, $F(3, 73) = 5.227$, $p = .003$, $\eta^2 = .177$.

Figure 5 Pattern of age differences in the Arithmetic subtest scores among the Libyan and British samples

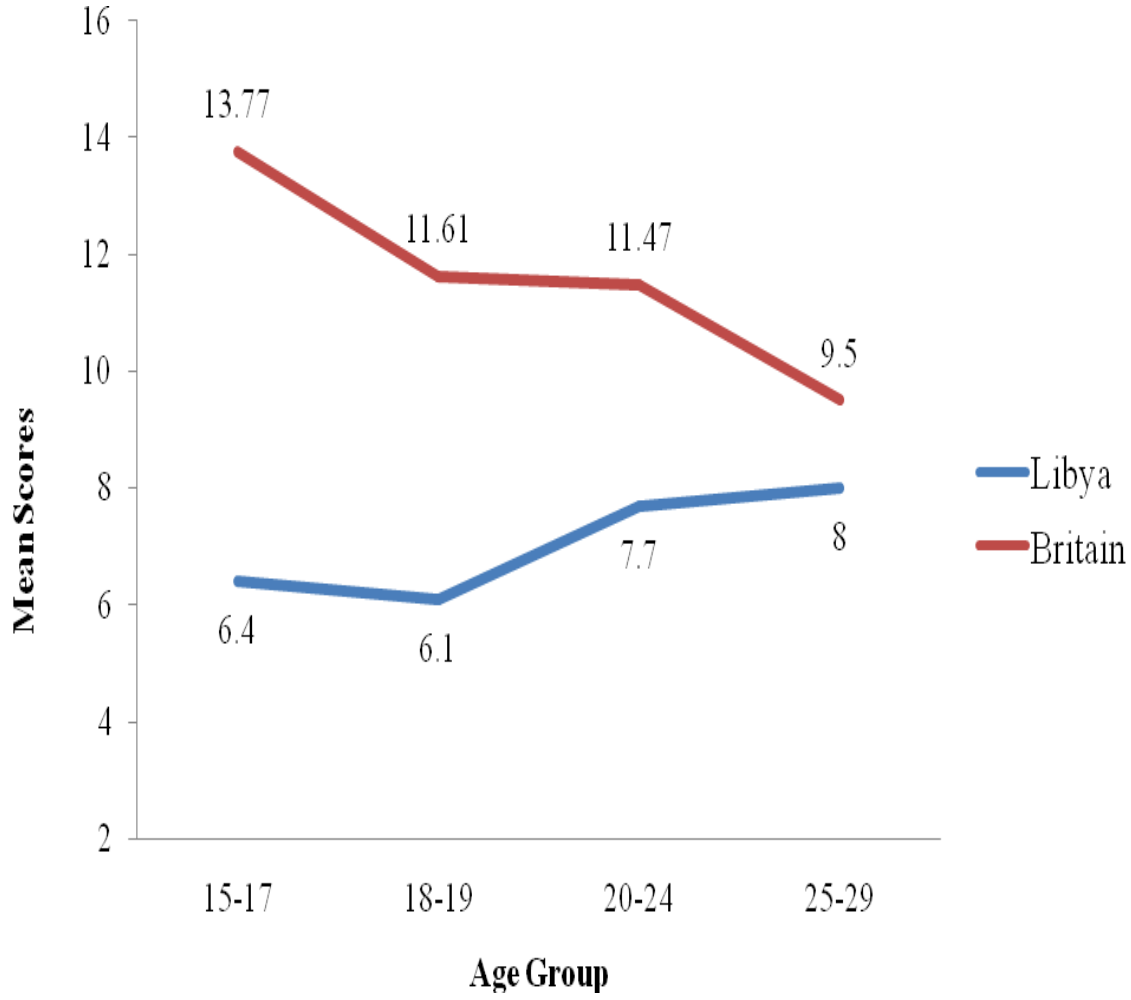
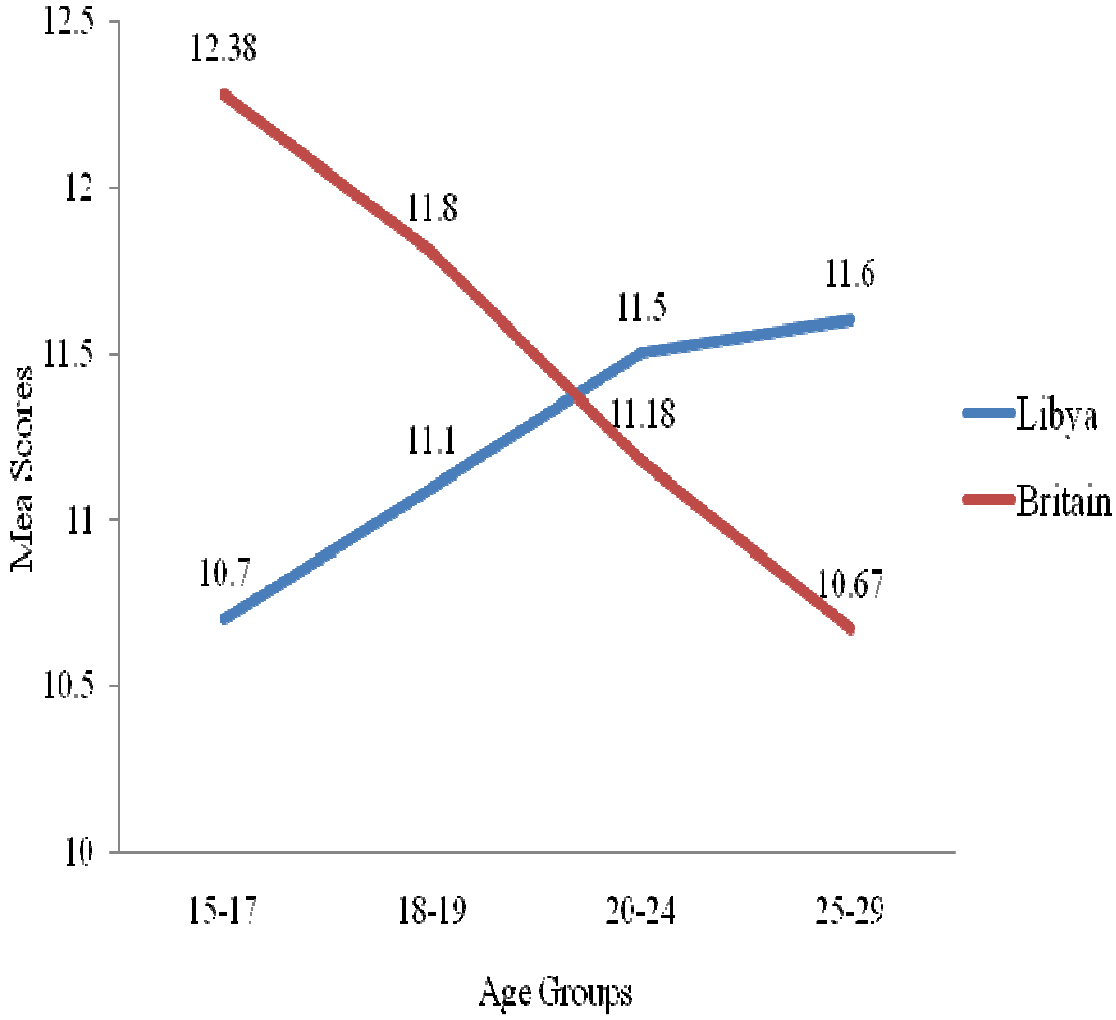


Figure 6 Pattern of age differences in the Digit Symbol subtest scores among the Libyan and British samples



7.3.3 Cultural Differences on the Relationship between Neuroticism and Intelligence Scores

To examine cultural differences in the relationship between neuroticism and intelligence scores, Pearson correlation coefficients between neuroticism and intelligence scores were calculated according to the culture of participants and these are presented in Table 27.

Table 27

Pearson Correlations between Neuroticism and Intelligence Scores among the Libyan and British Samples

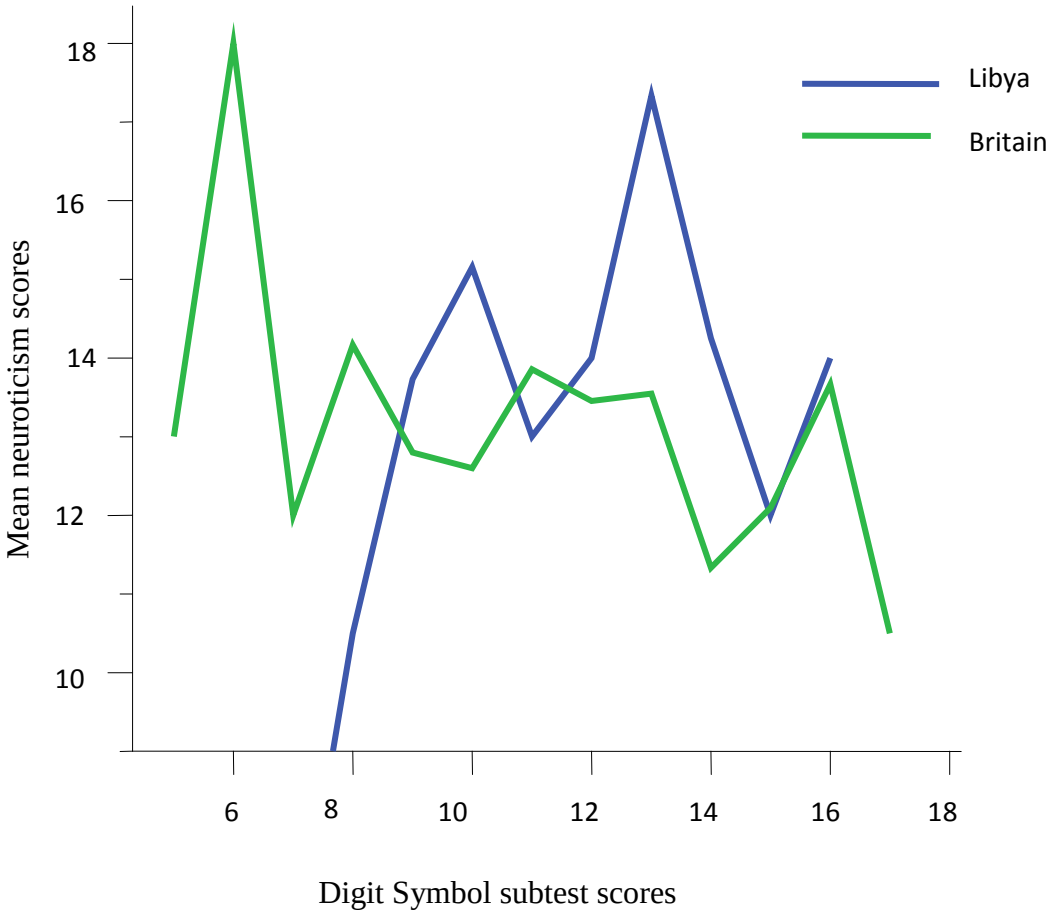
IQs and subtests	Pearson correlations		Fisher's *z*
	Libya	Britain	
Full Scale IQ	-.19	-.35**	1.049
Verbal IQ	-.19	-.27*	0.516
Performance IQ	-.06	-.32**	1.649*
Vocabulary	-.10	-.24*	0.879
Similarities	-.12	-.17	0.309
Arithmetic	-.30**	-.22	0.522
Digit Span	-.09	-.23*	0.873
Information	-.26*	-.15	0.697
Comprehension	.07	-.30**	1.395
Picture Completion	-.23*	-.18	0.315
Digit Symbol	.20	-.14	0.376
Block Design	-.06	-.30**	1.516
Object Assembly	-.22	-.06	0.994
Picture Arrangement	.02	-.28*	1.625

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

As shown in Table 27, correlations between neuroticism and intelligence scores for the British samples were higher than those among the Libyan sample on all the IQ scales and most of the subtests. However, differences between these correlations were only significant on the Performance IQ scale, $z = 1.649$, $p = .05$. The influence of neuroticism in the performance of the participants on the Verbal and Performance IQ scales was not similar across the Libyan and British samples. As Table 27 shows, the correlation among the British sample on the Performance IQ scale was higher than the correlation on the Verbal IQ scale. Among the Libyan sample, these correlations were reversed and the high correlation was on the Verbal IQ scale. Differences between these correlations were however not statistically significant, either among the Libyan sample ($z = .795$, $p = .21$) or among the British sample ($z = .335$, $p = .37$). Table 27 also

illustrates how the pattern of correlations were similar across the Libyan and British samples on the full scale IQ, Verbal IQ and Performance IQ as well as the majority of the individual subtests. Nevertheless, the notable difference is on the Digit Symbol subtest (CD). As *Figure 7* suggests, the CD scores of the Libyan sample tended to increase for participants with high neuroticism scores, while CD scores of the British sample decreased for participants with high neuroticism scores. However, Pearson correlation coefficients of both samples were not statistically significant.

Figure 7 Pattern of correlations between neuroticism and Digit Symbol subtest scores among Libyan and British participants



To examine any variation in the influence of levels of neuroticism on intelligence scores among the Libyan and British samples, the current study compared the effect sizes of the levels of neuroticism (low, medium and high) on the intelligence scores of

the Libyan sample with those of the British sample. These effect sizes are presented in Table 28.

As shown in Table 28, the effect sizes of the levels of neuroticism on the intelligence scores of the Wechsler intelligence scales were small and relatively similar across Libyan and British samples in all the IQ scales and subtests except in the Block Design subtest, where the effect size among the British sample was medium and higher than the effect size among the Libyan sample. Using Fisher's *z* transformation of the correlation coefficient, there were no significant differences between all the effect sizes of the level of neuroticism in intelligence scores among the Libyan sample and among the British sample.

Table 28

Effect Sizes of the Level of Neuroticism on Intelligences Scores among the Libyan and British Samples

IQs and subtests	Effect sizes		Fisher's *z*
	Libya	Britain	
Full Scale IQ	.00	.16	0.953
Verbal IQ	.05	.04	0.061
Performance IQ	.16	.20	0.255
Vocabulary	.11	.09	0.121
Similarities	.11	.08	0.182
Arithmetic	.11	.12	0.075
Digit Span	.11	.15	0.286
Information	.17	.05	0.740
Comprehension	.08	.19	0.664
Picture Completion	.04	.04	0.061
Digit Symbol	.02	.08	0.382
Block Design	.04	.27	1.338
Object Assembly	.06	.03	0.182
Picture Arrangement	.11	.03	0.485

The influence of levels of neuroticism on the differences between the Verbal IQ and Performance IQ scores was not similar across the Libyan and British student participants. As shown in Table 29, while effect sizes of the low, medium and high level of neuroticism among the British sample were small, medium and medium, respectively, the effect sizes of the low and high levels among the Libyan sample were larger; in particular, the effect size of the high level, where 48% of the variance was accounted for by the high level of neuroticism (compared to 35% among the British sample). However, using Fisher's z test, there were no significant differences between all the effect sizes.

Table 29

Effect Sizes of Levels of Neuroticism on the Differences between VIQ and PIQ Scores among Libyan and British Samples

	Effect sizes		
Level of neuroticism	Britain	Libya	Fisher's z
Low	0.18	0.64	1.543
Medium	0.30	0.46	0.891
High	0.59	0.69	0.328

7.3.4 Sex and Age Differences on the Relationship between Neuroticism and Intelligence Scores

The next analysis investigates the effect of age and sex in the relationship between neuroticism and intelligence scores across the two cultures. Table 30 summarises the partial correlations between neuroticism scores and the Wechsler intelligence scores and subtests scores among the Libyan and British samples also controlling for sex and age differences. In Table 30, it appears age has no effect on the relationship between neuroticism and intelligence scores among both the Libyan and British samples, since all the correlations remain very similar to those before they were controlling the age variable.

As Table 30 shows, the effect of sex on all these correlations was relatively higher than the effect of age among both the Libyan and British samples; in particular, in the Full Scale IQ and Verbal IQ scale and in the Arithmetic and Information subtests, since the correlations between neuroticism and these scales and subtests scores decreased when they were controlling for age. Nonetheless, using Fisher's *z* test, differences between all the correlations before and after controlling the age and sex variables were not statistically significant among the Libyan and British samples.

Table 30

Partial Correlations between Neuroticism Scores and WBIS and WAIS-III IQs and Subtests Scores among the Libyan and British Samples Controlling for Sex and Age

	Controlled variables					
	Non		Sex		Age	
IQ	Libya	Britain	Libya	Britain	Libya	Britain
Full Scale IQ	-.19	-.35**	-.15	-.30**	-.20	-.36**
Verbal IQ	-.19	-.27*	-.14	-.19	-.20	-.27*
Performance IQ	-.06	-.32**	-.04	-.34**	-.06	-.32**
Vocabulary	-.10	-.24*	-.06	-.24*	-.10	-.24*
Similarities	-.12	-.17	-.15	-.11	-.11	-.17
Arithmetic	-.30**	-.22	-.25*	-.17	-.30**	-.21
Digit Span	-.09	-.23*	-.08	-.21	-.09	-.24*
Information	-.26*	-.14	-.22	-.03	-.27*	-.15
Comprehension	.07	-.30**	.10	-.30**	.08	-.30**
Picture Completion	-.23*	-.18	-.19	-.15	-.23*	-.18
Digit Symbol	.20	-.14	.20	-.20	.21	-.14
Block Design	-.06	-.30**	-.04	-.33**	-.06	-.31**
Object Assembly	-.22	-.06	-.19	-.10	-.22	-.07
Picture Arrangement	.02	-.28**	.01	-.23*	.03	-.29**

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

Sex differences in the relationship between neuroticism and the performance intelligence scores of the Wechsler intelligence scales were relatively similar across both samples. As shown in Table 31, the correlations of males in both samples were higher than the correlations of females on the Performance IQ scale and most of the Performance scale subtests. On the other hand, sex differences in the correlations between scores on the neuroticism scale and the Verbal IQ scale and subtests were not similar across the Libyan and British samples. Indeed, correlations of males were higher than correlations of females among the Libyan sample on the Verbal IQ scale and most of the Verbal subtest. Among the British sample this pattern is reversed and the higher correlations were for females.

Table 31

Pearson Correlations between Neuroticism Scores and WBIS and WAIS-III IQs and Subtests Scores among the Libyan and British Samples according to Sex

	Female		Male	
IQ	Libya	Britain	Libya	Britain
Full Scale IQ	.06	-.33*	-.36*	-.28
Verbal IQ	.04	-.32*	-.32	-.04
Performance IQ	.18	-.24	-.27	-.50**
Vocabulary	.08	-.18	-.22	-.31
Similarities	-.11	-.23	-.20	-.01
Arithmetic	-.33*	-.31*	-.23	.01
Digit Span	.08	-.25	-.27	-.14
Information	-.23	-.12	-.23	.11
Comprehension	.25	-.38*	-.03	-.18
Picture Completion	-.06	-.14	-.32	-.16
Digit Symbol	.34*	.07	-.04	-.50**
Block Design	.10	-.40**	-.19	-.28
Object Assembly	-.07	-.10	-.35*	-.10
Picture Arrangement	.17	-.27	-.22	-.40*

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

7.3.5 Best Pattern of Variables to Predict Intelligence Scores

The final set of analyses explores the pattern of variables that may be useful in predicting intelligence scores and how this pattern may differ between Libyan and British samples. In particular, it examines whether a person's IQ scores can be predicted from their sex, age and neuroticism scores. Using the stepwise multiple regression method, the models that were significant are not similar across the Libyan and British samples. The results of this statistical technique is summarised in Table 32.

Table 32

Summary of Stepwise Multiple Regression: Sex, Age and Neuroticism Scores as Predictors of Intelligence Scores

Variables	R^2 change		R^2		Beta	
	Libya	Britain	Libya	Britain	Libya	Britain
Full Scale IQ scores						
Age	.12	-	.12	-	.31**	.14
Sex	.06	-	.18	-	.25*	.02
Neuroticism	-	.13	-	.13	-.15	-.35**
Verbal IQ scores						
Age	.19	-	.19	-	.39***	-.19
Sex	.09	.10	.28	.10	.30**	.31*
Neuroticism	-	-	-	-	-.14	-.03
Performance IQ scores						
Age	.09	-	.09	-	.31**	.06
Sex	-	-	-	-	.09	-.14
Neuroticism	-	.10	-	.10	-.05	-.32**

Note. Dashes indicate the R^2 and R^2 changes were not estimated. * $p < .05$. ** $p < .01$. *** $p < .001$.

As shown in table 32, the best model for predicting general IQ (Full Scale IQ) scores among the Libyan population includes age and sex variables, F (2,72) = 8.12, $p < 001$. Age is the first and explained 12% variance in the Full Scale IQ scores. The sex variable is the second and, together with age, explained 18% of the variance in the Full Scale IQ

scores. The third variable, neuroticism score, was not included in this model as it was not significant. Among the British sample, the best model for predicting Full Scale IQ scores includes only neuroticism, F (1, 75) = 10.78, $p < .05$. The model explained 13% of the variance ($R^2 = .13$). The sex and age variables were not included in this model as they were not significant. Similarly, a significant model emerged for predicting Verbal IQ scores among the Libyan sample, F (2, 72) = 13.71, $p < 001$. This model includes two variables: the first is age and explained 19% of the variance in the Verbal IQ scores. The second is sex and resulted in an additional 9% of the variance being explained (R^2 change = .09) and together with age explained 28% of the variance in the Verbal IQ scores. Among the British sample, sex is the only predictor that was significant, F (1, 75) = 8.13, $p < .01$. This model explained 10% of the variance in the Verbal IQ scores. The age and neuroticism variables were not included in this model as they were not significant. Finally, the best model for predicting Performance IQ scores among the Libyan sample includes only the age variable, F (1, 73) = 7.56, $p < .01$, which accounted for 9% of variance ($R^2 = .09$). The sex and neuroticism variables were not included in this model as they were not significant. Neuroticism again shaped the best model for predicting Performance IQ scores among the British sample, F (1, 75) = 8.47, $p < .01$. This model explained 10% of the variance in the Performance IQ scores. Sex and age were not significant predictors; as a result they were excluded from this model.

7.4 Discussion and Conclusions

The current study investigated the role of cultural differences between Libya and Britain in the relationship between neuroticism and intelligence scores. This study also examined the role of sex and age in explaining this relationship across Libya and Britain. There were three main findings from this study. First, the level of sex and age in neuroticism scores were similar across the Libyan and British samples. Furthermore, while age differences in intelligence scores were greater among the Libyan sample, sex differences in intelligence scores were relatively similar across both cultures. Secondly, the relationship between neuroticism and intelligence scores was not similar across both samples and the effect of sex in this relationship was slightly higher than the effect of age. Thirdly, the effect of sex, age and neuroticism scores as predictors of intelligence scores were dissimilar across the Libyan and British samples.

With respect to the first finding, there were no differences in either age or sex when looking at neuroticism scores across Libyan and British samples; indeed, the effect sizes of sex in neuroticism scores were very similar across Libyan and British samples (r = .27 and .26, respectively). This finding fails to support earlier claims that sex difference in neuroticism scores reflects the differences between developing countries, such as Libya, and advanced countries, such as Britain (e.g., Lynn, 1981; Lynn & Martin, 1997). Moreover, the effect of age on neuroticism scores was also very similar among the Libyan and British samples (r = .07 and .08, respectively) and was smaller than the effect of sex in neuroticism scores among both cultures.

The weak influence of culture on sex and age differences in neuroticism scores also appeared in the similarity of the patterns of age differences in neuroticism scores among the Libyan and British samples. In both samples, while neuroticism scores tended to decrease with age among males, neuroticism scores tended to increase with age among females. These findings also fails to support earlier claims that neuroticism decreases with age as a reflection of maturational changes (Costa et al., 2000; McCrae, 2001a) and that this decline occurs similarly for males and females across different cultures (H. Eysenck & Eysenck, 1991a; McCrae et al., 1999; McCrae, 2001a; 2001b). Therefore, this reversed pattern of age differences among males and females across both samples would provide evidence for a strong biological explanation of sex differences in the neuroticism. One biological basis of sex differences in neuroticism points to sex differences in cerebral arousability. Eysenck (1967) argued that higher neuroticism scores are associated with greater activation of the sympathetic division of the autonomic nervous system. Robinson (1998) supported Eysenck's (1967) argument and suggested that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; he reported that that female groups are higher on cerebral arousal than male groups. Therefore, females are more likely than males to become autonomically aroused, and to experience distress and agitation when subjected to stress. Another biological explanation for sex differences in neuroticism points to hormonal differences and their effects on mood and personality (Berenbaum, 1999; Costa et al., 2001). For example, women, compared to men, may experience naturally mood changes along the menstrual cycle, as levels of estrogen varied (Kimura, 2002;

Payne et al., 2007); as result, they may become more sensitive during this period and experience a higher level of anxiety and depression (Payne et al., 2007).

This study also examined cultural factors in sex and age differences in intelligence scores. Similar sex differences have been seen in both samples on most of the Wechsler IQ scales subtests. Nevertheless, both samples show variations in the magnitude of differences seen. Among the Libyan sample, sex differences were exaggerated; in particular, on the Verbal IQ scale and in the Vocabulary, Arithmetic and the Information subtest, while among the British sample, differences were significant only on the Information and Digit Symbol subtests. One explanation for the magnitude of sex differences in the Verbal IQ scores and most of the Verbal subtest scores among the Libyan sample, compared to British sample, is that verbal intelligence is dependent on the information and skills that are acquired through experience and education within a specific culture (Cattell, 1971; Chamorro-Premuzic, 2003). The results therefore would suggest that there are unequal opportunities to learn and acquire knowledge and develop expertise between males and females in some cultures of the developing countries such as Libya, compared to the developed countries such as Britain (e.g., Keddie, 2007; Lynn & Martin, 1997; Matthews et al., 2003; United Nations Development Programme, 2009). Therefore, sex differences in the Verbal intelligence scores were greater in Libya than in Britain.

Differences between developing and advanced countries in terms of technology, sources of knowledge, educational systems and sex roles may lead to variations in the magnitude of age differences in explaining individual differences in intelligence scores across Libyan and British student populations. As this study revealed, while the age of Libyan participants was positively and significantly correlated with their intelligence scores on all the WBIS IQ scale and most of the verbal subtests, correlations between the age of British participants and their intelligence scores were very small on all the Wechsler Adult Intelligence scale (WAIS-III) IQs and most of the subtests. This finding is in line with that of previous researchers (e.g., Lynn & Vanhanen, 2006; Neisser et al., 1996; Rushton & Čvorović, 2009; Westen, 1999), who have acknowledged the importance of cultural factors in intelligence scores, in particular, in verbal intelligence (Cattell, 1971; Chamorro-Premuzic, 2003).

One possible explanation for the variations in the magnitude of age differences in intelligence scores across the Libyan and British cultures is that in Britain, diverse sources of knowledge (e.g. books, the Internet and games) are available to individuals from an early age within and outside the family (e.g. schools, public libraries and community centres) and the purpose of education is learning how to learn (Hofstede, 2001). In Libya, this is not the case; the purpose of education is learning how to do (Hofstede, 2001), therefore, schools are the main source of knowledge. With increases in age, in particular during the university stage, individuals become relatively free from the control of their families and from the domination of schools upon the sources of knowledge; they become able to utilise the diverse sources of knowledge that are available within and outside the university. As a result, their knowledge, experience and skills improve with age. However, this case is not similar among Libyan males and females; in Libyan society the sex roles are generally more distinct and there is less equality between the sexes (Hofstede, 2001; Keddie, 2007; Lynn & Martin, 1997). As a result, families may just allow boys to go out with their friends after school time and participate in various social and scientific activities within and outside their community (Althir, 2005). This increases the experience of boys and develops their skills, and thus their intelligence, more than girls. The opportunity for females to develop their skills and knowledge beyond the limits of the school curriculum begins with their entry to university, where they are relatively set free from the control of the family (Althir, 2005). Therefore, this study revealed that most of the correlations between age and intelligence scores among the Libyan female sample were higher than the correlations of the Libyan males, and all of them were positive.

The further key finding of this study is how the relationship between neuroticism and intelligence scores were similar among the Libyan and British samples. In both samples, neuroticism was negatively related to the performance of participants on all the Wechsler intelligence IQ scales and on almost all of the subtests. However, both samples showed variations in the magnitude of correlations seen. The correlations among the British sample were notably higher than the correlations among the Libyan sample and were significant on all the WAIS-III IQ scales and five subtests. Moreover, the relationship between neuroticism and intelligence scores was independent of the effect of age and sex variables among both samples, since the change on the partial

correlations were small and the significant correlations remained significant. An exception to this was that among the British sample, sex positively affected the relationship between neuroticism and the Verbal IQ scores.

One explanation for the high correlations among the British sample is that during the performance of intelligence tests, people of western cultures, compared to non-western cultures, were found to be more serious, more interested, work more efficiently, or do not quickly give up on items they find difficult (c.f., Nell, 2000); this raises test anxiety and conscious activity in the cerebral cortex (Bishop et al., 2008), particularly in the timed tasks (Socan & Bucik, 1998); this high activity level may increase cortical arousal and, as Eysenck (1967) suggests, performance may be influenced by cortical arousal and stimulation in the task. Therefore, almost all the correlations of the British sample on the timed subtest in the WAIS-III (i.e. Arithmetic, Digit Span, Block Design and Picture Arrangement) were higher than other subtests.

This study also revealed that the effect sizes of the level of neuroticism on intelligence scores were small among both the Libyan and British samples on all the Wechsler Intelligence IQ scales and subtests. However, the influence of a high level of neuroticism on the discrepancy between Verbal and Performance IQ scores was higher among the Libyan sample than among the British sample. Nonetheless, the patterns of differences were not similar among both samples. Indeed, the mean scores of the British sample were higher on the Verbal IQ scale than on the Performance IQ scale. For the Libyan sample, this pattern is reversed and the high scores were on the Performance IQ scale among the three group levels. These pattern differences may be the result of the effect of culture on developing verbal intelligence, rather than the impact of neuroticism. Indeed, it is argued that crystallised intelligence, such as the Verbal IQ scale of the Wechsler's intelligences scales, is a product of environmental variation and depends on information and skills that are acquired through experience and education within a culture (Cattell, 1963; 1971), and although all the Libyan participants in this study were university and secondary school students, their performance on the Verbal IQ scale was significantly lower than their performance on the Performance IQ scale; in particular, on the Arithmetic subtest where their mean scores was under the subtest's norms mean of 10 among all the three levels of neuroticism. Therefore, it may be assumed that the verbal intelligence of the Libyan sample was mainly low, and the

verbal-performance discrepancy in their intelligence scores may not only reflect the effect of neuroticism on the performance of participants on the Verbal scale.

Finally, from this study it appeared that there are differences between Libyan and British cultures as the best predictors of intelligence scores. From three variables, namely neuroticism, age and sex, neuroticism was found to be the only variable that was significant for predicting Full Scale IQ and Performance IQ scores among the British sample, while the best model for predicting Full Scale IQ and Verbal IQ scores among the Libyan sample included the age and sex variables. These novel findings therefore reflect the important role of culture on explaining the effect of neuroticism on an individual's intelligence scores, and do not only support the idea that the type of performance required to complete an ability test is influenced by the trait of neuroticism (c.f., Ackerman & Hegesstad, 1997; Moutafi et al., 2005; Moutafi et al., 2006) but further revealed that the influence of neuroticism in the performance of individuals on intelligence scales is not equal across cultures. The implications of these findings will discuss in the following chapter.

CHAPTER 8 General Discussion and Conclusions

This thesis was undertaken to examine the relationship between neuroticism and intelligence scores in Libyan and British cultures. Neuroticism was assessed primarily through the Neurotic Behaviour Scale (Elmadani, 2001), and intelligence was measured through the Wechsler-Bellevue Intelligence Scale (Maleka, 1996) and the Wechsler Adult Intelligence Scale-Third Edition (Wechsler, 1997). The sample in the current thesis comprised 152 students from two different cultures: Britain and Libya. The thesis focused on four aspects of studying: (1) differences in neuroticism and intelligence scores according to sex and age; (2) differences in intelligence scores according to levels of neuroticism; (3) the moderating effect of sex and age in the relationship between neuroticism and intelligence scores; and (4) the role of cultural differences in explaining the relationship between neuroticism and intelligence scores.

It was recognised that many of the previous studies on the relationship between neuroticism and intelligence scores have provided conflicting findings, have been based largely on western samples and have not considered cross-cultural differences in this relationship. One culture that has not been considered is that of Libyan students, among whom are strong cultural differences as compared to students in western cultures, especially in terms of language, religion, economy, gender roles, interests and customs, all of which may vary significantly (Hofstede, 2001; Keddie, 2007). Therefore, the current thesis examined, for the first time, the relationship between neuroticism and intelligence scores among a Libyan population to extend the earlier findings on the relationship between neuroticism and intelligence scores among individuals within an Arabic culture. The thesis also extended the findings from previous studies by examining how age and sex mediate the relationship between neuroticism and intelligence scores among both the Britain and Libyan student samples. The unique and novel contribution of the current thesis was to test the effect of cultural differences between Libya and Britain on the magnitude of sex and age differences in neuroticism and intelligence scores, and in the relationship between neuroticism and intelligence scores.

8.1 Differences in Neuroticism and Intelligence Scores According to Sex and Age

The results in the current thesis show that the neuroticism scores of females were significantly higher than the neuroticism scores of males, both in the Libyan sample and in the British sample. These findings are in line with most previous studies (e.g. Elmadani, 2001; H. Eysenck & Eysenck, 1991a; S. Eysenck et al., 1993; Furnham et al., 2006; Rubinstein & Strul, 2007), and support Eysenck's (1967) and McCrae and Costa's (1999) argument that sex is an essential factor in explaining individual differences in neuroticism scores, and that differences in the trait of neuroticism are more expressions of human biology than the product of life experience (Eysenck, 1967; McCrae et al., 2000). Eysenck argued that higher neuroticism scores are associated with greater activation of the sympathetic division of the autonomic nervous system. Robinson (1998) supported Eysenck's (1967) argument and suggested that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; he reported that females are higher on cerebral arousal than males. Therefore, females are more likely than males to become autonomically aroused, and to experience distress and agitation when subjected to stress. In contrast to these strong sex differences in neuroticism, age differences in neuroticism scores were not found to be significant in either the British or Libyan sample, as Study 2 and 3 in the current thesis showed. These findings do not support previous researchers (e.g. Costa et al., 2000; H. Eysenck & Eysenck, 1991a; McCrae, 2001a, 2001b) which argued that the degree of neuroticism among individuals is not equal at all ages; it changes with age, with the highest level appearing in adolescence. However, the current findings might be limited to this thesis because of the narrowness of the age range (15–29) recruited in the current thesis, given its current focus on student populations. The samples of previous researchers (e.g., Donnellan & Lucas, 2008; Fung & Ng, 2006; McCrae et al., 2004; Ready & Robinson, 2008) found age differences in neuroticism scores included a wide range of ages (age ranged from 15 to 85).

With regard to intelligence scores, the findings from Studies 2 and 3 showed that the impact of sex on the Verbal scale subtests was substantially stronger than on the Performance scale, particularly in the Libyan sample. The performance of males on the

Full and Verbal IQ scales and on the most of the Verbal scale subtests was higher than the performance of females on the same subtests in both samples, and the differences between them were statistically significant on the Verbal IQ, Vocabulary, Arithmetic and Information subtests in the Libyan sample, and on the Information subtest in the British sample. On the other hand, the performance of females of both samples on the Performance scale subtests was higher than the performance of males on the same subtests, particularly on the Digit Symbol subtest, where the difference between them was statistically significant in the British sample. The findings from Studies 2 and 3 supported the advantage for males on the Information subtest and the advantage for females on the Digit Symbol subtest. Such findings were also supported by previous researchers (e.g., Lynn & Dai, 1993; Snow & Weinstock, 1990; Van der Sluis et al., 2008). Van der Sluis et al. (2008) claimed that the Information subtest is supposed to measure general knowledge, therefore, the sex differences on this subtest is not indicative of a difference with respect to verbal comprehension. However, it may well be indicative of a genuine male advantage in general knowledge. Similarly, the advantage of females in the Digit Symbol subtest may refer to the cognitive processes involved in completing this test. The Digit Symbol subtest involves looking for matches between the digits on the answer form and digits in the key, in addition to checking for matches between the given symbols and the symbols drawn. Therefore the performance on the Digit Symbol subtest is affected by clerical speed (Wechsler, 1997). Examinations of sex differences have constantly revealed females outperform males in clerical speed (Burns & Nettelbeck, 2005; Majeres, 1988; Majeres, 2007).

In contrast to these sex differences in performance and verbal scales, the current findings with regard to sex differences in general scores remain somewhat inconclusive. Unlike earlier claims, the current findings failed to show any trend that males score highly on tests measuring general intelligence (e.g., Furnham & Monsen, 2009; Rushton et al., 2007). However, sex differences in general intelligence scores appeared to reflect the type of tests that were administrated to participants. Since researchers (e.g., Holland et al., 1995; Maleka, 1996) who used Wechsler intelligence tests did not find significant sex differences in general intelligence, while researchers (e.g., Furnham & Monsen, 2009; Rushton et al., 2007), who used different general intelligence tests such as Raven's Standard Progressive Matrices (SPM), found significant sex differences. The

Standard Progressive Matrices (SPM) is a nonverbal test that assesses intelligence through abstract reasoning tasks (Maltby et al., 2007) and therefore any sex differences on this test may simply reflect differences on abstract reasoning ability rather than general intelligence per se. Unlike the SPM, the Wechsler intelligence tests are verbal and nonverbal tests designed to measure a wider range of cognitive abilities and therefore more indicative of intelligence ability (Wechsler, 1975). The numerous subtests of the Wechsler's tests provide an extensive understanding of the overall intelligence of the individual (Maltby et al., 2007). Females may be better performing than males in some of these subtests, while males outperform females on others. However, in the general IQ, as it is the product of performance on all the subtests of the Wechsler's tests, sex differences may not be found or at last may not be found significant as has been revealed by the current study, and by Holland et al. (1995) and Maleka (1996).

While there were no considerable differences in any of the WAIS-III IQ scores and most of the subtests across age groups in the British students, notable differences were found in the Libyan sample across age groups; intelligence scores of the older students were considerably higher than the intelligence scores of the younger students, particularly on the Verbal intelligence scale and subtests, and the differences were significant in the Verbal IQ, Vocabulary, Similarities and Digit Span subtests. These findings were expected because verbal intelligence is dependent on the information and skills that are acquired through experience and education within a specific culture (Cattell, 1971; Chamorro-Premuzic, 2003). Therefore, the individuals performance on the Verbal intelligence scales (such as the Verbal scale of WBIS), increases with age which may coincide with greater knowledge and experience (Maltby et al., 2007; Moutafi et al., 2003). Differences between Libya, as a developing country, and Britain as an advanced country, in terms of technology, sources of knowledge, educational systems and economy (Greenfield, 1998, Hofstede, 2001; United Nations Development Programme, 2009) may explain the variations in the magnitude of age differences in intelligence scores across the Libyan and British samples. That is, In Libya, the sources of knowledge that may help to increase an individual knowledge and skills (e.g. books, the Internet and social activity) are not available to individuals from an early age. Therefore, schools are the main source of knowledge. With increases in age, individuals

become relatively free from the control of their families and from the domination of schools upon the sources of knowledge; they become able to utilise the diverse sources of knowledge that are available within their community. As a result, their knowledge, experience and skills improve with age (c.f., Greenfield, 1998, Hofstede, 2001).

8.2 Differences in Intelligence Scores According to Levels of Neuroticism

A further key aspect of the current thesis was to consider differences in neuroticism scores and their influence on students' intelligence test scores across the Libyan and British cultures. As shown in Studies 2 and 3, the data revealed how the three levels of neuroticism (namely, low, medium and high) had a relatively small effect on participants' intelligence scores on the Verbal scale and on most of the WBIS and WAIS-III subtests within both the Libyan and British samples. However, The effect of the high level of neuroticism on an individual's intelligence scores was significant in the performance of the British sample on the Full Scale IQ, Performance IQ and the Block Design subtest, and the largest difference (10.04 IQ scores) was observed on the Performance scale between low and high neuroticism groups. This relationship between high levels of neuroticism and intelligence scores for performance-related measures supported previous research (e.g., Maleka, 1996; Saggino & Balsamo, 2003), which found that neuroticism affects the performance of individuals on the Performance IQ scale more than their performance on the Verbal IQ scales, and a possible explanation for this may relate to the nature of these subtests and underlying cognitive skills required to complete these IQ-related tasks. As discussed is chapter 2, while verbal IQ scales are more associated with formal education and schooling, and assess an individual's language comprehension and arithmetical ability, performance on which is largely dependent on information and skills that are acquired through experience and education within a specific culture (Chamorro-Premuzic, 2003). However, the performance on performance IQ scales is more associated with efficient problem-solving and solving problems in a timed response. The underlying cognitive skills are different and, perhaps, more prone to levels of neuroticism. For example, it is likely that performance of fluid intelligence tasks increases conscious activity in the cerebral cortex more than crystallised tasks (Bishop, Fossella, Croucher, & Duncan, 2008),

particularly in the timed tasks (Socan & Bucik, 1998), such as the Block design subtest of the WAIS-III; this high activity may increase the cortical arousal as Eysenck (1967) suggested, performance may have been influenced by high cortical arousal and stimulation while performing the task. Similarly, it is possible that those people with higher levels of neuroticism "are more likely than low neuroticism scorers to become autonomically aroused and to experience distress and agitation when subjected to stress" (Matthews et al., 2003, p. 170). As The Full scale IQ is a reflection of both Verbal IQ and Performance IQ, The significant affect of the high level of neuroticism on the performance IQ scores affected also the Full scale IQ of the British sample.

The effect of high neuroticism on the performance of individuals on the Performance IQ scale negatively reflected on the verbal-performance discrepancy since the biggest difference between Performance IQ and Verbal IQ scores was found among the high-neuroticism group in both the Libyan and British samples; however, the differences were not equal or exceeded the value of 8.76 to be significant at .05 level of significance (Wechsler, 1997). These findings supported the notion that differences between Verbal and Performance IQ scores increase among individuals who have difficulties in adaptation or have neurotic disorders (Demsky et al., 1998; Maleka, 1996). However, the samples in the current thesis are all student (normal population); their mean neuroticism scores was medium. Therefore, the level of neuroticism was not high to the extent that it significantly affects the homogeneity of an individual's intelligence scores.

8.3 Sex and Age Differences in the Relationship between Neuroticism and Intelligence Scores

The current thesis investigated the relationship between neuroticism and intelligence scores, and the possible moderated effect of age and sex on this association. In line with most previous studies (e.g., Ackerman & Heggestad, 1997; Austin et al., 2002; Furnham et al., 2006; Lounsbury et al., 2005; Moutafi et al.,2006), Study 2 and 3 in the current thesis showed that neuroticism and intelligence were negatively related. In addition, Study 3 revealed that the performance of individuals with high neuroticism scores on the Performance IQ scale of WAIS-III is lower than their performance on the Verbal IQ scales, which support previous study conducted by Saggino and Balsamo (2003). However, these findings are contrary to an earlier claim that neuroticism is not related

to any of the WAIS IQ scales (Holland et al., 1995), and this may reflect differences between the samples of the current thesis (i.e., secondary and university student) and the sample of the study of Holland et al. (i.e., rehabilitation clients). Moreover, the thesis showed that while the correlations among the British sample (Study 3) were significant, where more than 57 % of the correlations between neuroticism and intelligence scores of the WAIS-III were significant, neuroticism and intelligence scores in the Libyan sample showed small associations (Study 2), where more than 78 % of the correlations were not statistically significant. This may relate to the level of arousal among the participants in completing the intelligence and neuroticism tests. Previous researchers reported that the negative relationship between neuroticism and intelligence scores is largely observable under stressful or arousing conditions (Chamorro-Premuzic, 2003; Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006), and intelligence would decrease with negative affectivity such as anxiety, worry, tension (Zeidner & Matthews, 2000). Bishop et al. (2008) reported that performance on intelligence tests increases conscious activity in the cerebral cortex; this high activity may increase the cortical arousal as Eysenck (1967) suggests, performance may be influenced by cortical arousal and stimulation on the task. However, the participants in this thesis were all made up of voluntary subjects (participants completed the ability tests under no pressure), and comprised normal people who were not seeking psychological treatment, and they know in advance that the results of their performance on the neuroticism and intelligence tests will not affect them personally; this may reduce test anxiety and conscious activity in the cerebral cortex. Therefore, the level of cortical arousal among them may have not increased to the extent that negatively affects their performance on the WBIS. Moreover, the current thesis revealed that the relationship between neuroticism and intelligence scores in this thesis was independent of the effect of age and sex variables in both samples, since the changes in the partial correlations were small and the significant correlations remained significant.

8.4 Cultural Differences in the Relationship between Neuroticism and Intelligence Scores

The final approach was to aggregate the data from Studies 2 and 3 to consider possible cross-cultural differences in explaining the possible relationship between

neuroticism and intelligence test scores. Study 4 in this thesis showed that cultural differences between Libya and Britain had an essential role in the magnitude of the relationship between neuroticism and intelligence scores. The patterns of correlations were similar across the Libyan and British samples on all of the intelligence test scales (and most though not all of the associated subtests). In both the British and Libyan samples, neuroticism negatively affected the performance of participants on all the Wechsler intelligence IQ scales and almost all the subtests. However, correlations between neuroticism and intelligence scores for the British samples were higher than those for the Libyan sample on all the IQ scales and most of the subtests, particularly on the Performance IQ scale. As a result, the neuroticism scores were found to be a significant predictor for the general intelligence and performance intelligence scores of the Wechsler intelligence scales only for the British students. The relationship between neuroticism and intelligence scores was independent of the effects of age and sex variables for both samples, since all the correlations remained similar to these before they were controlling both variables. Study 4 in the current thesis also showed that cultural differences between Libya and Britain had no role in the influence of the level of neuroticism on an individual's performance on the Wechsler intelligence scales; the effect sizes of the level of neuroticism on the intelligence scores of the Wechsler intelligence scales were small and relatively similar across Libyan and British samples in all the IQ scales and subtests.

The level of arousal among the participants in completing the intelligence and neuroticism tests within the current thesis may also explain the differences in the magnitude of the relationship between neuroticism and intelligence scores across Libyan and British samples. As discussed in Section 8.3, intelligence would decrease with negative affect such as anxiety, worry, and tension (Zeidner & Matthews, 2000) and performance on intelligence tests increases conscious activity in the cerebral cortex (Bishop et al., 2008). Because all the participants were volunteers, the level of test anxiety and conscious activity in the cerebral cortex among the Libyan sample may have not increased to the extent that negatively affects their performance on the intelligence scales. However, this case was not similar among the British sample. Nell (2000) found that people of Western cultures, compared to those of non-Western cultures, are more serious, are more interested, work more efficiently or do not quickly

give up on items they find difficult this raises test anxiety and conscious activity in the cerebral cortex (Bishop et al., 2008). As a result, it was proposed (see Section 7.4 and 8.2) that the increase in cortical arousal in the British sample during the performance on the intelligence tests, particularly in the timed tasks, may have been negatively affected their performance on the intelligence test since Study 3 showed negative and significant relationship between neuroticism and the intelligence IQ scores of the WAIS-III among the British sample.

The results of Study 4, reported in Chapter 7, clearly showed that cultural differences between Libya and Britain had little influence on the sex and age differences in neuroticism scores. This conclusion is based on two key findings. The first, the magnitude of the sex differences in the neuroticism scores, remained very similar across the Libyan and British samples. This finding weakened the claim of Lynn and his Colleagues (e.g., Lynn, 1981; Lynn & Martin, 1997), who argue that sex differences in neuroticism scores in developing countries are higher than sex differences in advanced countries, and these differences reflect the differences between developing and advanced countries in many things such as economy, democracy and sex roles. Further, these findings weakened the clam of Costa et al. (2001) and McCrae and Terracciano (2005) who argued that Western countries with individualistic values have greater sex differences in neuroticism scores than non-Western countries; these sex differences in neuroticism scores reflect differences in cultural norms for sex roles between individualistic and collectivistic cultures.

A possible explanation for these discrepancy findings regarding sex difference in neuroticism scores across cultures is that the cultural factors such as democracy and sex roles appeared to be auxiliary factors that could contribute to some degree in the high or low levels of neuroticism among individuals within their communities according to the characteristics of that culture and are therefore subject to change with time according to the normal growth of community. Instead, the primary factor in neuroticism is the biological basis (Eysenck, 1967; Robinson, 1998), and thus the sex differences in neuroticism reflect sex differences in the biological basis, which is general in the human being. One biological basis of sex differences in neuroticism points to sex differences in cerebral arousability. Eysenck (1967) argued that higher neuroticism scores are associated with greater activation of the sympathetic division of the autonomic nervous

system. Robinson (1998) supported Eysenck's (1967) argument and suggested that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; he reported that that female groups are higher on cerebral arousal than male groups. Therefore, females are more likely than males to become autonomically aroused, and to experience distress and agitation when subjected to stress.

A further key finding concerns the pattern of age differences in neuroticism scores which remained relatively similar for the Libyan and British samples. In both samples, neuroticism scores tended to decrease with age among the males, while neuroticism scores tended to increase with age among the females. Although this result may have proved inconsistent with the findings from previous research, notably by Costa et al. (2000), who suggested that "different environments might be expected to give rise to different patterns of adult [males and females] development" (Costa et al., 2000, p. 237), it might be limited to the current thesis because of the narrowness of the age range (15–29) recruited in the current thesis. However, this issue requires further consideration to clarify whether this mediation of age and sex differences in explaining neuroticism scores across different cultures remains true and consistent.

A further key finding in the current thesis concerns the role of cultural factors in explaining sex and age differences in intelligence scores. As reported in Chapter 7, both samples show variations in the magnitude of the differences seen. The ages of participants in both cultures were positively correlated to their intelligence scores. However, age differences in intelligences scores were significantly higher for the Libyan sample than age differences for the British sample on all the WBIS and WAIS-III IQ scales and most of the Verbal scale subtests. Chapter 7 showed also that, although patterns of sex differences in intelligence scores were similar across both cultures, sex differences on the Verbal IQ scale and subtests scores for the Libyan sample were exaggerated; the males' scores in both the Libyan and British samples on this scale were higher than the scores of the females. However, the difference was only significant among the Libyan sample.

It has been argued in Chapter 7 (see Section 7.4) that differences between Libya and Britain in terms of technology, sources of knowledge, educational systems and sex roles

were a possible explanation for the cultural differences in the magnitude of the age and sex difference in intelligence scores, particularly, in the Verbal scale of the WBIS and WAIS-III. This explanation has additional support within the psychological literature, where it is argued that crystallised intelligence may be dependent on information and skills that are acquired through experience and education within a given culture or setting (Cattell, 1971; Chamorro-Premuzic, 2003) and that performance in intelligence particularly those which measure crystallised abilities such as the Verbal scale subtests of Wechsler's tests, tend to increase with age as they rely on an individuals knowledge and experience (Kaufman & Horn, 1996; Moutafi et al., 2003; Ryan et al., 2000; Sattler, 1982; Tucker-Drob & Salthouse, 2008). However, there are differences between Libya and Britain. In Britain, diverse sources of knowledge (e.g. books, the Internet and games) are available to individuals from an early age within and outside the family, and the purpose of education is learning how to learn (Hofstede, 2001). In Libya, this is not the case; the purpose of education is learning how to do (Hofstede, 2001), therefore, schools are the main source of knowledge. One possible interpretation is that with age, and attendance at university, individuals may become relatively free from the control of their families and from the domination of schools upon the sources of knowledge; they become able to utilise the diverse sources of knowledge that are available within and outside the university. As a result, their verbal intelligence increases with age as increasing in knowledge, skills and experience. However, Study 2 in the current thesis revealed that verbal intelligence scores of the Libyan male sample were significantly higher than scores of the female sample. The results therefore would suggest that in Libyan culture, compared to Britain, the sex roles are generally more distinct and there are unequal opportunities to learn and acquire knowledge and develop expertise between males and females (Hofstede, 2001; Keddie, 2007; Lynn & Martin, 1997; Matthews et al., 2003; United Nations Development Programme, 2009). As result, the opportunities for females to develop their skills and knowledge, and thus their intelligence, are limited.

8.5 Theoretical and Practical Implications

Although the results in the current thesis should be considered in the context of the next limitations, the following findings of interest can be discussed. From a theoretical

perspective, the findings of Studies 2 and 3 showed that the pattern of age differences in neuroticism scores was not similar among males and females across both Libyan and British samples; while neuroticism scores tended to decrease with age in the male sample, neuroticism scores tended to increase with age in the female sample. These findings supported the importance of establishing shifts in both sex and age in individuals' neuroticism scores. Researchers (e.g., Donnellan & Lucas, 2008; Fung & Ng, 2006; Ready & Robinson, 2008) who investigated patterns of age differences in neuroticism scores across different cultures did not consider the role of sex in these patterns. Moreover, the findings from this thesis showed little support for earlier claims that neuroticism decreases with age as a reflection of maturational changes (Costa et al., 2000; McCrae, 2001a) and that this decline occurs similarly for males and females across different cultures (H. Eysenck & Eysenck, 1991a; McCrae et al., 1999; McCrae, 2001a; 2001b). However, the current findings, in opposition, show that females' neuroticism scores tend to increase with age. The author attributed these reversed patterns of age differences among males and females in the Libyan sample to social and cultural factors in Libya (see Sections 5.4 and 6.4). However, the patterns of age differences in neuroticism scores were not similar for males and females in the British sample; these reversed patterns across both samples would provide support for a biological basis of sex differences in the neuroticism trait, as opposed to on a social basis. As mentioned in Section 8.4, sex differences in neuroticism may reflect sex differences in cerebral arousability. Robinson (1998) argued that cerebral arousability is a primary and direct determinant of sex differences in neuroticism scores; he reported that females are higher on cerebral arousal than males. Therefore, females are more likely than males to become autonomically aroused, and to experience distress and agitation when subjected to stress. Researchers (e.g., Costa, 2000; McCrae, 2001a, 2001b) reported that there is evidence suggesting that an individual's neuroticism score reduces with age as a reflection of maturational changes, and that this decline begins almost at the age of 18. However, this decline may not occur in a similar way across sexes, as Study 2 and 3 showed; the level of neuroticism among females continued higher compared to males, and this may reflect hormonal differences and their effects on mood and personality. For example, women, compared to men, may experience natural mood changes along the menstrual cycle, as levels of estrogen vary (Kimura,

2002; Payne et al., 2007); as a result, they may become more sensitive during this period and experience a higher level of anxiety and stress (Payne et al., 2007).

Whereas, theoretically, a variety of variables, from test conditions and distractibility to test-anxiety and physical illness, may have an important implications for discussing the test results (Chamorro-Premuzic, 2003), it is possible that the neuroticism trait has a considerable impact on IQ and performance on ability tests, as shown by the significant correlations between neuroticism and intelligence scores reported in studies 3. Since intelligence scores, as estimated by the Wechsler intelligence scales, are related to neuroticism scores, it seems possible to assume that the type of performance required to complete an ability test is influenced by the neuroticism trait. This supports the notion that the intellectual factors are required for intelligent behaviour as well as non-intellective factors such as personality traits (Wechsler, 1950; Wechsler, 1975). Thus, this suggests that the Wechsler intelligence scales are, indeed, measures of cognitive and non-cognitive factors as proposed by Wechsler (1950). In fact, there are two other results from the current thesis that may support this suggestion. Firstly, the scaled scores for the intelligence subtests of the high neuroticism group were more scattered than other groups as reported in Study 2. Secondly, the discrepancy between Verbal and Performance IQ scores was significant among the high neuroticism group as reported in Studies 2 and 3. These two findings support the argument that the influence of non-cognitive factors on intelligence behaviour appear as differences in individuals' scores on the subtests and in the differences between verbal and performance subtests scores of the Wechsler intelligence scales (c.f., Maleka, 1996; Wechsler, 1943; 1950). As a consequence, the findings from this thesis are in opposition to the idea that an individual's intellectual abilities are distinct characteristics and hence unrelated to well-established personality traits (c.f., Di Fabio & Palazzeschi, 2009; Ettinger & Corr, 2001; Furnham & Chamorro-premuzic, 2004; Zeidner & Matthews, 2000). Instead, the idea that the performance of individuals on IQ tests may be influenced not only by their intellectual factors but also by non-intellective factors such as their personality traits (c.f., Ackerman & Hegesstad, 1997; Moutafi et al., 2005; Moutafi et al., 2006; Wechsler, 1943, 1950, 1975) can be supported by the results of the current thesis.

Another interesting and theoretically important issue is that the negative relationship between neuroticism and intelligence scores as found in studies 2 and 3 in the current

thesis and as reported by many other researchers (e,g., Ackerman & Hegesstad, 1997; Austin et al., 2002; Furnham et al., 2006; Lounsbury et al., 2005) raises questions about the use of intelligence tests as accurate measures of true intellectual capability. Indeed, intelligence tests have become a commonly used method for the understanding and prediction of human performance across a variety of occupations and settings and for all sorts of purposes such as selection, diagnosis and evaluation (Chamorro-Premuzic, 2003; Huffman, 2004; Maltby et al., 2007; Neisser et al., 1996). Thus, when colleges and universities, for example, use intelligence tests to select candidates and reject those who do not score well in intelligence tests or to classify their students into different groups according to their abilities, they may have made an inaccurate, or at least, unfair decision. This is because the low scores of the candidates or students in intelligence tests may not reflect their actual abilities but rather may reflect the negative impact of the high levels of neuroticism they have on their performance on that intelligence test (as found in Studies 2 & 3). Test conditions usually raise the state anxiety which is a certain level of anxiety that is experienced in a particular situation, and is associated with the autonomic nervous system activity (Moutafi et al., 2006; Zeidner & Matthews, 2000). Moutafi et al. (2006) reported that individuals with high neuroticism are more stressed under testing conditions than those with low neuroticism. As result neurotic individuals experiencing higher levels of anxiety which interfere with their performance on the intelligence test. Individuals who are severely anxious about testing will not perform to the best of their ability (Bernstein, Penner, Clark-Stewart & Roy, 2006). Therefore, intelligence tests may underestimate the true capacity of individuals with high levels of neuroticism. However, this problem may not be similar across cultures and sexes. As shown in Study 4, the impact of neuroticism on intelligence scores was greater among the British students, in particularly females, than among the Libyan students. It was suggested that people of Western cultures, compared to those of non-Western cultures, are more serious, are more interested, work more efficiently or do not quickly give up on items they find difficult (Nell, 2000), and that female groups are higher on cerebral arousal than male groups (Robinson, 1998). Therefore, it is being suggested that the British student, particularly females, become more anxious under testing conditions, and this anxiety negatively affects their performance on the intelligence tests compared to the Libyan student. Accordingly, intelligence test results

cannot be considered pure measures of intelligence; the effect of non-cognitive factors such as neuroticism, and the size of this effect, varies according to the sex and cultural background of the test taker.

The current data also leads to a number of potential practical applications and issues. Firstly, the findings from Study 1 provided evidence for the reliability and validity of an English version of the Neurotic Behaviour Scale; this is a new scale of personality measures that separates the neuroticism trait from other personality traits. Thus, researchers who aim to estimate neuroticism scores no longer need to use tests that measure a wide variety of personality traits and often overlook more detailed explanations of individual personality traits such as the Fifteen Factor Questionnaire (comprising 200 items measuring 15 personality traits) or use scales consisting of a large number of items (for example, the Eysenck Personality Profiler [EPP] comprising 420 items measuring the three Eysenckian personality dimensions), which might be difficult to answer in one session.

Similarly, the current work has revealed that while the general intelligence and the performance intelligence IQs can be successfully predicted by neuroticism traits, the Verbal intelligence scores cannot be successfully predicted from an individual's level of neuroticism. Moreover, because the neuroticism trait accounts for the high variance in the prediction of general and performance intelligence IQs in the British student population, it is important not only that researchers, psychologists and educators begin to consider personality inventories in the evaluation of an individual's personality traits in general, but also in the prediction of intelligence scores.

Finally, while there is strong evidence to suggest that personality tests should be used as potential predictors of job performance (Judge & Bono, 2001; Salgado, 1997), additional considerations may be required to ascertain the validity of such approaches. This is based on the hypothesis that individuals with certain personality characteristics will function better in some occupations than in others (Manktelow & Lewis, 2005). Given that the neuroticism trait has been found to be negatively related to job performance across many occupations (Judge & Bono, 2001; Salgado, 1997), it is argued that the NBS could be extended and possible consideration given for its use in job selection procedures, especially since the NBS (as shown in Study 4) is not sensitive

to the cultural background of the test takers. However, given the research evidence showing the strong link between intelligence and job performance (c.f., Kuncel, Hezlett, & Ones, 2004; Schmidt, 2002), and the negative relationship between neuroticism and intelligence scores, as found in Studies 2 and 3 in the current thesis, it would be most useful to use both neuroticism and intelligence scales together as predictors of job performance instead of using either individually.

8.6 Limitations and Recommendations for Further Research

As mentioned earlier (Sections 8.1and 8.4), there are some limitations to the studies reported in this thesis that should be addressed and considered for future research on this topic. First, it should be noted that all studies were based on relatively small samples ($N < 152$). Although the size of these samples may still be considered acceptable, this may restrict the generality of the results. Furthermore, the range of ages was small (15–29) given its current focus on student populations. Therefore, it could be expanded in a future study to involve a larger sample with a broader age range. Chamorro-Premuzic (2003) suggested that personality and intelligence scores may be differentially related at earlier or later stages of an individual's life. Moreover, it is also likely that in more heterogeneous samples, where there is a larger range in the distribution of intelligence and neuroticism scores, the correlational pattern between neuroticism and intelligence scores may vary from that of the present studies.

The second issue of the present thesis concerns the focus being solely on student populations. This may limit the possibility of generalising the results to various other samples, especially since there has been previous research which found significant differences in neuroticism scores across many professions (c.f., Rubinstein, 2005; Rubinstein & Strul, 2007). Therefore, it would be useful to investigate the relationship between neuroticism and intelligence scores across variant populations. This would help to examine the role of career in the relationship between neuroticism and intelligence scores. Furthermore, samples of the present thesis were comprised of normal people who were not seeking psychological treatment. As previous researchers reported, the negative relationship between neuroticism and intelligence scores is largely observable under stressful or arousing conditions (Chamorro-Premuzic, 2003; Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006) and the performance on intelligence

scales would decrease with negative affectivity such as anxiety, worry, tension (Zeidner & Matthews, 2000). As neuroticism is associated with a greater risk of early-onset depressive and anxiety disorders (Chien, Ko, & Wu, 2007; Clark, Watson, & Mineka, 1994), further research involving clinical samples would be useful. The proposed study will make an original contribution to understanding the relationship between neuroticism and intelligence and the effect of neurotic disorders on the size and direction of this association. Moreover the proposed study will have different intelligence test profiles for each neurotic disorder and for the normal sample that would be investigated. This would help psychologists in their clinics to benefit from the application of the Wechsler tests to diagnose cases involving neurotic disorders. Holland et al. (1995) argued that studying the relationship between intelligence and personality would be an appropriate method of connecting intelligence test profiles to specific diagnostic groups.

A third issue that may require additional consideration concerns the measure of intelligence and the reliance on the Wechsler intelligence scales. Although these scales were designed to measure a wider range of cognitive abilities in addition to the general factor of intelligence 'g' (Wechsler, 1975), they represent the psychometric approach to intelligence. There is another approach called the cognitive psychology approach, which reflects biological and physiological processes and aspects of intelligence. Biological and physiological measures (such as Kauffman's ability tests) are supposed to be very good indicators of intelligence (Maltby et al., 2007). Chamorro-Premuzic (2003) suggested that multiple estimations of intelligence would have been useful with regards to individuals' actual scores. Accordingly, further research using both approaches to estimate intelligence scores would be useful; it is possible that estimations of different aspects of intelligence are differentially related to the neuroticism trait and, therefore, require closer consideration.

A similar concern may relate to the inclusion of the Wechsler-Bellevue intelligence scale (WBIS) to estimate the intelligence scores of the Libyan sample. Although the WBIS is the only version of the Wechsler intelligence scales that is available for use in the Arab culture, it is an old version in comparison to the third version of the Wechsler Adult Intelligence Scale (WAIS-III). Therefore, while the WBIS is the most widely used measure of intelligence in Arab society (Maleka, 1996), additional measures to tap

into intelligence scores may be considered and developed. Therefore, further research should be conducted to standardise the WAIS-III in the Arab culture, particularly since it has added three new tests and the scale is, therefore, able to produce the three traditional IQ scores in addition to four new Index scores. Moreover, although all the Libyan participants in Study 2 were university and secondary school students, their mean scores on the Full Scale IQ (M = 96) and on the Verbal IQ scale (M = 93) were under the WBIS IQ scales' norms' mean of 100. This may increase the importance of the proposed study to standardise the WAIS-III in the Arab culture and to develop up-to-date norms for the IQ scales and subtests based on a large standardisation sample.

Future research should investigate the relationship between neuroticism and intelligence scores after controlling or at least reducing the effect of test anxiety. As Study 2 and 3 in the current thesis showed, the intelligence scores of the participants were negatively associated with their neuroticism scores, and one explanation for that refers to the mediation of test anxiety on this relationship. That is, test conditions usually raise the state of anxiety, and individuals with high neuroticism are more stressed under testing conditions than those with low neuroticism (Moutafi et al., 2006). As result, individuals who are severely anxious about testing will not perform to the best of their ability (Bernstein et al., 2006). Therefore, it may be useful to move from the direct application of tests, where the examiner and participant in one place, face to face, and under terms that are often restricted, to an indirect method such as online. This may reduce the level of test anxiety, which often arise in the direct method. Moreover, it may be useful to integrate both the direct and indirect methods of test application in one study. For example, Standard Progressive Matrices (SPM) are tests of abstract reasoning ability, and comprises five sets of 12 items each (Raven, Raven, & Court, 1998); therefore, a number of these sets along with a neuroticism scale may administer to participants online and the remaining sets of matrices administer to the same participants directly. Thus, comparing the correlation coefficients between neuroticism and intelligence scores from the two methods may allow an examination of the role of test anxiety on the relationship between neuroticism and intelligence scores; any differences in the correlations of the proposed study could be explained by differences in test conditions.

It would also be useful to investigate the relationship between neuroticism and intelligence scores across variant cultures. The current thesis revealed, for the first time, that culture has a significant role on the magnitude of the relationship between neuroticism and intelligence scores. As Study 4 in the current thesis showed, the correlations for the British samples were higher than those among the Libyan sample on all the IQ scales. However, future research may be useful to replicate and extend these finding among different cultures; particularly since cultures are variant in the level of neuroticism (Costa et al., 2001; Eysenck et al., 1993; Hanin et al., 1991; Schmitt et al., 2007). Schmitt et al. (2007) found that the lowest neuroticism scores were for Africa, while South America and Southern Europe scored higher than other world regions except East Asia. The proposed study would help to examine whether these differences in neuroticism scores across cultures will be reflected on the magnitude of the relationship between neuroticism and intelligence scores.

Finally, although Study 1 in the current thesis has provided evidence for the reliability and validity of the English version of the neurotic Behaviour Scale (NBS), future research should a replication and extension to the findings from Study 1. For example, further research should estimate the test-retest reliability of the English version of the NBS. Other types of validity (e.g., predictive) and other indicators for the construct validity (e.g., discriminant) should also be examined. In addition, this tool should be validated using other populations (e.g., teachers, doctors, older adults and individuals with psychological disorders). Norms of the English version of the NBS should be developed in further research and this would perhaps enhance the confidence in the use of the NBS in empirical studies and its practical application.

Overall, this thesis has provided a strong theoretical contribution to understanding the relationship between neuroticism and intelligence scores and the role of age and sex in this association in two different cultures: Libya and Britain. It has also provided a novel theoretical contribution to understanding the effect of cultural differences between Libya and Britain on the magnitude of sex and age differences in neuroticism and intelligence scores, and in the relationship between neuroticism and intelligence scores. The results of this thesis support previous studies that reported a negative correlation between neuroticism and intelligence scores by using two versions of the Wechsler’s

intelligence scales and a new scale for neuroticism, and have also revealed the role of culture on this association, which has not received much attention. Indeed, the idea that the performance of individuals in IQ tests may be influenced not only by their intellectual factors but also by non-intellective factors, such as the trait of neuroticism, can be supported by the results of this thesis. Thus, as has been proposed in previous studies (e.g., Chamorro-Premuzic, Furnham, & Petrides, 2006; Moutafi et al., 2006) it is suggested that the negative correlation between neuroticism and intelligence scores is because people with high level of neuroticism became more anxious during the application of intelligence tests, and, as result, this negatively impacts upon their performance on IQ tests. However, this effect may not be similar across cultures. It should be noted that intelligence is usually used as predictor for academic and occupational success; therefore, it is critical to consider the negative (dampening) effect of neuroticism on the performance of individuals on intelligence tests (particularly for performance-related measures).

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Appendix A: Differences between WAIS-III and WBIS

Deference between WAIS-III and WBIS According to Number of Items, Bonus Points, Timed, Starting Point and the Range of Age

	Number of items		Bonus points		Timed		Starting Point		Range of age	
Subtests	WAIS III	WBIS	WAIS III	WBIS	WAIS III	WBIS	WAIS III	WBIS	WAIS III	WBIS
Verbal subtests									From 16 -89 years divided into 13 gropes	From 15 -60 and upward divided into 11 gropes
Vocabulary	33	42					Item 4	Item1		
Similarities	19	12					Item 6	Item1		
Arithmetic	20	10	Yeas	Yeas	Yeas	Yeas	Item 5	Item1		
Digit span	8	9					Item 1	Item1		
Information	28	26					Item 5	Item1		
Comprehension	18	10					Item 4	Item1		
Performance subtests										
Picture Completion	25	15			Yeas	Yeas	Item 6	Item1		
Digit Symbol	133	67			Yeas	Yeas	Sample Item	Sample Item		
Block Design	14 (9 Blocks)	7 (16 Blocks)	Yeas	Yeas	Yeas	Yeas	Item 5	Item1		
Object Assembly	5	3	Yeas	Yeas	Yeas	Yeas	Item 1	Item1		
Picture Arrangement	11	6		Yeas	Yeas	Yeas	Item 1	Item1		

Appendix B: Neurotic Behaviour Scale (NBS, the Arabic Version)

The Scale of Emotional Behaviour

S. R	N	T

The following is a number of items which describe your behaviour in different situations (how do you feel, how do you think, how do you act). Please read each item carefully, and think about your behaviours or your feelings and select the appropriate response according to your usual behaviours and feeling. If you agree with the item, please tick "**Yes**" which means you usually (more than 50% of the time) feel, think or act this way. If you do not agree with the item, please tick **"No**" which means you rarely (less than 50% of the time) feel, think or act this way.

Please try to answer all the items as you really feel and act in your life. Be sure that this data will be dealt with confidentially. Furthermore, please do not write your name.

This an example to help you

I feel uncomfortable when I am in crowded places.

	Yes	No
If you usually feel uncomfortable when you are in crowded places, please tick a box under "Yes"	✓	
Otherwise, if you usually feel normal (comfortable) when you are in crowded places, please tick a box under "No"		✓

Likewise with the other items

Before you start answering, please fill the following:

Sex :(Male, female) …….. Age: ……

Now turn the page and please try to answer all items.

Appendix B The Original Version of NBS *(continued)*

N	Facets	Items	Yes	No
1	1	I feel uncomfortable when I am in crowded places.	✓	
2	2	My hands shiver when I hold anything in them.	✓	
3	1	I feel that people like me.		✓
4	3	I think I am a sensitive person.	✓	
5	4	I feel stressed when I think about important things.	✓	
6	5	I usually think about many things when I want to sleep.	✓	
7	6	I like to socialise with others		✓
8	6	I feel that I am not acceptable to others.	✓	
9	7	I always think that my opinions are not good enough.	✓	
10	5	I am a restless sleeper.	✓	
11	4	I think I can solve most of the problems which I might have.		✓
12	2	My fingers tremble when I am in a difficult situation.	✓	
13	7	I feel that other people do not accept the things that I have done.	✓	
14	6	It never matters to me whether others are pleased with me or not.		✓
15	4	I change my mind a lot about things.	✓	
16	1	I think I am not as happy as my friends.	✓	
17	3	It is difficult to make me angry.		✓
18	7	I expect to fail at anything I do.	✓	
19	2	I think I am a healthy person		✓
20	1	I am not worried about my future.		✓
21	4	I say things without thinking, then I regret it.	✓	
22	1	I feel stressed when I am outside the house.	✓	
23	7	I make decisions about my life quickly.		✓

Appendix B The Original Version of NBS *(continued)*

N	Facets	Items	Yes	No
24	2	I get headaches when I am in difficult situations.	✓	
25	3	I feel uncomfortable when other people look at me.	✓	
26	1	I hardly ever worry without reason.		✓
27	5	Sometimes I cannot fall asleep.	✓	
28	3	I hate it when others criticize me.	✓	
29	1	I feel that I am a nervous person.	✓	
30	6	When I buy clothes, I concentrate on quality more than appearance.		✓
31	7	I am fearful of meeting important people.	✓	
32	3	I feel I am a very shy person.	✓	
33	1	I am very forgetful.	✓	
34	CM	Ideas flood into my mind when I fall asleep.		
35	CM	I feel that other people do not like me.		
36	CM	I think my friends are happier than I am.		
37	CM	I think I will fail at every thing I do.		
38	CM	I usually say things then regret what I have said.		
39	CM	I dislike it when others censure me.		

Note. Facets N. 1= anxiety, 2 = body disorder, 3 = reactive sensitivity dimension, 4 = social relation disorder, 5 = sleeping disorder, 6 = thinking problem, and 7 = inferiority complex; CM = the consonance measure; ✓= the key answer.

Table B. 1 *The T norms of the NBS*

Raw score	Equivalent *T* scores		Raw score	Equivalent *T* scores	
	Male	Female		Male	Female
3	24.94	18.08	19	60.98	55.62
4	27.19	20.43	20	63.23	57.96
5	29.44	22.78	21	65.49	60.31
6	31.70	25.12	22	67.74	62.65
7	33.95	27.47	23	69.99	65
8	36.20	29.81	24	72.24	67.35
9	38.45	32.16	25	74.50	69.68
10	40.71	34.50	26	76.75	72.04
11	42.96	36.85	27	79	74.38
12	45.21	39.20	28	81.25	76.73
13	47.46	41.51	29	83.51	79.07
14	49.72	43.89	30	85.76	81.42
15	51.97	46.23	31	88.01	83.77
16	54.22	48.58	32	90.27	86.11
17	56.48	50.93	33	92.52	88.46
18	58.73	53.27			

Source: Elmadani (2001).

Appendix C: The Neurotic Behaviour Scale (NBS, the English Version)

The Scale of Emotional Behaviour

S. R	N	T

The following is a number of items which describe your behaviour in different situations (how do you feel, how do you think, how do you act). Please read each item carefully, and think about your behaviours or your feelings and select the appropriate response according to your usual behaviours and feeling. If you agree with the item, please tick "**Yes**" which means you usually (more than 50% of the time) feel, think or act this way. If you do not agree with the item, please tick **"No**" which means you rarely (less than 50% of the time) feel, think or act this way.

Please try to answer all the items as you really feel and act in your life. Be sure that this data will be dealt with confidentially. Furthermore, please do not write your name.

This an example to help you

I feel uncomfortable when I am in crowded places.

	Yes	No
If you usually feel uncomfortable when you are in crowded places, please tick a box under "Yes"	✓	
Otherwise, if you usually feel normal (comfortable) when you are in crowded places, please tick a box under "No"		✓

Likewise with the other items

Before you start answering, please fill the following:

Sex :(Male, female) …….. Age: ……

Now turn the page and please try to answer all items.

Appendix C The English Version of NBS *(continued)*

N	Facets	Items	Yes	No
1	2	My hands shiver when I hold anything in them.	✓	
2	1	I feel that people like me.		✓
3	3	I think I am a sensitive person.	✓	
4	4	I feel stressed when I think about important things.	✓	
5	5	I usually think about many things when I want to sleep.	✓	
6	6	I like to socialise with others		✓
7	7	I always think that my opinions are not good enough.	✓	
8	5	I am a restless sleeper.	✓	
9	4	I think I can solve most of the problems which I might have.		✓
10	2	My fingers tremble when I am in a difficult situation.	✓	
11	7	I feel that other people do not accept the things that I have done.	✓	
12	6	It never matters to me whether others are pleased with me or not.		✓
13	4	I change my mind a lot about things.	✓	
14	1	I think I am not as happy as my friends.	✓	
15	3	It is difficult to make me angry.		✓
16	7	I expect to fail at anything I do.	✓	
17	2	I think I am a healthy person		✓
18	1	I am not worried about my future.		✓
19	4	I say things without thinking, then I regret it.	✓	
20	7	I make decisions about my life quickly.		✓

Appendix C The English Version of NBS *(continued)*

N	Facets	Items	Yes	No
21	2	I get headaches when I am in difficult situations.	✓	
22	3	I feel uncomfortable when other people look at me.	✓	
23	1	I hardly ever worry without reason.		✓
24	5	Sometimes I cannot fall asleep.	✓	
25	3	I hate it when others criticize me.	✓	
26	1	I feel that I am a nervous person.	✓	
27	6	When I buy clothes, I concentrate on quality more than appearance.		✓
28	7	I am fearful of meeting important people.	✓	
29	3	I feel I am a very shy person.	✓	
30	1	I am very forgetful.	✓	
31	CM	Ideas flood into my mind when I fall asleep.		
32	CM	I always feel that my views are not good enough.		
33	CM	I think my friends are happier than I am.		
34	CM	I think I will fail at every thing I do.		
35	CM	I usually say things then regret what I have said.		
36	CM	I dislike it when others censure me.		

Note. Facets N. 1= anxiety, 2 = body disorder, 3 = reactive sensitivity dimension, 4 = social relation disorder, 5 = sleeping disorder, 6 = thinking problem, and 7 = inferiority complex; CM = the consonance measure; ✓= the key answer.